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Patent exploitation in an Open Innovation model: the case of China

Gizem Ogsuz

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Et de l'**Ecole Doctorale Organisations, Marchés, Institutions**

**Patent exploitation in an Open Innovation model: The
case of China**

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L'exploitation des brevets dans un modèle d'innovation ouverte : Le cas de la Chine

Resumé : L'objectif principal de cette étude est d'examiner les stratégies de brevets employées par les entreprises chinoises. Basée sur une approche occidentale, la littérature sur l'innovation ouverte fournit des facteurs et des barrières impliqués dans l'adoption de l'innovation ouverte. Elle explore également les processus inbound et outbound dans le cadre de l'innovation ouverte ainsi que les stratégies offensives et défensives en matière de brevets. En nous appuyant sur cette littérature, nous visons à découvrir les stratégies de brevets employées par les entreprises chinoises, à les classer en fonction de leur approche et à comprendre comment les processus d'innovation ouverte diffèrent en Chine. Pour atteindre ces objectifs, nous avons mené une enquête quantitative auprès de 129 entreprises chinoises de divers secteurs. Ces entreprises ont été sélectionnées en fonction de leur niveau d'intensité en R&D. Notre étude révèle que les entreprises chinoises utilisent principalement des stratégies défensives en matière de brevets. Elles ont tendance à se concentrer davantage sur l'octroi de licences ou de brevets inbound afin d'améliorer leur capacité d'absorption interne et leurs compétences en matière de R&D. L'octroi de licences outbound est principalement effectué dans le cadre de génération de revenus supplémentaires. Malgré ces résultats, il est important de noter que les entreprises chinoises recherchent une plus grande ouverture dans leurs pratiques. La présente étude apporte plusieurs contributions importantes. Certaines entreprises poursuivent une stratégie offensive en matière de brevets, cherchant à se développer sur les marchés étrangers par l'octroi de licences outbound. En revanche, les entreprises chinoises s'appuient fortement sur les patent pool pour les licences inbound et donnent la priorité à la réputation de leurs partenaires dans le cadre de ce processus. L'analyse clusters a permis d'identifier deux groupes distincts. Le groupe 2 se concentre principalement sur l'octroi de licences pour augmenter les revenus, tandis que le groupe 1 s'engage dans des joint-ventures, des fusions-acquisitions (M&A) et des partenariats à long terme avec des entités étrangères. Par rapport aux entreprises occidentales, il existe des différences significatives dans les préférences des entreprises chinoises en matière de partenariat. Alors que les entreprises occidentales ont tendance à collaborer avec des universités, leurs homologues chinoises préfèrent travailler avec des instituts de recherche et développement (R&D). Contrairement aux conclusions de la littérature antérieure, les entreprises chinoises ne considèrent plus les expériences passées négatives comme le principal barrière qu'elles doivent relever en matière d'innovation ouverte. Au contraire, elles considèrent désormais que les longues périodes de négociation constituent la barrière la plus importante lors de la mise en œuvre de stratégies d'innovation ouverte.

Patent exploitation in an Open Innovation model: The case of China

Abstract: The main objective of this study is to examine the patenting approaches employed by Chinese companies. Based on a Western approach, the open innovation literature provides evidence of the factors and barriers involved in adopting open innovation. It also explores both inbound and outbound processes within open innovation and offensive and defensive patenting strategies. Drawing from this literature, we aim to uncover the patenting strategies employed by Chinese companies, classify them based on their approach, and gain insights into how Open Innovation processes differ in China. We conducted a quantitative survey involving 129 Chinese companies from various industries to achieve these goals. These companies were selected based on their R&D intensity level. Our study reveals that Chinese companies primarily employ defensive patenting strategies. They tend to focus more on inbound licensing or patenting to enhance their internal absorptive capacity and R&D capabilities. Outbound licensing is mainly pursued for additional revenue generation purposes. Despite these findings, it is important to note that Chinese companies seek greater openness in their practices. The study makes several important contributions. A few companies pursue an offensive patenting strategy, seeking to expand into foreign markets through outbound licensing. In contrast, Chinese companies rely heavily on patent pools for inbound licensing and prioritize the reputation of their partners in this process. Two distinct clusters were identified through cluster analysis. Cluster 2 primarily focuses on licensing-out to increase revenue, while Cluster 1 engages in joint ventures (M&A) and long-term partnerships with foreign entities. Compared to Western companies, there are notable differences in the partnering preferences of Chinese companies. While Western firms tend to collaborate with universities, their Chinese counterparts prefer working with research and development (R&D) institutes. Contrary to previous literature findings, Chinese firms no longer consider negative past experiences with inbound open innovation the primary obstacle they face. Instead, they now identify lengthy negotiation periods as the most significant barrier when implementing inbound open innovation strategies.

L'université n'entend donner aucune approbation ni improbation aux opinions émises dans les thèses : ces opinions doivent être considérées comme propres à leurs auteurs.

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I never expected such a journey when I decided to write my doctoral thesis. It's a simultaneous journey into our depths and our knowledge. On this journey, we learn to express ourselves in writing and to expand our understanding. Paradoxically, however, the more we learn and tell ourselves that we know it all this time, the more we realize that we're dealing with vast knowledge, like the tip of an iceberg, knowledge without end. In this journey, I would like to express my deep gratitude to my supervisor, Liliana Mitkova, who never abandoned me, even in the worst moments I endured, and helped, guided, and supported me in every situation. I can't thank you enough for your patience and compassion. In this regard, I would like to thank Cécile Ayerbe and Faouzi Bensebaa for having accepted to be the rapporteurs of this dissertation and to Yvon Pesqueux and Remi Jardat for having accepted to be a member of the jury. I would like to thank Cédric Gossart and Isabelle Derumez for supporting me throughout my study. Many thanks to my Chinese colleagues who worked hard with me to contribute to this research on their side.

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Introduction

In innovation, companies strongly emphasize Open Innovation practices and expand their Open Innovation efforts by establishing specialized departments solely dedicated to Open Innovation (ENGIE, 2023; Huawei, 2023). Boston Dynamics, a spin-off company from Massachusetts Institute of Technology (MIT) known for its robotics, was acquired by the South Korean automotive manufacturer Hyundai in 2020 (Hyundai, 2023). Nokia, the Finnish 5G infrastructure provider, renewed its license-selling agreement with Apple, enabling Apple to use Nokia's technology again for 2 years (Economic Times, 2023). Consequently, technology transfer through patent exploitation and licensing (Chesbrough, 2003a) has gained even greater significance.

With the increasing emphasis on technology transfer, companies recognize the significance of Open Innovation processes, particularly inbound and outbound activities (Chesbrough, 2003a; Lichtenthaler & Ernst, 2006). According to Chesbrough's description, open innovation involves "*purposeful inflows and outflows of knowledge*". In other words, a company can benefit from internally generated knowledge and external ideas protected by intellectual property rights (IPR), specifically patents. These external ideas can be exchanged through licensing agreements (Chesbrough, 2003a, 2003b).

Therefore, the protection and exchange tool of intellectual property (IP), namely patents, are crucial in open innovation processes. Besides patents, the companies continue using secrecy or lead-time advantage as informal ways of IP protection. Our study will focus on the first type of protection, the invention patents, specifically in China.

In 1949, China embraced communism and a planned economy. However, in 1978, under the influence of Deng Xiaoping, China began transitioning towards a market economy. Following the events 1989, China focused on enhancing its economy by shifting from agriculture to a market-driven approach. This shift resulted in increased innovation activity and capacity within the country. The opening up of China's economy also attracted foreign countries to invest. As a result of this increased foreign direct investment and technology transfer through licensing agreements, China was able to enhance its technological knowledge capacity (Ning et al., 2017).

The government also plays a pivotal role in driving this transformation. Science and technology (S&T) programs encourage research and development activities within companies. Specifically, in 1980, the Chinese government initiated its first S&T program. The Key Technology R&D program in 1982, followed by the High-Tech Program in 1986, positively impacted domestic companies' capacity for research and development. China's accession to the World Trade Organization (WTO) in 2001, after the launch of the Torch program in 1988, significantly increased patent application numbers and transfers within the country. The most recent plan, Made in China 2025 (MIC 2025), aims to position China as a global leader in science and technology by 2050. Consequently, it has become increasingly important for foreign companies to understand both China as well as its technology market.

Patenting in Open Innovation Model

A company may choose to apply for a patent for various reasons. Companies have the option of obtaining a license from an established technology provider to gain entry into a market. Patents can impede market entry, either due to the risk of legal action or because standardized technology dominates the market. In these circumstances, companies may purchase a license for existing technology to gain access to the market (Arora, 1997). Patents can serve as barriers against competition and prevent copying. They grant monopoly rights to patent holders and restrict imitation of their products (Holgersson & Granstrand, 2017). Additionally, patents deter potential competitors from entering the market (Ayerbe, 2016). They also facilitate the establishment of industry standards and ensure freedom to operate for companies holding patents (Caviggioli & Ughetto, 2013; Koruna, 2004). Patents also create a rich patent portfolio during cross-licensing negotiations (Blind et al., 2006; W. M. Cohen et al., 2000; Pénin & Neicu, 2018). It also provides technical information about the other's technology (Ayerbe, 2016; James et al., 2013; Mazzoleni & Nelson, 1998). Patents also help improve a company's reputation by indirectly communicating the firm's technology level (James et al., 2013; Pénin & Neicu, 2018). It can also be used as an internal performance measure tool for the company workers and as a reward system for the R&D workers (W. M. Cohen, Goto, et al., 2002). Sometimes, the government may provide incentives for R&D studies. In that case, patenting is used to use government incentives (Holgersson & Granstrand, 2017) or enter a new and foreign market; a company can patent in the country they want to enter. This territorial protection provides an entry tool for this company (Archontakis & Varsakelis, 2017)

However, the reasons for seeking patents are connected to specific patenting approaches. Existing research has highlighted various strategies. In this study, we will concentrate on offensive and defensive strategies. The offensive patenting strategy may involve motivations such as generating financial income, utilizing patents for marketing objectives, using them as bargaining chips in economic or R&D partnerships, gaining entry into new markets, and establishing a positive reputation within the industry. On the other hand, the defensive strategy also encompasses motivations such as maintaining monopolistic power to safeguard against imitation and competition from newcomers while protecting the company's image (Ayerbe & Mitkova, 2008).

Once a company grants a patent, besides the strategies we cite above, it can exploit the internal or external patent, called the patent exploitation strategy. A company can use the patent internally for a new product or process development (Bianchi et al., 2014), for stocking and selling licenses to newcomer companies, or for keeping unused for using infringements in the future (Torrise et al., 2016). Alternatively, the company may exploit its patents externally. In that case, a company may sell or license its patents (Ayerbe & Mitkova, 2006; Jeong et al., 2013) or use them as a negotiation tool during cross-licensing (Ernst et al., 2016). The patents can also be used for non-commercial types, such as for an R&D collaboration (Hagedoorn & Zobel, 2015), the establishment of a joint venture, or M&A (Hagedoorn & Sadowski, 1999).

The use of patents and their utilization is examined through a unique perspective in Open Innovation. Chesbrough introduced the concept in the literature, defining Open Innovation as *“the integration of internal and external concepts into platforms, systems (...), and business models that determine the specifications for these systems”* (Chesbrough & Bogers, 2014). Transferring technical knowledge from one organization to another is known as technology transfer. According to the literature, there are three ways in which technology transfer can occur. These include transfer through procurement, which involves R&D institutes and collaborations; transfer through joint development projects; and, finally, through patent or license transfers (Amaldi, 1999). Our research will focus on technology transfer through patents in the open innovation process.

Patents have a unique role in open innovation processes. The inbound process involves purposive inflows of external knowledge and is closely connected to technology transfer through patent purchasing or licensing-in activities. Conversely, the outbound process, which involves purposive outflows of internal knowledge, is also closely associated with selling

patents or granting licenses to external partners (Dahlander & Gann, 2010). The inbound processes encompass obtaining, integrating and commercializing external knowledge (Chesbrough & Bogers, 2014). Despite various forms of inbound processes such as R&D contracting (Brunswicker & Vanhaverbeke, 2015), involvement of customers or suppliers (Brunswicker & Vanhaverbeke, 2015; Gassmann & Enkel, 2004), R&D outsourcing (Van De Vrande, de Jong, et al., 2009), alliances and networking (Enkel & Gassmann, 2010), we are particularly interested in the form of inbound open innovation known as patent or license buying (Bianchi & Lejarraga, 2016; Gassmann & Enkel, 2004).

The inbound processes include obtaining, integrating and commercializing the external knowledge (Chesbrough & Bogers, 2014). Despite different forms of the inbound process, such as R&D contracting (Brunswicker & Vanhaverbeke, 2015), customer or supplier involvement (Brunswicker & Vanhaverbeke, 2015; Gassmann & Enkel, 2004), R&D outsourcing (Van De Vrande, de Jong, et al., 2009), alliances and networking (Enkel & Gassmann, 2010), we are closely interested in the form of inbound open innovation, the patent or licence buying (Bianchi & Lejarraga, 2016; Gassmann & Enkel, 2004).

The reasons behind engaging in inbound open innovation, specifically through inbound patenting or licensing, can vary. One company's motivation might be acquiring a patent or license technology to expedite market entry (Gassmann et al., 2018). Another reason could be to prevent competitors from imitating their patented technology and thus gain a competitive advantage (Grimpe & Hussinger, 2008; Holgersson & Granstrand, 2017). Additionally, companies may choose to utilize patented technology already in the market as a means of reducing the time it takes to access the market (Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994), especially if that technology has proven successful (Chesbrough & Crowther, 2006). The process of technology development can be both lengthy and expensive. In order to minimize research and development costs, a company may opt to acquire external technology through licensing agreements or by purchasing patents directly (Gassmann et al., 2018; Gassmann & Enkel, 2004). This external technology could complement the company's existing technological capabilities (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016). Additionally, purchasing external technology through patents or licenses can provide easy access to foreign markets for companies seeking expansion (Greul et al., 2018; Harhoff et al., 2014) or manufacturers and subcontractors working with partners requiring specific technologies. In such cases, inbound licensing is ideal for

maintaining partnerships (Azzam et al., 2017; Gassmann & Enkel, 2004). Moreover, joining a patent pool can prove beneficial in reducing licensing fees and research costs for companies. However, if a company wishes to enter a patent pool and engage in cross-licensing agreements (Davis, 2008), it needs to possess an attractive patent portfolio in order to negotiate from a position of strength during these negotiations (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016).

The process of outbound open innovation consists of two distinct phases: opportunity identification and external technology transfer. The latter phase encompasses three sub-steps: market and technology exploration, portfolio assessment, and transfer (Aloini, Farina, et al., 2017; Aloini et al., 2019). In The Outbound, there are several modes by which open innovation can be pursued. These include the creation of a spin-off company (Chesbrough, 2003a), participation in corporate business incubation programs (Lichtenthaler, 2005), establishment of joint ventures, as well as licensing out or selling patents (Brunswick & Chesbrough, 2018; Gassmann & Enkel, 2004; Grzegorzczuk & Głowiński, 2019; Holgersson & Granstrand, 2017; Lichtenthaler, 2005).

The reasons for engaging in outbound open innovation are diverse as well. Existing literature highlights that the primary motive behind selling or licensing-out a patent is to generate additional income (Gassmann & Enkel, 2004; Lichtenthaler, 2007; Zuniga & Guellec, 2009). In addition to generating extra revenue, this decision may also be purely strategic (Kutvonen, 2011), influenced by the company's business model (Caviggioli & Ughetto, 2013; Kutvonen, 2011) if the technology in question is not core to the company's operations. Alternatively, these patents might belong to a portfolio acquired through a merger or acquisition (M&A) and are not aligned with the company's current strategic direction (Caviggioli & Ughetto, 2013; Monk, 2009). Another possibility is that a company sells off its entire patent portfolio or ceases utilizing certain technologies altogether (Caviggioli & Ughetto, 2013; Monk, 2009; Zuniga & Guellec, 2009).

The selection of a partner is a crucial decision for companies. It involves a thorough process through which the chosen partner gains access to the company's innovation procedures. The literature highlights the importance of criteria for partner selection and different types of partners. These partners can come from patent pool companies (Prud'homme, 2016; Shapiro, 2001), universities (Brunswick & Vanhaverbeke, 2015; Fu et al., 2016) or governmental institutions such as R&D institutes (Fu et al., 2016). A partner can also be an independent entity

(Fu et al., 2016) or a consulting firm (Fu et al., 2016; Laursen & Salter, 2006). Additionally, they could be spin-off companies with high innovative potential (Chesbrough, 2003b; Gentile-Lüdecke et al., 2020; Gianiodis et al., 2010; Lichtenthaler, 2007; Savitskaya et al., 2010; Sikimic et al., 2016).

In any open innovation process, the criteria for selecting partners tend to be similar due to the reciprocal nature of the concept. When a company intends to purchase a patent, it implies that there is another company willing to sell patents. This cross-cutting nature highlights some important considerations. Firstly, the relevance of the technology and the technological level of the companies selling licenses demonstrate how applicable their proposed technology is and indicate their absorptive capacity (Cassiman & Veugelers, 2006; Cesaroni, 2004; Chesbrough & Crowther, 2006; Van de Vrande, 2013, p. 611). Company affiliation (Giuri et al., 2007) and reputation help reduce uncertainty between parties and establish trust (Y. Hu et al., 2015; Lamberti et al., 2017; Lichtenthaler & Ernst, 2007), while price plays an important role for both parties involved in any proposal negotiation (Fosfuri, 2006). In addition to these factors, open innovation processes allow both parties to collaborate long-term on various R&D projects. The potential opportunity for R&D collaboration between partners is also considered an essential criterion in evaluating partnerships (W. M. Cohen, Goto, et al., 2002; Dahlander & Gann, 2010; Somaya et al., 2011).

In addition, the citation of a patent is seen as an indicator of its value (Blind et al., 2009), while the company's market size provides information about its partner (Koruna, 2004, p. 244), making these indicators important.

The process of outbound open innovation necessitates partner contact. These activities play a crucial role in the selection of partners. The literature highlights the significance of commercials (Landry et al., 2013, p. 447), networking among R&D personnel during scientific seminars (Landry et al., 2013, p. 447; Laursen & Salter, 2006), and the recruitment of new R&D employees (Cassiman & Veugelers, 2006) as means to gather information about other parties and foster networking between two entities. Lastly, establishing direct contact with the partner company (Landry et al., 2013, p. 447) is feasible while involving an intermediary/agent (F. Hochleitner et al., 2020) also serves to minimize misunderstandings between partners and facilitates smoother relationships.

Factors and Barriers for Open Innovation

Implementing open innovation can bring new perspectives and solutions to a company. It not only lowers R&D expenses but also enhances the organization's ability to innovate by enabling the transfer of technology, establishing networks, and generating additional revenue by utilizing existing patents. Nevertheless, several factors specific to the company must be considered when embracing open innovation, including internal factors, external factors, and barriers that may hinder its implementation.

The literature classifies the internal factors influencing a company's adoption of open innovation. One factor is the company's size, with larger companies more likely to adopt open innovation than smaller ones (Peeters & van Pottelsberghe de la Potterie, 2006). However, recent studies have shown that small and medium-sized enterprises (SMEs) adopt open innovation easily (Greco et al., 2017). Nevertheless, some studies suggest that company size does not consistently impact open innovation adoption and may even have no effect at all (Lichtenthaler, 2008a). Another factor is the age of the company. Younger companies are generally more receptive to open innovation than older ones (Michelino et al., 2015). However, older companies increase their investment in process improvement over time (Huerigo & Jaumandreu, 2004). The organizational structure and corporate culture are considered facilitators for embracing open innovation practices within a company's operations (Mortara et al., 2010).

Additionally, management involvement is crucial in promoting an environment that is conducive to adopting open innovation strategies (Lichtenthaler & Ernst, 2006). Furthermore, knowledge exchange capabilities related to information and communication technologies contribute significantly towards facilitating the adoption of open innovation approaches within organizations (Dodgson et al., 2006). Core competencies also play an essential role as they help enhance absorptive capacity and facilitate the adoption of new innovative practices within a business setting (Christensen, 2006; Prahalad & Hamel, 1990).

The company's geographical location plays a significant role in promoting outbound open innovation. Factors such as proximity to universities and technology development zones contribute to this (Chesbrough, 2003a; Kapetaniou & Lee, 2019; Triguero & Fernández, 2018). Additionally, the level of familiarity with the partner firms' technology (Gulati, 1995; Higgins & Rodriguez, 2006) and the nature of the existing technology (Lichtenthaler & Ernst, 2009)

also influence innovation efforts. The complexity of the product (Sengupta & Sengupta, 2014) and its modularity are also important considerations (Ulrich, 1995; Vos et al., 2018; H. Wang & Shu, 2020). Furthermore, a company's product strategy determines its ability to innovate. If a high level of innovation in the market influences product lifecycle decisions, companies will be motivated to develop new products quickly. This cycle promotes outbound open innovation and strengthens R&D capabilities (Chesbrough, 2003a; Chesbrough & Crowther, 2006; Dziurski & Sopińska, 2020; Martinez et al., 2014; Oduro, 2020). Patent activity and R&D intensity also play a role in market dynamics by pushing companies to increase their patenting activities (Chesbrough, 2003a; Dang & Motohashi, 2015; De Noni et al., 2017)

Adopting open innovation is influenced by external factors surrounding the company. The company's environment, especially market factors such as rapid and frequent changes, can impact open innovation adoption (Ganioudis et al., 2010; Laursen & Salter, 2006; Verbano et al., 2015). The intensity of competition may increase licensing-in activities but hinder outbound open innovation activities due to high competition levels (Fosfuri, 2006; Lichtenthaler, 2009b). Additionally, the diffusion of ICT (Guellec, 2017b; Rogers & Everett, 1983) promotes rapid interaction outside the organization (Dodgson et al., 2006).

According to Lichtenthaler (2009), technological turbulence refers to the speed at which technology changes within an environment. This can impact the product lifecycle and prompt companies to engage in new product development (Gassmann & Enkel, 2004; Lichtenthaler, 2009a). Industry speed, on the other hand, pertains to how quickly industries introduce new products, streamline their "time to market" processes, and adopt advanced technologies (Chesbrough, 2003a).

Hence, the rate at which the industry operates greatly impacts the adoption of open innovation. This is particularly evident in pharmaceutical industries, where companies delegate nonessential technology to external partners and sell their patents during the early stages when further development is required (Gassmann et al., 2018). Globalization has led to an increase in the movement of highly educated and skilled individuals across the globe. This influx of talent has brought a valuable number of people and ideas into the market, expanding knowledge and a spill-over effect (Chesbrough, 2003a). Furthermore, various authors support the idea that globalization has facilitated this mobility and its positive impact on various industries (Gassmann & Enkel, 2004; Popa et al., 2017). Promoting collaboration and governmental involvement contributes to the expansion of open innovation endeavours

(Muzamil Naqshbandi & Kaur, 2014) Strong patent protection within a country (Arora & Gambardella, 2010; Fu, 2015; Mazzoleni & Nelson, 1998; Papageorgiadis et al., 2014) benefits the processes involved in open innovation. This effect is evident through increased foreign direct investment and technology transfers facilitated by licensing agreements (Papageorgiadis et al., 2014).

The open innovation literature also provides some different hindering factors of open innovation processes.

The resistance to adopting inbound open innovation processes, known as the Not Invented Here Syndrome (NIH Syndrome), can stem from various factors. Some companies may be wary of involving rival companies in their business, while others fear a decrease in their innovation capacity by relying too heavily on new technology. Additionally, a lack of trust in external knowledge can hinder the success of inbound open innovation processes (Lichtenthaler & Ernst, 2006; Van De Vrande, de Jong, et al., 2009). Inbound open innovation may face obstacles due to past negative experiences, which can lead to uncertainty regarding the level of cooperation from potential partners (Dubouloz et al., 2021; Dziurski & Sopińska, 2020; Van De Vrande, de Jong et al., 2009). Government incentives can potentially have a positive impact on small and medium-sized enterprises (SMEs). However, open innovation initiatives may be adversely affected if there is a lack of government support (Greco et al., 2017). Due to the complex nature of these contracts, the negotiations may be long. This could potentially harm the company's acquisition process for patents or licenses (Barchi & Greco, 2018; Prud'homme, 2019; Van De Vrande, de Jong, et al., 2009). The level of complexity in technology can create a challenge. If a company does not possess the same technological capabilities, the transferred technology may not be utilized effectively. This disparity in technology levels between two parties, or the idea itself, may create a barrier to inbound open innovation (Lichtenthaler & Ernst, 2006; Oduro, 2020). Lastly, the costly nature of transferring technology could impede the inbound process due to high transaction costs (Dziurski & Sopińska, 2020; Verbano et al., 2015). The progress of outbound open innovation can be impeded by the complexity of intellectual property rights (IPR) in the country. The higher the complexity of IPR, the more paperwork is involved, resulting in longer processing times for patent applications (Savitskaya et al., 2010; Zuniga & Guellec, 2009). The "not sold here" syndrome refers to the fear of losing control over technology and a monopoly in the market, which can obstruct open innovation processes (Bianchi et al., 2014; Lichtenthaler, 2009b; Rivette & Kline, 2000). The adoption of

open innovation can be hindered by the complexity of contracts (Hoffmann & Schlosser, 2001), as well as by the perception that a company's technology is not yet fully developed and does not align with its overall strategy (Amann et al., 2022; Burcharth et al., 2014; Lichtenthaler, 2010; Peeters & van Pottelsberghe de la Potterie, 2006). The uncertainty can be intensified by negative past experiences or the absence of any prior experience (Lichtenthaler, 2010).

The Research Question

For a long time, China was ruled by dynasties, and later, after the agricultural revolution, it became a communist republic led by the country's communist party. Deng Xiaoping, the leader between 1981 and 1989, started the opening-up process of China to the world economy. Since then, China has undergone three significant changes in its economic history: adopting a planned economy, market orientation, and opening up the process of economic activities. China increased its high-tech production through FDI and technology transfer via licensing. The patent application level rose incredibly after its adherence to WTO in 2001. The Chinese government led an Open Innovation policy by promoting the indigenous innovation capacity of Chinese companies. To do so, the government put in action different promotions for R&D collaboration and patent applications and increased the absorptive capacity of the companies to increase internal R&D capacity and R&D quality. The statistics previously show that those policies gave their fruits and increased the companies' patent application level and the country's high-tech production level.

Nevertheless, an immense country, both geographically and in production capacity, transformed its economy from agricultural to industrial production. It ruled for decades under the reign of empires, first and now under a single political party. It may have some differences or specificities while practising the Open Innovation process.

The existing literature on Open Innovation studies is most generally focused on Open Innovation processes (inbound, outbound, and coupled), patents and patenting strategies (offensive and defensive), as well as the exploitation modes of the patents (internal and external) in the western countries, and put in evidence some typologies of the companies according to size or industry and other internal or external factors which may affect to Open Innovation adoption of a company (Holgersson & Granstrand, 2017; Verbano et al., 2015).

The patent exploitation is closely related to the Open Innovation process adopted by the company. The external exploitation of patents, in the form of licensing-out or patent

exploitation, is a part of the pecuniary form of the outbound Open Innovation process. The internal exploitation form of the patents, such as using internally for new product development and exploration of new technologies to use internally for a product or process development, is a part of the pecuniary form of the inbound Open Innovation process in the form of inbound licensing or patent acquisition (Aloini, Lazzarotti, et al., 2017a; Sikimic et al., 2016).

The Open Innovation literature does not focus yet on the patent strategies (offensive or defensive) and exploitation forms of the patents in Chinese companies.

Therefore, we formulate our problematic related to this gap as follows:

“Analysis of Chinese companies' patent strategies in the context of the open innovation process.”

To address this gap, we asked three questions:

“What forms of patent exploitation do Chinese companies use during the open innovation process, and how do different factors influence the open innovation process?”

“What types of Chinese companies adopt the open innovation model and engage in patent exploitation?”

“What drivers influence patenting and patent exploitation strategies in open innovation processes in China? Are there specific features that influence Chinese patent exploitation strategy in China?”

In order to respond to those questions, we have created our research design as follows: we studied the literature first. We have analysed and found the gap in the literature where we have shaped our problematic for this study. Then, we approached our problematic with research questions. This step led us to our methodological design, allowing us to shape our survey questions in English and then translate them into Chinese. We tested the questionnaire and started the research after making some adjustments to the questionnaire. The data analysis allows us to respond to all our research questions. First, we conducted a descriptive analysis to see Chinese companies' patenting strategies. Then, we have conducted a CART decision tree analysis to analyse what forms of patent exploitation Chinese companies use and what are the factors that affect this decision.

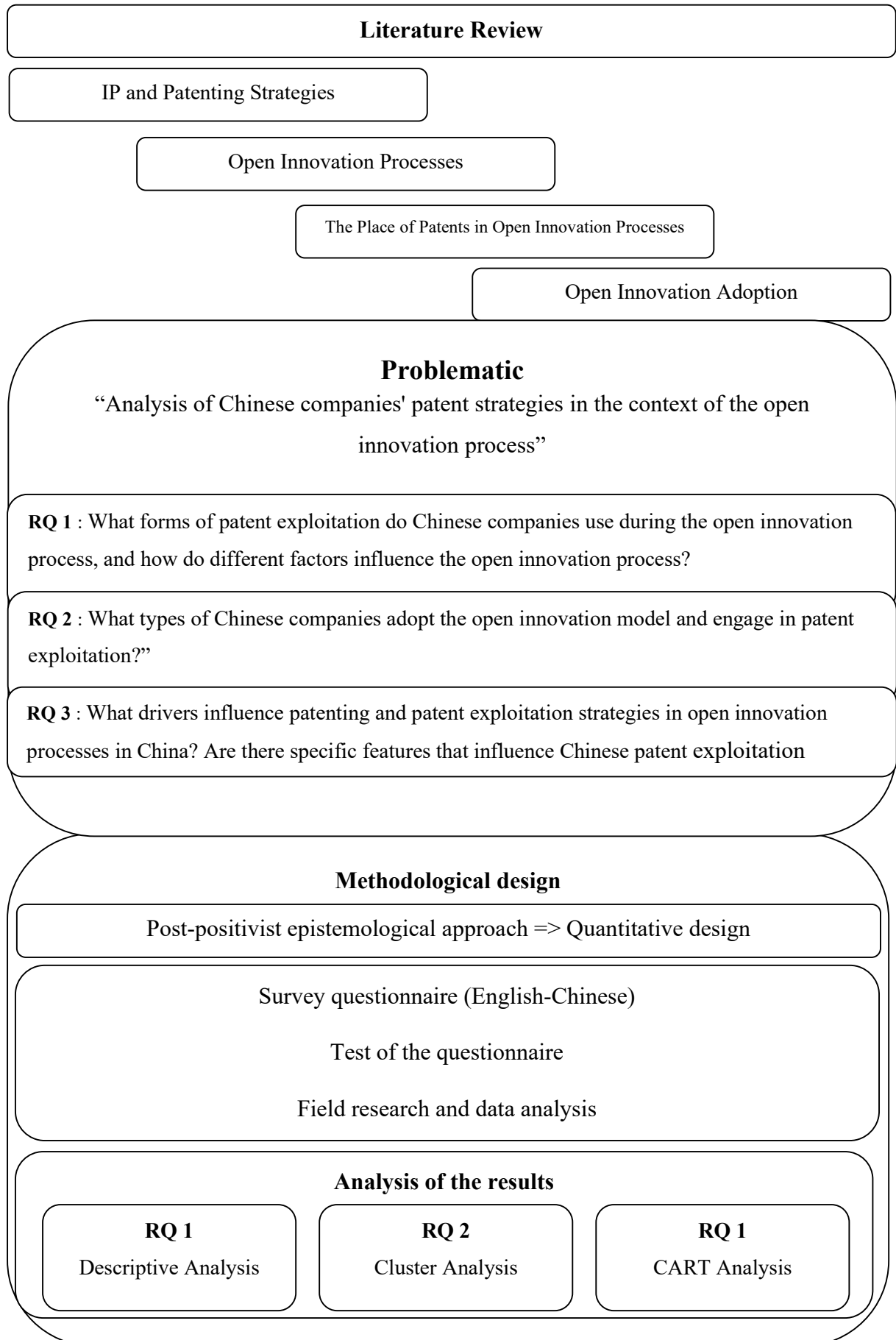
Methodology

In the context of open innovation, where the national boundaries have become more permeable and open due to the establishment of GATT and subsequent international institutions aimed at facilitating global trade, international technology transfer became more important. Consequently, one of the biggest countries, China, opened its economy and became a member of WTO in early 2000 (UNCTAD, 2021). Regarding trade, China marked a significant increase in high-tech manufacturing and export (UNCTAD, 2021). Using low-cost labour with technology transfer via licensing, FDI, or interaction with foreign buyers or sellers (Fatima, 2017; Ning et al., 2017), the Chinese economy shifted from low-productivity agriculture to high-productivity manufacturing by innovation-led productivity. The increase in patent applications proves this shift (Ning et al., 2017). Two leading Chinese telecommunication companies, Huawei and Oppo, recently signed a global cross-licensing agreement for their 5G technology (Huawei, 2022). Google does the same with Tencent for different technologies (Reuters, 2018).

The Chinese companies have started and continue to open up their IOP portfolios both in national and international fields. Therefore, their open innovation strategies may present specificities not yet explored in the literature and more widely disseminated.

We adopt a post-positivist approach, which provides us flexibility in analysing tools because of the special nature of the field. Our research question led us to an explorative study. Using existing variables, we used a deductive approach to see the specificities of the Chinese companies. To collect a high amount of information and because of the specific nature of the Chinese context through foreigners, we have conducted quantitative research (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Mbengue & Vandangeon-Derumez, 1999; Yin, 2003, 2014, 2018).

Figure 1 Research design



The plan of our study

Our study is comprised of three primary sections and twelve subsections within them. The initial main section introduces the theoretical basis of our investigation. The second section focuses on the chosen methodology and the outcomes obtained from our survey. The concluding part of our research encompasses a discussion of the results and a summary of our findings.

In the first part of our study, we have divided it into four theoretical subsections. The first subsection focuses on intellectual property (IP) rights, patenting strategies, motivations behind patenting for companies, and ways to exploit patents. Moving on to the second subsection, it delves into innovation and various models of innovation, highlighting the significance of the Open Innovation model. The third sub-section is dedicated to understanding the role and importance of patents in open innovation processes. It explores how companies utilize patents, their motivation for practising inbound and outbound open innovation, and the criteria for choosing partners. Lastly, within this first part of our research lies a two subsections that concentrates on decision-making regarding adopting open innovation practices and the factors influencing such decisions and barriers faced during adoption of open innovation. In the same part of our study, we delve into the initial section that focuses on the background of our research. The subsequent subsection elucidates our epistemological standpoint while highlighting the challenges encountered during data collection and analysis.

In the second part, we delve into descriptive statistics data composed by three sub chapters. The first chapter is dedicated to patenting strategies in the open innovation processes. The second chapter examines Chinese companies' adoption of open innovation and patent exploitation strategies. The third subsection tackles the decision-making path regarding patenting in open innovation processes.

In the third part of our research, we have dedicated our attention to the discussion and conclusion. A summary of our findings has been presented. The outcomes indicate that not all but certain Chinese companies involved in export activities are actively seeking collaborations with foreign companies for long-term partnerships. Contrary to prevailing theories, these Chinese companies prefer collaborating with independent firms and R&D institutes for inbound open innovation initiatives rather than universities. The most significant barrier faced

during the inbound open innovation process is not any of the barriers mentioned in existing literature but instead long negotiation periods.

Additionally, all Chinese companies adopt a defensive strategy for patent acquisition by utilizing patents as protective measures and enabling access to new markets. Inbound open innovation methods are more widely utilized than outbound activities. The main purpose behind outbound open innovation is solely revenue generation through licensing agreements. Finally, we delve into our results' theoretical and managerial implications while acknowledging their limitations and potential avenues for future research.

Our research has significantly contributed to the existing body of literature. Our findings demonstrate that Chinese companies employ a defensive patenting strategy to safeguard themselves against competitors. On the other hand, a small subset of companies utilizes an offensive strategy to access foreign markets through outbound licensing agreements. Our study indicates that companies predominantly engage in inbound licensing regarding open innovation activities. The primary motive behind outbound licensing is to enhance revenue generation. Regarding the patenting decisions made by Chinese companies, they are primarily driven by protective factors and heavily influenced by market turbulence. These decisions generally revolve around increasing the company's internal R&D capabilities and absorptive capacity.

Our study presents various managerial findings. Chinese companies are striving for increased openness. Government policies play a crucial role in this endeavour. However, high competition in the market lowers trust and raises uncertainty in business partnerships. Furthermore, high market competition leads to an increase in patent applications by these companies. Additionally, Chinese firms consistently work towards increasing their absorptive capacity.

PART 1

Our study is divided into three parts, starting with this part dedicated to the theoretical review of the literature.

Chapter 1 reviews the literature on intellectual property and patenting strategies. First, we present the intellectual property and the protection forms of intellectual property rights, focusing on patents. Then, in the second place, we present offensive and defensive patenting strategies. Finally, we present internal and external patent exploitation strategies.

Chapter 2 presents the innovation models' literature. First, we start with a review of previous linear and non-linear models. After that, we studied the open innovation model. In this second part, we study the necessary conditions for adopting Open Innovation, the importance of absorptive capacity and the business model.

Chapter 3 offers the place of the specific intellectual protection mechanism, the patents, in Open Innovation processes. In this chapter, we delve into the Open Innovation processes and study the inbound and outbound open innovation processes through patent exploitation modes. The last part of this chapter is dedicated to the partner typology and selection criteria of the partner.

Chapter 4 presents the state of the art of internal and external factors of Open Innovation adoption in the first place. The second part of this chapter is dedicated to the factors hindering the adoption of open innovation.

Chapter 5 elucidates the context of our empirical study, China, and the epistemological paradigm within which our research is carried, together with the methodological choice. First, we study China's innovation context, the IPR and Open Innovation policies. Then, we present the epistemological positioning and methodological choice – post-positivist deductive approach, followed by the quantitative survey method.

Chapter 1 Intellectual Property and Patenting strategies

This chapter explores the literature surrounding intellectual property (IP) and safeguarding intellectual property rights (IPR). Our research places great importance on intellectual property, particularly its role in China's open innovation process. Consequently, this initial chapter will explore the existing body of literature regarding intellectual property.

Regarding intellectual property, there are two main categories: artistic or literary and industrial creations. We are specifically interested in industrial creations and their protection. Intellectual property rights can be legally protected through patents and utility models or informally through secrecy. Our study aims to investigate the use of patents within open innovation processes. Therefore, this chapter will focus primarily on examining patents.

By definition, a patent grants exclusive rights to an individual's creation. It serves as a means of protecting the invention and enables the inventor to reap financial benefits. In addition to granting monopolistic power over the invention, a patent application can serve various purposes. These include gaining access to new markets, deterring plagiarism, establishing industry standards, impeding competition, fostering cross-licensing negotiations, enhancing reputation, assessing internal research and development performance, and availing government incentives. Apart from patents for inventions, utility models offer relatively easier acquisition but provide shorter protection periods.

In addition to formal methods of Intellectual Property Rights (IPR) protection, informal methods such as secrecy, lead time advantage, and product complexity also play a role in safeguarding inventions within a company's confines. These alternative protective measures provide flexibility in keeping valuable innovations secure. In this chapter, our main focus lies on patents and the strategies associated with patenting. We will specifically delve into two different strategies known as offensive and defensive. The primary goal of the offensive patenting strategy is to generate further revenue from patents and establish a long-term business relationship or trade with partner companies. On the other hand, a defensive strategy is employed to safeguard the company's intellectual property (IP) and maintain a competitive edge in the market.

The patent exploitation strategy is utilized for both defensive and offensive purposes. Companies have the option to exploit these strategies internally or externally. Internal

exploitation involves preserving the patent for future use or utilizing it within the company for new product development (NPD) or process development. On the other hand, external exploitation entails maximizing the use of patents by selling or licensing them and incorporating them into joint ventures or M&A agreements.

This chapter is divided into 3 sub-chapters. First, we outline the importance of IPR and the motivations for patenting (sub-chapter 1.1). Then, we focus on using patents and patenting strategies in the second sub-chapter (sub-chapter 1.2). Finally, we are introducing the patent exploitation strategies (sub-chapter 1.3)

1.1. The definition of intellectual property rights

The creation of a body of knowledge is generally a result of previous efforts and accumulation of knowledge and is worth preserving. Intellectual property (IP) is the general term which defines a set of exclusive rights granted for intellectual works. It refers to *creations of the mind*, such as inventions, literary and artistic works, designs, symbols, names and images used in commerce (WIPO, 2021b). The term IP entered the literature during the Paris Convention for the Protection of Industrial Property in 1883. This international agreement guarantees the inventors the protection of their work in other countries. This convention covers the invention patents, trademarks and industrial designs. In 1886, the Berne Convention followed the wave under the guidance of Victor Hugo for artistic and literary works at the international level. It includes all types of literary works (novels, stories, poems, and plays), musical works (songs, operas, etc.), and artistic works (drawings, paintings, sculptures, etc.). In 1893, the United International Bureau for Intellectual Property Protection (Bureau International des Droits de la Propriété Intellectuelle) was established in Switzerland. Shortly, this bureau became the WIPO (World Intellectual Property Office) in 1970 as an intergovernmental organization. WIPO joined the UN in 1974 and launched the Patent Cooperation Treaty (PCT) system, which allows them to simultaneously grant protection for their invention in different countries (WIPO, 2021c).

Nevertheless, national intellectual property protection was already established in several countries before an international patent office was established. The very first patent filling and grant dated in 1421 in Florence to an architect, Filippo Brunelleschi, gives the right of monopoly on the production of a vehicle with special gear for marble transportation 3 years

after the patent grant in Italy (Britannica, 2021). Hence, the first patent law was established in Venice in 1774. Under the patent protection, inventors gain a monopoly right for a limited time. However, the patent protection provides a territorial protection to the patent holder. In other words, if a patent filing is given in a country, it will not apply to other countries. In order to protect the invention, the patent holder must fill out a patent application in other countries (Bian et al., 2021). However, the PCT system provides international coverage for the patent owner (if the inventor asks for an international patent), protecting the PCT countries (WIPO, 2021e).

Intellectual property provides twofold protection (Pénin et al., 2013)—artistic, literary and industrial property protection. In our research, we will focus on the industrial property protection fold of IPR.

Strong IP rights may provide a marketing advantage for the first mover to a market. It will also legitimize the new technology with strong IP protection, encourage the company's image in the market and, most importantly, increase and enhance licensing opportunities (Hurmelinna et al., 2007). In a research conducted by Sweet et al. (2015), through the IPR index (Ginarte Park Index) of over 110 countries, the scholars show that when the level of IPR is high, the innovation activities measured through exported product complexity are also high in the developed countries. However, the IPR complexity has no negative effect on economically developing countries (Sweet & Eterovic Maggio, 2015, p. 665).

Prior research shows that strong IPR can “enhance the efficiency of technology transfers and encourage the diffusion of technology, including parts of a technology that patents do not protect” (Arora et al., 2002, p. 117). In this research, the authors conducted a survey on Indian companies to show how know-how can be transferred through arm's length contracts, provided it is bundled with complementary inputs. As a result, the authors proved that even in the field's (India) weak patent protection conditions, the patents provided a high level of protection for tacit knowledge. Accordingly, in the areas where a higher level of IPR exists, technology transfer through licensing would enhance the inflow of knowledge and make the transfer more efficient (Arora et al., 2002, p. 140). Strong IPR can also reduce the technology transfer cost and give the possibility to inward and outward technology flows (OECD, 2019a, p. 141)

The literature also shows contrary evidence that IP moves very fast to the areas where the IP protection is low (Oz, 1995 in Borg, 2001), but also, as a strategic resource, IP has a commercial value (Borg, 2001).

Various tools are available for protecting intellectual property (IP) based on specific needs. Formal protection options include patents and utility models, copyrights, trademarks, industrial design, and geographical indications. Informal protections are more restricted and include trade secrets and, as a tool for secrecy, the lead-time advantage. This article will focus on patents since the Open Innovation process has led to a different status for IP, which protects inventions from competitors and helps companies identify suitable partners and establish trustworthy relationships between them (Mignon et al., 2020). However, it is important first to explain the different IP protection tools available.

1.1.1. Patent protection

The formal protection of intellectual property rights provides legal protection to the owner and serves as a deterrent against potential infringement. By the definition of WIPO, “*a patent is an exclusive right granted for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem*” (WIPO, 2023a). In the subsequent phase of our research, we will examine various forms of patent exploitation.

The invention patent provides protection and a guarantee of exploitation to its owner. By definition, a patent demand must be made on a specific territory (in a country patent office such as INPI in France, EPO in Europe or CNIPA in China, etc.), and the demand can be made for the protection of a maximum of 20 years. In order to be patentable, an invention has to be

- New for the public: a novel for the public and without any antecedent¹.
- To be able to applicable in the industry: the ideas cannot be patented, but the inventions with an industrially reproducible nature (Pénin et al., 2013)

¹ If there is an antecedent, the application may be made for a “utility model,” which brings an update or a new approach to an existing invention. However, our work will focus on patents and exclude the utility model.

- A patent gives its owner the exclusive right to protect and profit from their invention. Holgersson et al. (2017) identified several reasons companies apply for patents, including protection, bargaining power, reputation enhancement, attracting investors, and internal purposes (Holgersson & Granstrand, 2017). These motivations for patent applications are explained in detail below.

Patent application motivations

A patent application can be related to different motivations according to the companies' objective, as the literature has put in evidence a range of diverse motivations that drive organizations to seek patents for their innovations. In this part, we are going to delve into those motivations.

Access in new markets

Patents have been used as an entry tool in the market since World War II (after this, referred to as WW2). Arora (1997) studied the use of patents in different industries and the influence of patents on the change in industry structure. A case study in the petrochemical industry shows that the increasing use of patents after WW2 is, first, to protect the market and limit market entry, which inherently pushes companies to patent their invention to access the market, and secondly, to create growth of the market size and the number of producers. Accordingly, licensing became more attractive for the companies as a tool for entering a market (Arora, 1997)

Concentrating on the problem of the high number of technology transfers in Japan compared to the US, Cohen et al. (2002) studied the difference in the use of patents in these countries. The authors researched the different uses of patents and argued that this is related to more than cross-national policy differences. The author conducted a cross-national survey of R&D-intensive manufacturing companies (50 million USD sales/ year). The results show that the patents are used in both countries as protection tools, lead time, complementary manufacturing, and sales abilities. However, the authors noted some differences in patent use in both countries. While secrecy is more used in the US, patents are much more preferred in Japan. The authors explain these countries' differences because of the imitation time-lapse difference. The imitation time is lesser in Japan than in the US, which increases the spillover effect and the use of patents. The patent protection policy difference between these countries is also a different factor. In Japan, patents are the source of information between rivals' innovations. However, the patents are used to access the market and to have the freedom to operate in Japan, while on

the contrary, in the US, the patents are used to protect the company and create an exclusion from the market. Finally, the last difference between those countries is that patents are more common in complex product manufacturing, and those industries tend to accumulate more patents in their portfolio. Japanese complex product manufacturers also do the same but are using patents as an information source, and the litigation of patents is lesser than USA companies. The authors emphasize that patents allow the holder to operate and enter a new market (Cohen et al., 2002).

Patents are not considered just a tool to protect inventions against imitation. A company's patent demand can have different reasons or motives according to the company's business model and the company's strategies for using the patents. The scholars have long researched this topic, which allows us to cite those reasons.

Prevention of copying, protecting business, blocking competition and standard setting:

A monopoly right to use the patent is the first and generally known use of the patent to hinder imitation and protect against any infringements. The patent creates a monopoly in favour of its owner to use its financial and reputational return (W. M. Cohen et al., 2000; Gassmann et al., 2010, p. 217; Lichtenthaler, 2009b) by excluding the imitators from the market. Somaya (2012) clarifies this monopolistic feature. The author explains this limited time monopolistic advantage from the angle of "excluding others" from using the invention by the verbal claims righted in the patent but not to give an eternal right to use the invention. There always exists the possibility to "invent around" for second parties. A patent can protect an invention. However, the practical use of the patents does not allow the holder to apply only for one patent to protect their invention. Generally, a patent stays vulnerable if other patents do not protect it from the same holder. Because the competitor companies may "invent around" this invention and demand patents similar to the invention with minor changes. As Rao (2005) argues, the invention of patents is a relatively low-cost solution. However, not every company can use this as a low-cost, short-cut solution to obtain a similar innovative solution. The invention around patents also requires a strong absorptive capacity and high in-house R&D to develop and demand a patent. Nevertheless, scholars suggest that strategic information about a patented product arrives to a competitor in 12 to 18 months after the launch of a product; 60% of patented innovations are imitated within 4 years (Rao, 2005, p. 33).

Pénin (2013) explains that monopolistic and public information sharing features work together to spread innovative ideas by providing protection and signal (Bianchi et al., 2014; Pénin et al., 2013, pp. 33–34). Similarly, Ayerbe (2016) highlights that in addition to protection, strategic

patenting serves as a means for businesses to capture and create value within their business model (Ayerbe, 2016, p. 91).

The protection and prevention of copying are important motives while patenting an invention. Holgersson et al. (2017) studied the motivation behind patenting and focused on the protective and bargaining motives in Open Innovation strategies. The research was conducted in 100 Swedish companies with varying R&D spending in different industries. Their quantitative research showed that the primary reason for patenting is to protect product technology from competitors, specifically from imitation (Blind et al., 2006, p. 657; Blind & Thumm, 2004; W. M. Cohen et al., 2000; Holgersson & Granstrand, 2017). Holgersson et al. (2017) state that even if other motives exist for patenting, the traditional reason for protecting product technology remains the dominant.

Blocking the competition against the rivals and reducing imitation risk, or “fencing”, is a strategy consisting of having different patents around a central invention to protect it from different angles. The patent portfolio, which consists of those protective patents, is generally not used for exploitation but to create a blocking factor and to keep away the concurrent from the market and the field of the invention (Ayerbe, 2016, p. 94).

The patent is often viewed as a means to discourage possible infringers rather than safeguarding or utilizing the innovation in the market. It does not usually reveal the innovation but presents a chance for revenue through potential infringement. Patent trolls typically use this as a business model to initiate litigation against imitators or demand a loyalty payment from their patent portfolio (Ayerbe & Chanal, 2010a, p. 103; W. M. Cohen et al., 2000; James et al., 2013, p. 1130). Therefore the patents provide protection of the business (Blind et al., 2006; Holgersson & Granstrand, 2017), reduce imitation risk (W. M. Cohen et al., 2000; Gassmann et al., 2010; Lichtenthaler, 2009b), and block the competition (Ayerbe, 2016; Ayerbe & Mitkova, 2013).

Standard setting in the market

One way for a company to benefit from their patents is by setting an industry standard. This approach allows the company to establish a market standard that other companies must follow. As a result, the company can either license their patents and create a market for their product and invention or profit from infringements. Setting an industry standard also ensures the

company's freedom to move and operate, making it a lucrative option (Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009). It also offers the use of patents in cross-licensing agreements.

The negotiation function, building a strong portfolio and using for cross-licensing:

The patent gives a right to use the invention to capture the value and the company's business model. Patents can be used as an exchange tool during technology transfer, can be used to access a patent pool which will give the right to have access to the technology of second parties or to be used purely for merchant reasons to make monetary profit (Ayerbe & Mitkova, 2012; Blind et al., 2006; W. M. Cohen et al., 2000). The most common and cited reason for licensing is to make money and earn licensing revenues (Lichtenthaler, 2009b).

It is the “*exchange money*” or “*bargaining chips*” role of the patent for the patent-pool entry or cross-licensing negotiations (Blind et al., 2006; W. M. Cohen et al., 2000; Holgersson, 2013; Pénin & Neicu, 2018).

Holgersson et al. (2017) emphasize that the bargaining motives of patenting are also important while using Open Innovation strategies. Patenting the new technologies increases technology transfer and trade possibilities with all other outbound and inbound Open Innovation activities (Holgersson & Granstrand, 2017, p. 1277). We can consider this as a negotiation tool for the patents. The scholars show the “*exchange money*” or “*bargaining chips*” role of the patent for the patent-pool entry or cross-licensing negotiations (Blind et al., 2006; W. M. Cohen et al., 2000; Holgersson, 2013; Pénin & Neicu, 2018).

Table 1 Benefits of patents

Benefits of patent		
Monopoly right	Protection & Exploitation	(Gassmann, Enkel, and Chesbrough 2010, p. 217; Lichtenthaler 2009)
Motivation for R&D workers	Incentive for R&D department	(Blind & Thumm, 2004; W. M. Cohen et al., 2000; Gassmann et al., 2010; Mazzoleni & Nelson, 1998)
Public information source	Detailed product or process information Technological information surveillance tool for companies	(Ayerbe, 2016; Mazzoleni & Nelson, 1998; Pénin et al., 2013, pp. 33–34)
Coordination	Inter-firm cooperation/ coordination	(Ayerbe & Mitkova, 2013, pp. 93–95)
Value creation	Exploitation through product Exchange tool for technology transfer Exchange tool to access a patent pool (Second parties patent portfolio) Inter-firm cooperation and collaboration tool (coupled OI) Signal (to show the technological capabilities of a company) public information source Formal knowledge creation (formalisation)	(Ayerbe, 2016; Ayerbe & Mitkova, 2012, 2013, pp. 93–95)
Value capture	Entry barrier Jurisdictional tool (for infringements) Blocking competitor Technological watchfulness (descriptive capacity) Negotiation tool	(Ayerbe, 2016)

The patents guarantee further developments of patented technology and prevent appropriation by licensing agreements (Ayerbe & Mitkova, 2013). Patents are significant in structuring collaborations, such as joint ventures, research groups, or consortiums. They facilitate the creation of a collective knowledge pool and help establish a synergy between collaborating parties. In a collaborative environment, patents aid in identifying potential partners and building trust by safeguarding both parties' know-how and technology. They also optimize the value creation process by exploiting the standard technology resulting from the collaboration. Furthermore, patents protect the outcomes of the collaboration and create a common language between parties from diverse fields like R&D researchers, consultants, and top-level managers, making communication easier (Pénin et al., 2013, pp. 35–36).

A source of technological information surveillance

A patent application also provides genuine knowledge in favour of the public. The inventor has to provide detailed information about his work to the patent office to grant a patent. Accordingly, once a patent is given, it also becomes public. The detailed information on the patent file goes to the patent database described in the patent itself, which Mazzoleni et al. (1998) call the “information disclosure” theory. The patent database provides valuable information about technological improvement. This exploration possibility that patents give to the researchers is also called the “exploration control” theory (Mazzoleni & Nelson, 1998). A patent, by nature, brought previous technological knowledge on its own. It is primarily a detailed description of the invention. It also brought economic information concerning the invention’s market development or innovation opportunities. Since the patent has a geographical limitation, it also allows exploiting it in non-covered geographical environments for those using the patent’s information as a tool for surveillance (Ayerbe, 2016, p. 93; James et al., 2013, p. 1130; Pitkethly, 2001, p. 432).

Improving image:

The patent can be a tool for technological knowledge accumulation and portfolio management, according to Ayerbe et al. (2006). At the same time, it is considered a “prestigious” signal tool, increasing the company’s positive image in the market.

Patents are the tools to show others the technological knowledge level of a company. The patents simultaneously communicate the capabilities to suppliers, customers, or competitors (James et al., 2013; Pénin & Neicu, 2018) and financial and industrial partners (Corbel, 2011). They will increase the *company’s value perception* in the eyes of those players (Corbel, 2011; James et al., 2013, p. 1131; Pénin & Neicu, 2018). More specifically, in their comprehensive literature research, James et al. (2013) show that patents undeniably influence a company’s reputation, mainly in the pharmaceutical industry. Also, Blind et al. (2006), in their study on German manufacturing companies’ patenting motives, put evidence that patenting is considered a reputation element, especially in the biotechnology & and pharmaceutical industry (Blind et al., 2006).

Holgersson et al. (2017) studied Swedish firms through a survey in their research of patenting motives related to technology strategy. The authors specifically focused on the bargaining and protection motives of the companies while patenting. The results show that besides protection

and bargaining motives, reputation and improving the motivation of the company by patenting a critical internal motives for companies while patenting (Holgersson & Granstrand, 2017).

Measuring tool for internal performance and a reward mechanism:

Scholars attribute patents as a reward given by the public to the inventors for their work (W. M. Cohen et al., 2000; Mazzoleni & Nelson, 1998). Accordingly, the authors emphasize the motivation function of patents for inventors. The anticipation of a patent incentivises to creation and investment of time and energy in an invention for R&D workers as an “invention motivation” theory (Gassmann et al., 2010; Mazzoleni & Nelson, 1998).

In their survey, where Cohen et al. (2002) compared the R&D knowledge flows and spillovers, the authors searched the patenting reasons for the manufacturing firm’s responsible. The responses included

- measuring the internal performance of the firm’s researchers,
- making licensing revenue,
- improving companies’ negotiation capabilities, such as cross-licensing to prevent patent infringements,
- blocking other companies from patenting the same invention, and
- increasing the company’s reputation.

Accordingly, the author put in evidence that the patents are not only used for companies’ external strategies but also for purely internal reasons, like measuring the internal R&D workers’ performance (W. M. Cohen et al., 2002, p. 1358).

In the same vein, besides the traditional motives of patenting, such as protection and bargaining for cross-licensing, Blind et al. (2006) considered an incentive for the employees of the R&D department as a performance indicator in their survey among German companies. Additionally, the results of their survey show differences between industries. The incentive function is more critical in sizeable electrical engineering companies than in metal production companies.

Patenting is used to measure the company’s innovation performance and to motivate the R&D department (Blind et al., 2006; Corbel, 2011; Holgersson & Granstrand, 2017) as an internal reason.

Attracting financial investors , use government incentives

Patenting is also a tool for using government incentives while attracting external financial resources (Blind et al., 2006; Holgersson & Granstrand, 2017).

Again, the previous literature proved that patenting is a measuring tool for a company's R&D intensity. Companies are using this tool to attract potential investors. Blind et al. (2006) use the term capital market for potential investors and study this concept as an "exchange motive for patenting" together with attracting financial investors, increasing licensing income, and cooperating with other companies. Their research results show that this is an essential motive for particularly small companies to increase their capital and large companies. Still, for them, it is for improving their licensing revenues and having a good hand for negotiation in cross-licensing agreements. The author also emphasizes that most biotechnology and pharmaceutical companies use patents to access capital markets (Blind et al., 2006).

Table 2 Patenting reasons

Reasons for patenting	
Protection of ...	Technology (Product or process technology) Against competitors, using as a punishing tool Blocking competitors from entering the market or a certain area Creating security to operate / standard-setting Securing markets (in patented countries)
Bargaining	Licence selling (licensing revenue) Creating cross-licensing agreement option R&D collaboration with others Bargaining opportunity creating while standard-setting in an area
Improving corporate image toward	Employees Customer Suppliers, Investors Local government Collaborators
Attracting external financial resources	Bank-loans or non-governmental investors Government incentives / loans/ grants Private equity/ venture capital
Internal reasons	Providing motivation to invent & measuring R&D productivity

Source: (Blind et al., 2006; Holgersson & Granstrand, 2017, p. 1273)

According to Mitkova (2005), the patent plays a crucial role in the innovation process, acting as a bridge between the invention and the actual innovation (Mitkova, 2005). Ayerbe et al. (2004) further elaborate on this, highlighting the significant power of patents in granting exclusive rights to the inventor for the exploitation and dissemination of their creation.

However, it is important to note that a patent does not always guarantee innovation. Firstly, a company can still innovate without patenting their ideas or technologies. Secondly, a patented concept or technology may remain unused in a patent portfolio without being developed into a product or process. In essence, patents can be utilized primarily for protective purposes within a company firm (Mitkova & Ayerbe, 2004). This protection can also extend internationally through patent applications in other countries. When companies' exportation increases the imitation risk, patenting abroad can solve imitation risk and protect their inventions in other countries. Archontakis et al. (2017) studied the patenting abroad concept within 28 OECD countries. Two groups of companies (big and small-medium countries) put evidence that Imitation risk in the destination country is the main driver for companies choosing to patent their invention abroad. The second reason which reinforces this decision is the risk of imitation, which comes with the exportation of the product to the destination country for both sizes of the group of countries (Archontakis & Varsakelis, 2017).

However, the patent applications of Chinese companies after 2000 have caught the attention of researchers due to their increasing inventive activities. A study by Ma et al. (2009) focused on analyzing the innovative activities of China and other countries, specifically examining patent applications. Utilizing the USPTO database, the authors closely examined the joint patent applications between Chinese companies and the eight most inventive countries in the OECD, South Korea and Taiwan. The study revealed a notable rise in Chinese companies' inventive activities and patent applications. This trend is predicted to continue in the coming years, indicating the growing significance of China in the field of invention and patent applications (Ma et al., 2009). This research sheds light on the transforming landscape of global innovation, highlighting China's progress in this area. Similarly, Wunch-Vincent et al. (2015) conducted a comprehensive study on Chinese companies to explore the surge in their patent applications in foreign countries. This research aimed to address the existing research gap in the literature. The authors undertook an extensive literature review and formulated four main questions to gain insights into the increasing trend of patenting abroad and its characteristics. These questions revolved around the volume of patenting abroad compared to domestic patent applications, the preferred countries by Chinese inventors, the profile of applicant companies, and the industries most involved in patenting abroad. By delving into these aspects, the study shed light on the growing importance of international patenting for Chinese firms, providing valuable academic insights into this area of research. In their study, the authors utilized the patent database to

analyze the trends in patent applications by Chinese companies. They also conducted selective interviews with key industry players to gather additional insights. Their research findings indicate that the volume of patent applications related to inventions, particularly within the domestic market, remains relatively low. However, a significant shift occurred after the year 2000 when Chinese companies began to increase their patent applications in foreign countries. Compared to other emerging economies such as Brazil, Russia, India, and South Korea, Chinese companies exhibited a greater surge in patent applications abroad. This indicates a growing interest and recognition of the importance of protecting their inventions in international markets. This data sheds light on the fact that Chinese companies have recognized the importance of protecting their inventions through patents on an international scale. Among the preferred countries for these companies to file patent applications, the top choices are the United States, Europe (specifically the European Patent Office), Japan, and South Korea. These findings emphasize Chinese companies' global outlook and ambitions regarding intellectual property protection and innovation. However, this result shows that Chinese companies' choices in patenting their inventions differ from those of OECD countries. The ranking of preferred countries for patenting is as follows: 1) Germany, 2) Japan, 3) Korea, and 4) the US. These findings highlight the divergent strategies employed by Chinese companies in protecting their intellectual property. Furthermore, the interviews with these companies shed light on the multiple drivers behind seeking patents abroad. First and foremost, companies aim to build a robust patent portfolio that minimizes the risk of litigation. This proactive approach allows them to safeguard their inventions and prevent legal disputes. In addition, patenting abroad also serves as a means for companies to establish future collaborations. By securing international patents, these companies increase their visibility and attractiveness to potential partners interested in joining forces to develop innovative solutions. Another reason companies engage in foreign patenting is the opportunity to sell or license their intellectual property to international entities. This strategic move allows them to monetize their inventions and expand their revenue streams beyond domestic markets. Lastly, companies recognize the significance of enhancing their reputation as innovative entities. They solidify their position as forward-thinking, cutting-edge organizations by obtaining patents abroad. This reputation boost attracts potential customers and investors and strengthens their competitive advantage in the market. In conclusion, Chinese companies' choices in patenting their inventions reflect a distinct approach from that of OECD countries. The drivers behind seeking patents abroad are multifaceted, including the desire to build a robust patent portfolio, explore future

collaborations, monetize intellectual property, and enhance their reputation as innovative entities. These findings provide valuable insights into the strategic considerations of Chinese companies in protecting and leveraging their inventions. One of the main reasons why companies choose to patent their inventions abroad is because they consider the patent to be of significant worth. As a result, only patents that are deemed worthy are selected for international filing (Wunsch-Vincent et al., 2015). In our research, we have identified a selection of countries where Chinese companies have shown a particular interest in seeking patent protection, including the United States, Japan, Germany, South Korea, and France. This highlights the global reach and importance of these countries when it comes to intellectual property and innovation. Through our study, we aim to shed light on the factors that influence Chinese companies' decisions in this regard, further contributing to academic research on patent protection and international business.

Ayerbe et al. (2006) explained the formal or informal protection arbitrage from a company's perspective as an alternative to patents. The authors emphasize that the decision of formal protection such as patents, designs, copyrights or trademarks, or semi-formal mechanisms such as confidential agreements, non-disclosure agreements or contracts (Aloini, Lazzarotti, et al., 2017b) and informal protection mechanisms (secrecy, product complexity or lead-time advantage (Aloini, Lazzarotti, et al., 2017b; Hurmelinna-Laukkanen & Puumalainen, 2007) depends not only the IP protection rules as Chesbrough emphasize, but also the difficulty of imitation of the invention, the gap between the protection cost (patenting cost) and the net profit which bring the patented technology after the patent, the strategic use of the patent correspond to the company's business model, and also the culture of the company (Ayerbe & Mitkova, 2006, p. 7).

1.1.2. Other forms of IP protection

In intellectual property, patents grant the inventor an exclusive right to their creation, whether a groundbreaking product or an innovative process. Obtaining a patent involves a meticulous process where the inventor must provide comprehensive technical details about their invention within the patent application, ensuring that all aspects are covered. Once the patent is granted, this information becomes publicly accessible, allowing others to learn from and build upon the inventor's creation. With a patent in hand, the inventor uses 20 years of protection, subject to paying annual fees to the patent office.

During this period, the patent owner also has the opportunity to earn licensing fees by allowing others to license their invention, further incentivising innovation and creativity in various fields of study. The patent system, therefore, plays a crucial role in fostering academic and technical progress by safeguarding the rights of inventors and encouraging the dissemination of knowledge and ideas. By protecting the ownership rights of inventors, patents foster an environment of academic growth and encourage researchers to push boundaries and develop groundbreaking inventions. This not only benefits the inventors but also contributes to the overall advancement of academia and technical knowledge. After the 20-year protection period ends, or if the owner decides to terminate the patent before its expiration, the invention becomes public knowledge and is no longer subject to legal disputes. This ensures that the knowledge and ideas behind the invention can be freely shared and built upon, furthering academic progress and allowing others to continue expanding upon the initial innovation. In this way, patents not only incentivise inventors but also benefit the academic community by promoting the exchange of ideas and fostering a culture of continuous learning and improvement.

Design patents and utility models are two types of intellectual property rights that offer protection for inventions. Design patents focus on protecting the aesthetic aspects of a product, such as its shape or patterns, while utility models protect small improvements made to existing products.

Both patents and utility models are important tools for inventors to safeguard their creations and ensure they have the exclusive rights to profit from their inventions. Design patents have a duration of 15 years, while utility models offer protection comparable to patents but with less stringent requirements. As academic scholars in the field of intellectual property, it is crucial to understand the distinctions between design patents and utility models to provide accurate information and guidance to inventors and businesses seeking to protect their innovative ideas. With the ever-evolving landscape of technology and innovation, it is essential to stay informed about the latest developments in patent law and its implications for inventors.

Thus, the utility model system provides 10 years for the granted technology to use exclusive rights to protect these minor inventions and ensure their improvements are duly acknowledged. It is worth noting that a utility model represents a specific category of patent rights, albeit with some variations in terms and conditions. This distinction is essential to understanding the nuanced differences between inventions and patents within the legal framework. By offering this extended protection period, the utility model system aims to foster innovation and

encourage inventors to refine and enhance their creations, ultimately contributing to society's overall progress and development.

According to the World Intellectual Property Organization (WIPO), when it comes to protecting an invention, understanding the differences between a patent and a utility model is crucial. Delving into the specifics, there are two key differentiating factors to consider: the complexity of requirements and the duration of protection.

Firstly, in terms of requirements, utility models offer a less complex and more accessible option compared to patents. This is particularly beneficial for innovators seeking protection for incremental improvements that may not meet the strict patentability criteria. Inventors can safeguard their creations without navigating intricate patent requirements by opting for a utility model.

Secondly, the duration of protection is another differentiating factor. While patents typically protect for 20 years from the filing date, the term for utility models is shorter and varies between countries. Generally, utility models offer a protection term of 7 to 10 years, allowing inventors to safeguard their innovations substantially, albeit shorter than patents. Understanding these key differences between patents and utility models is essential for inventors and innovators looking to protect their intellectual property. By considering the requirements' complexity and the protection duration, individuals can make informed decisions about which avenue suits their specific invention best. WIPO's insights shed light on the intricacies of these two forms of intellectual property protection, empowering inventors to navigate the legal landscape confidently.

Regarding utility model applications, one notable distinction from patents is that they are not subject to a thorough examination process to determine if there is a substance of prior registration, as is done for patents. This key difference implies that utility models' application and registration process is comparatively more effortless.

Another advantage of utility models lies in their cost efficiency. Obtaining a utility model is generally cheaper than acquiring a patent. This cost factor makes utility models attractive for inventors who may have budget constraints but still seek legal protection for their innovations.

Finally, the availability of utility models varies across different countries. While utility models can be obtained for products in some jurisdictions, they may not apply to processes. This distinction is important to consider when evaluating the suitability of utility models for

different types of inventions (Beneito, 2006; WIPO, 2023b). The ease of application, the cost advantage, and the fast grant associated with utility models make them particularly valuable for short lifecycle technologies. This is an important consideration in academia, where swift and cost-effective protection of intellectual property can significantly impact research and development progress (Prud'homme, 2017). Therefore, utility models offer a compelling alternative to patents, particularly for inventors looking to safeguard their innovations in an academic setting.

Copyright is a legal concept that grants exclusive rights to the creators of artistic or literary works, safeguarding their intellectual property and ensuring they control how their work is reproduced, distributed, and displayed. This protection extends to a wide range of creative expressions, encompassing traditional forms such as books, paintings, and sculptures, and modern mediums like movies, computer programs, and technical drawings. By granting copyright, society acknowledges the importance of originality and creativity, allowing creators to benefit from their creations both during their lifetime and for an additional 70 years after their death. This legal framework fosters a thriving cultural landscape and incentivises further innovation and creativity. The concept of copyright is an integral part of the academic discourse surrounding intellectual property rights. It serves as a cornerstone in protecting and encouraging artistic and literary endeavours.

Trademarks, conversely, serve as distinctive signs companies use to differentiate their products from those of other companies. Protected by intellectual property rights (IPR), trademarks can encompass drawings, numbers, symbols, sounds, fragrances, and colours. These trademarks play a crucial role in building brand identity and consumer recognition. A company can establish legal protection and exclusive rights over their unique sign or symbol by registering a trademark. Trademark protection lasts for a specified duration, typically spanning 10 years. During this time, the trademark owner can prevent others from using a similar sign or symbol that may confuse consumers. However, it is important for trademark owners to actively manage and renew their trademark registration to maintain its protection. By doing so, companies can ensure that their distinctive signs continue to serve as effective differentiating factors in the marketplace. Trademarks are invaluable assets for businesses, helping them establish a strong market presence and fostering brand loyalty. With their ability to encompass various elements, trademarks allow companies to create a visual or auditory representation that resonates with consumers. By understanding the significance of trademarks and their protection, businesses

can leverage this intellectual property right to effectively position themselves amidst competition and thrive in the global marketplace.

In the realm of intellectual property, geographical indications function as labels that designate products as having unique attributes or hailing from specific geographic areas. These indications, commonly associated with agricultural commodities like wine, dairy, and industrial goods, protect the reputation and quality of such products. It is worth noting that geographical indications are subject to renewal every decade, ensuring their continued significance and relevance in the marketplace. Expanding on the importance of geographical indications in preserving regional identity and consumer trust, it becomes apparent that these labels play a crucial role in the academic study of intellectual property and its impact on diverse industries.

Formal protection tools are not the only means available when protecting intellectual property. Informal protection tools also play a significant role in providing flexibility and freedom to the intellectual property holder. Though not legally binding, these informal methods can offer some level of reassurance and security. From establishing non-disclosure agreements and trade secrets to leveraging the power of branding and reputation, informal protection tools can help protect intellectual property in various ways. While formal protection measures like patents, trademarks, and copyrights provide legal recourse in infringement, informal tools serve as an additional layer of defence by creating a culture of respect and trust in the business ecosystem. By acknowledging the significance of both formal and informal protection tools, intellectual property holders can maximise their ability to safeguard their creative works and innovative ideas. Overall, it is important to recognize that intellectual property protection is not limited to formal means alone, and informal tools can offer valuable support to ensure the rights and interests of IP owners are respected and preserved.

Secrecy

All types of information that create a company's competitive advantage can be subject to a trade secret. The technical information of a product, or production process, design, ingredients etc., can be considered a trade secret unless a patent protects it. Generally, it is protected by a non-disclosure agreement or non-compete agreement when the company decide to cooperate with another company. Informal protection is generally used in discrete technology areas, such as the pharmaceutical industry, where the product ingredients are easier to distinguish. It is also

the case for small firms which protect themselves from large enterprises being copied when they reveal their invention by patenting in the patent office.

Secrecy, also known as trade secrets, refers to confidential information held by a company that is not disclosed to others. This can include a range of valuable knowledge, such as proprietary formulas, innovative devices, unique methods, and intricate processes. This informal IP protection aims to maintain a competitive edge and prevent competitors from accessing or replicating such valuable information. However, it is crucial to note that while trade secrets provide a certain level of protection, there is always a risk of secrecy being compromised through techniques like reverse engineering. Consequently, companies must consider additional measures such as product complexity, which involves incorporating intricate manufacturing processes and integrating diverse technologies. This complexity serves as a deterrent to potential imitators, making it challenging for them to replicate the product.

Furthermore, businesses can gain a significant advantage through lead time, which allows them to secure both time and a substantial market share over a sustained period. By combining these various elements, companies can protect their intellectual property and maintain a competitive position within the market. Lead time advantage is widely recognized as crucial in gaining and safeguarding a competitive edge in the market (Gallié & Legros, 2012). In intellectual property (IP) protection, the literature has highlighted several strategies, such as secrecy, lead time advantage, and product complexity, which work harmoniously to provide a solid defense (Gallié & Legros, 2012). These informal IP protection mechanisms significantly fortify a company's position and deter potential competitors. By utilizing lead time advantage, businesses can stay ahead of the curve, ensuring that their innovations reach the market before others, thus establishing a strong foothold and securing their competitive advantage.

Hall et al. (2014) conducted a study to explore the factors influencing companies' preference for informal IP protection over formal IP protection, drawing on previous research and survey data. The authors observed that cost considerations do not solely drive the decision to opt for informal IP protection. Instead, strategic considerations and the proactive or defensive moves of the companies play a significant role in shaping this choice. By delving deeper into the dynamics of informal IP protection, the study sheds light on the complex decision-making processes undertaken by businesses in safeguarding their intellectual property. The authors compellingly highlight the intricate trade-off between maintaining secrecy and seeking patent protection in their comprehensive analysis of various survey data. This trade-off is found to be

influenced by several crucial factors, including the nature of innovation (whether it is a product or process innovation, discrete or complex), the type of the product (whether it is discrete or complex), and the level of competition prevailing in the market. By delving into these factors, the study sheds valuable light on the complexities surrounding the informal protection of intellectual property.

Developing new and distinct products in industries like pharmaceuticals heavily relies on patent protection to safeguard intellectual property. However, it is important to recognize that not all innovations related to processes are eligible for patent protection. When dealing with information that can be patented, divulging excessive details may discourage competitors from directly imitating the innovation but could motivate them to create alternative inventions. Consequently, maintaining secrecy may be necessary for process innovation rather than relying solely on patents. This informal method of protecting intellectual property helps maintain a competitive advantage in the market. In scholarly discussions, it is essential to acknowledge the subtle distinctions between different forms of innovation and the strategies employed to safeguard intellectual property rights.

Furthermore, it is of utmost importance to consider the existing environmental circumstances, particularly concerning competition, as they heavily influence the decisions made by organizations. As emphasized by B. Hall et al. (2014), when companies perceive the level of intellectual property (IP) protection in the market as inadequate, they tend to rely more on a strategy of secrecy rather than seeking formal patent protection. This informal approach towards IP protection enables companies to safeguard their innovations and maintain a competitive advantage without disclosing sensitive information through the patenting process. By comprehending the impact of environmental factors on strategies for protecting IP, businesses can make well-informed choices to preserve their rights over intellectual property while navigating through an ever-evolving competitive landscape (B. Hall et al., 2014). Veugelers et al. (2018) bring attention to the fact that emerging companies in the field of innovation not only rely on formal intellectual property (IP) protection measures but actively employ informal mechanisms for protecting their IP. It is important to note that these young, innovative companies strategically combine formal and informal forms of IP protection, recognizing the value and effectiveness of adopting a comprehensive approach to preserve their intellectual assets. By embracing this nuanced approach, these companies can leverage the benefits offered by both types of IP protection, thereby ensuring a robust and all-encompassing

strategy for protecting their innovations. Essentially, Veugelers et al. (2018) findings emphasize the significance of informal IP protection in complementing formal tools within the arsenal of young, innovative companies. This underscores its role as an essential component in preserving and enhancing their intellectual property assets. (Veugelers, 2018).

Various authors explain that the benchmark between formal and informal protection tools is related to the company's patenting strategy. We will delve deeper into the use of one particular formal protection tool, namely patents, as it relates to a company's patenting strategy. By examining the strategic aspects of patenting, we aim to shed light on the significance and impact of this formal protection tool in the realm of innovation and intellectual property.

1.2. Patent application strategies

“A strategy shows the directions and goals of a company and points out possible ways to achieve them. A patent strategy provides answers to questions (...) about which invention areas are patented for which purpose, also; which market and production areas are covered by patent protection, what means, expenses, and risk-taking appetite are used to defend this protection, and how far this risk propensity of this protection will be carried” (Gassmann et al., 2021, p. 27)

The patenting strategy cannot be considered as a standalone concept. Once the patenting decision is made, patenting reasons enter the scene. Depending on what patenting reason the company is about to choose, the patenting strategy will be clarified (Ayerbe & Mitkova, 2006; Somaya, 2012).

Ayerbe et al. (2006) propose a comprehensive three-step analysis that sheds light on a company's strategic decision-making process. This analysis considers various factors, such as the unique characteristics of the intellectual property (IP) in question, including novelty and imitability. The first step of this analysis involves determining the most suitable mode of protection, which can either be formal (through patenting) or informal (via secrecy). Once this choice is made, the second step focuses on establishing the desired protection objective, whether direct or indirect patent utilisation. By following this structured approach, companies can make informed decisions that align with their overall patenting strategy, ensuring the safeguarding of their innovations most effectively and efficiently. The direct use of patents grants the patent holder exclusive rights to their invention, providing them with a significant advantage in the market. By obtaining a patent, the owner can prevent others from using,

making, selling, or importing their patented invention without their consent. This monopoly advantage allows the patentee to control the commercialisation and distribution of their innovation, which can lead to increased profits and market dominance. In addition to the direct use of patents, there is also an indirect way for patent holders to extract profit from their intellectual property. This patenting strategy involves licensing the patent to other companies or individuals, allowing them to use the patented invention in exchange for royalty payments or licensing fees. This approach enables the patent holder to leverage the value of their invention without directly manufacturing or selling the product themselves.

Furthermore, patent holders can also generate profit through strategic partnerships and collaborations. By licensing their patented technology to other companies, the patent owner can form strategic alliances that leverage the strengths and capabilities of both parties. These partnerships can lead to joint ventures, research collaborations, or product development agreements, generating additional revenue streams and market opportunities. In summary, the patent owner's direct use of patents provides a monopoly advantage. In contrast, the indirect use of patents through licensing and partnerships allows them to extract profit in multiple ways. This patenting strategy not only safeguards the inventor's intellectual property but also opens up avenues for commercialisation and collaboration, enhancing the overall value of the patented invention. A company must carefully consider its patenting strategy in this decision-making process's third and final step. This strategy involves determining the precise description of the invention, which plays a crucial role in reducing the imitation attempts made by other companies. By crafting a detailed and specific description, the company can discourage competitors from inventing the invention, thereby protecting the commercial activity of the company.

Moreover, the patenting strategy also encompasses decisions regarding the territory of protection, which is essential for limiting competition and the duration of the patent. It is important to note that maintaining an active patent requires the payment of a protection fee each year. Formulating an effective patenting strategy is vital for safeguarding the company's innovation and ensuring long-term success. Several authors put in evidence that a patent's lifecycle is approximately 10 to 6 years, depending on the change speed in the industry (Ayerbe & Mitkova, 2006).

However, granting patents will inevitably influence a company's strategic approach. These influences can be categorised into two types: direct impacts and indirect impacts. The direct

impacts encompass “*defensive, offensive, and opportunistic*” patenting strategies. On the other hand, the indirect impacts include “*technological reserve, information source, and prestige-related roles*” that patents play within a company’s overall strategy.

In their study, Ayerbe et al. (2006) shed light on various patenting strategies employed by organizations. They define a *defensive strategy* as a robust approach aimed at safeguarding against imitation and maintaining a monopoly position in the market. On the other hand, the offensive strategy centres around harnessing the potential of patents to generate revenue, increase market share, and actively explore opportunities for licensing. Lastly, an opportunist strategy allows patent holders to occasionally benefit from their patents without actively seeking intensive exploitation. These patenting strategies are crucial in shaping a company’s approach to protecting and profiting from its intellectual property (Ayerbe & Mitkova, 2006).

Similarly, Blind et al. (2006) also put in evidence the offensive and defensive strategies. The authors emphasize that offensive patenting is the way to prevent technological capacity and inform rivals about the company’s technological capabilities. Defensive patenting, as the previous patenting reason, is the way to prevent and inform rivals about the technological capabilities, but the aim is to keep the liberty in the field and not to reduce the technological capacity by the other companies’ patents. This is the most common use to prevent patent infringements (Blind et al., 2006). Defensive patenting is also called as “*competition blocking function of patents*”. It is the combination of different patents around one central patent in a patent portfolio which aims to discourage competitors and communicate the technological abilities of a company (Ayerbe, 2016, p. 94).

Our research focuses on the formal protection mechanisms that allow the Open Innovation process through technology transfer. In the following part of our research, we are going to study the formal protection options and their exploitation strategies.

1.2.1. Offensive strategy

The English dictionary Merriam-Webster defines the word offensive as “making an attack, designed for attack, or relating to an attempt to score in a game or contest” (Merriam-Webster, 2023a). In the context of patenting, the word offensive holds a similar meaning. When it comes to patenting strategy, a firm may choose to patent offensively to block or prevent others from submitting similar patent applications. Much like its defensive counterpart, this offensive strategy aims to create a protective wall around the patent portfolio, ultimately deterring

competitors from entering the market. This strategic approach safeguards intellectual property and can provide a significant advantage in today's highly competitive business landscape. By leveraging an offensive patenting strategy, companies can solidify their position in the market and maintain a strong foothold in their respective industries. (Blind et al., 2009; Guellec et al., 2008).

In this sense, it is essential to delve deeper into blocking, specifically in the context of offensive strategy. When applied in an offensive sense, this term pertains to the deliberate act of impeding or inhibiting competitors' progress, thereby creating an advantageous position for oneself. By strategically slowing down or even halting the advancement of rivals, one can assert their dominance and gain a competitive edge. By implementing a well-thought-out offensive strategy, companies can effectively utilize blocking to achieve their objectives (Somaya, 2012). According to Somaya (2012), offensive strategy is an integral component of generic patent strategies. The author describes offensive strategy as a proprietary approach to establish strong barriers around a patent. This is often achieved through various means, such as acquiring substitute technologies or enlisting the expertise of industry professionals. Somaya aptly names this strategic approach *offensive blocking*, highlighting its proactive nature in safeguarding the original technology (Blind et al., 2006). In the same vein, offensive thickets are an effective defensive strategy to prevent the unauthorized copying of a particular technology. It is worth noting that patent thickets refer to a collection of patents with distinct patent holders, but the patented technology exhibits similarities with minor variations. When faced with patent thickets, the holders can only bring a commercial product to market after obtaining the consent of all the different patent holders involved.

Consequently, in such cases, the patent holder may be cautious and reluctant to license their technology to prevent other companies from producing similar products. This strategic defensive measure aims to safeguard the exclusivity and market share of the patented technology (Yanagisawa & Guellec, 2009). By maintaining tight control over the licensing of the technology, the patent holder ensures that their competitors can only exploit their innovations with proper authorization. Implementing offensive strategies, such as offensive thickets, is a pivotal mechanism in the complex world of intellectual property rights, protecting the inventors' interests and fostering innovation in diverse industries. (Somaya, 2012).

Nevertheless, scholars also widely recognize and acknowledge the offensive strategy as a powerful *leveraging strategy* within the context of technological development and intellectual

property rights. A company may opt to implement an offensive patenting strategy, aiming to generate supplementary income from other companies directly and potentially engage in trade with them. This strategic approach is frequently embraced to enlarge the firm's market share within the industry (Ayerbe & Mitkova, 2006). Using patents “outside of the company's business” to boost the worth of the innovations can be perceived as an offensive strategy. In fact, licensing is commonly regarded as the initial phase towards a potential collaboration, be it in terms of research and development (R&D) or the realm of economic partnerships such as mergers and acquisitions (M&A) or joint ventures. This approach enables companies to protect their intellectual property and strategically position themselves in the market, leveraging their patents to create mutually beneficial alliances for growth and innovation (Mitkova, 2009; Xi & Mitkova, 2013).

While its primary objective is to prevent other firms from utilizing a particular technology, companies also employ it to license it and secure advantageous litigation settlements (Guellec et al., 2012). Moreover, another key aspect of the offensive strategy lies in its potential to be effectively utilized in cross-licensing agreements, allowing firms to leverage their technological advancements further and forge collaborative partnerships to pursue mutual growth and success. This academic discourse highlights the significance of the offensive strategy as a strategic tool that firms employ to protect their intellectual property rights while simultaneously exploring opportunities for collaboration and innovation.

Somaya (2012) also, in contrast to the previous definition of offensive strategy, provides an alternative perspective by defining the leveraging strategy as the utilization of “non-commercialized patents to generate supplementary revenue. Ayerbe et al. (2006) refer to this approach as an opportunist strategy, wherein the company strategically retains the patent within their portfolio for further utilization. This offensive strategy allows the company to patiently wait for the opportune moment to make use of their patents, all the while ensuring that they are safeguarded within their portfolio, ready to be deployed when the time is right (Ayerbe & Mitkova, 2006).

Furthermore, these patents can also serve as bargaining chips during cross-licensing agreements. Notably, these particular patents are often sought after and collected by patent trolls or patent sharks, who strategically stockpile them, anticipating their utilization in litigation processes. This scholarly perspective further delves into the notion of offensive

strategy, providing insights into the intricate aspects of utilizing strategies in patent procurement and application.

Accordingly, the management of those strategies will require different management structures. In their research, Ayerbe et al. (2008) put in evidence the organizational differences between IP management and organization differences related to the strategies in use, offensive or defensive. The study highlighted that different types of organizations exist depending on the strategy employed. Moreover, the qualitative field research conducted among five French companies demonstrated that companies with an offensive strategy proactively assigned extensive responsibilities to the license and patent management departments. This finding indicates that organizations with offensive strategies understand the importance of effectively managing their intellectual property to gain a competitive advantage in the market. Therefore, such organizations must establish robust management structures that align with their offensive strategy. Offensive strategy-related companies are known for their open and proactive organizational structures, allowing for increased liberty and interaction among team members. These companies are often considered independent business units within larger organizations, solely focused on offensive strategy. Notably, when it comes to patent applications, offensive strategy companies take a collective and proactive approach. They involve various departments, including marketing, research and development, and the patent department, in addition to obtaining the board's decision. This collaborative effort ensures offensive strategy companies have a comprehensive and well-rounded patent application process.

According to the authors, the offensive strategy in patent management encompasses philosophy, motivation, and exploitation choices. In the realm of offensive strategy, the philosophy revolves around the idea of maximizing the value derived from the patent. It is not merely seen as a means of protection but as a valuable “product” that can be leveraged for financial gain through selling or renting. This multifaceted approach to offensive strategy is a key component in effectively navigating the complex landscape of patent management. The motivations behind patenting include:

- creating financial revenue,
- using for marketing purposes, as a negotiation tool for economic or R&D collaborations,
- having access to new markets, and
- creating a reputation as an “innovation company” for the firm.

Blind et al. (2009) suggest that in complex technologies, such as information and communication technologies, semiconductors, and electronics, the production process is intricately connected to the utilization of other complementary technologies. These interdependencies are crucial as they contribute to the seamless functioning and advancement of these multifaceted industries. Consequently, the manufacturing of complex technologies necessitates the integration and coordination of various technological components and systems, ensuring that each element operates harmoniously to achieve optimal performance (B. Hall & Ziedonis, 2000). Therefore, the patents are using for negotiations for technology exchange or technology access, particularly in the case of complex technologies. This allows companies to establish mutually beneficial agreements, where they can share their expertise and knowledge to advance their respective fields of study further. By leveraging patents as bargaining tools, businesses ensure that they can gain access to intricate and advanced technologies, effectively fostering innovation and progress (Blind et al., 2009; B. Hall & Ziedonis, 2000; Mandard, 2018). In such cases, it is highly probable that companies employ patents extensively, aiming to establish *patent thickets consisting of complementary technology*. This approach serves to leverage patents as bargaining chips in cross-licensing agreements whenever the need arises. (Guellec et al., 2012). As previously defined, the implementation of an offensive patenting strategy predominantly occurs within the context of outbound Open Innovation activities. This strategy proves effective in generating additional revenue for unused technology, or as a means of facilitating cross-licensing endeavors (Chesbrough, 2004; Lichtenthaler, 2009b; Mitkova & Wang, 2015).

1.2.2. Defensive strategy

The English dictionary Merriam-Webster defines the word defensive as “serving to defend or to protect, devoted to resisting or preventing aggression to attack”(Merriam-Webster, 2023).

The primary purpose of patents is to safeguard and protect a company's valuable and intricate technologies by isolating them from imitation. This serves as an essential means for companies to maintain their key competitive advantages, ensuring that they remain protected and inaccessible to potential imitators. By doing so, companies are able to maintain the freedom to operate while also establishing large defensive portfolio (Blind et al., 2006; Somaya, 2016). This strategy, commonly referred to as "building fences" in the literature (Arora & Ceccagnoli, 2006; Somaya, 2012) is particularly vital when dealing with complex technologies. By

leveraging patents, companies can effectively prevent copying and unauthorized use of their innovative solutions (Somaya, 2012).

To effectively implement a defensive strategy, it is crucial to entrust the management of patents to experienced consultants and lawyers who possess specialized knowledge in this area. These professionals meticulously renew and examine the patents, ensuring their ongoing relevance and effectiveness in protecting intellectual property. If deemed necessary, the defensive strategy may be further strengthened by acquiring new patents that complement the existing portfolio. This comprehensive approach not only safeguards the organization's innovations but also enhances its competitive advantage in the market. (Somaya, 2012).

A defensive strategy is adopted by companies when they are hesitant to share their patents unless there exists a potential partner possessing specialized complementary assets. In this case, the patent holder company can leverage the complementary assets provided by the potential partner (Somaya, 2012, p. 1093). His defensive strategy is employed when drafting and enforcing licensing contracts that preserve the exclusive benefits of utilizing the technology becomes intricate. The primary objective is to protect the company's intellectual property and maintain a competitive edge in the market (Hill, 1989; Somaya, 2012).

According to Ayerbe et al. (2008), defensive companies have been observed to employ a specific defensive strategy to safeguard their technological capabilities and shield themselves from competition. This defensive strategy entails confining the decision-making process to a patenting committee, typically composed of patent engineers, R&D personnel, and other decision-makers possessing relevant expertise in the same field. The primary objective of this defensive approach is to safeguard the company's valuable proprietary knowledge from potential counterfeiting, piracy, and patent infringements. The underlying philosophy behind this defensive strategy is to preserve the company's monopolistic position within the industry by hindering competitors in the technology sector while deterring any violations of their patents. The underlying motives for pursuing patents align with this philosophy and can be summarized as follows:

- keep the monopolistic power in the market,
- protect against infringements and imitation,
- create a barrier for newcomers in the market,
- protect the image of an “innovation company”, and

- access to new markets.

Regarding the exploitation ways of the patent, it is important to note that a defensive strategy is often employed. This strategy focuses on using the patent exclusively for internal exploitation rather than licensing it for external use. Keeping the technology within the company allows for greater control and protection of intellectual property. However, licensing remains an option for disseminating technology and establishing a market standard. Additionally, the patent may occasionally be utilized for R&D collaboration (Ayerbe & Mitkova, 2008).

While the primary objective of a defensive strategy in the market is to prevent the entry of competitors, it is important to note that granting a patent is only sometimes essential for it to be utilized as a defensive patent. Merely being recognized as the inventor of a novel technology by other companies can deter others from pursuing patenting and thus offer the necessary freedom to operate (Guellec et al., 2012).

In the literature, defensive patent strategy encompasses various approaches to protect an organization's intellectual property rights and minimize potential risks. These strategies include blocking and pre-emption, patent thickets, validity changes, and defensive strategic patenting. In other words, a defensive strategy refers to the proactive measures taken by companies to protect their inventions from infringement and ensure their competitive advantage in the market (Somaya, 2012).

The defensive strategy not only incentivises other companies to increase their research and development efforts to stay competitive but also plays a vital role in protecting firms operating in discrete technologies like pharmaceuticals. In industries where inventions often act as substitutes rather than complements, and a single patent can cover a complete line of products, firms tend to build a patent fence using substitute patents to protect themselves from potential threats. This defensive approach has proven effective in protecting these firms' interests. Overall, the defensive strategy is crucial in maintaining a strong position in the market and protecting valuable intellectual property. Implementing a defensive strategy allows companies to safeguard their intellectual assets and preserve their standing within the market (Guellec et al., 2012).

By leveraging a defensive patent, a company can protect its intellectual property and establish a solid foundation for potential legal action against other companies that may infringe upon its

patents. By emphasising the potential repercussions, this defensive approach is a deterrent, dissuading competing firms from infringing upon the company's innovative pursuits. This helps protect the company's revenue and creates a protective barrier around its patent portfolio, ensuring that its innovations remain secure and its position in the market remains strong (Blind et al., 2009). Similarly, Kafouros et al. (2021) conducted a study to delve deeper into the profitability of patent litigation for companies. Their research centred around an in-depth analysis of a vast database of patent litigation cases in the United States. By collecting and examining litigation data spanning a decade from 2004 to 2014, and involving a substantial number of 386 companies operating in the highly competitive IT industry, the authors unravelled the intricacies surrounding the cost and profitability of engaging in patent litigation. Their findings revealed that patent litigation can be a costly endeavour for companies that do not specialise in the litigation process and may not always yield profitable outcomes. However, despite the potential drawbacks, the authors highlighted that having the option to engage in litigation can serve as a valuable defensive strategy for companies, enabling them to create barriers and protect their intellectual property rights. (Kafouros et al., 2021).

Defensive patent strategy safeguards a company's intellectual property and presents a unique opportunity for businesses to establish a substantial patent portfolio. This strategic approach empowers companies to shield themselves from infringements or patent hold-up manoeuvres. By cultivating a robust patent portfolio through a defensive strategy, companies can proactively protect their innovations and ensure their continued success in the ever-evolving landscape of intellectual property rights (Somaya, 2012, p. 1094).

Large defensive patent portfolio companies prefer to enter cross-licensing agreements (Grindley & Teece, 1997; Somaya, 2012) when there is a large patent investment. This strategy is generally related to inbound Open Innovation activity because of the protective nature of the company's technical field and its technology from external parties. Companies often employ this defensive strategy to safeguard their valuable intellectual property and maintain a competitive advantage in the market. By entering into cross-licensing agreements, these companies can ensure that their patents are protected and that they have access to the technologies and innovations of other parties. This strategic approach allows companies to not only defend their technology from potential infringement but also to leverage the knowledge and expertise of external parties to enhance their own research and development efforts. Thus, the defensive strategy of entering cross-licensing agreements is crucial in facilitating inbound

Open Innovation activity within the company (Mitkova & Wang, 2015). A defensive strategy can be adopted to minimise or mitigate potential conflicts or disputes with competitors. Azzam et al. (2017) conducted a study in the aerospace industry highlighting the importance of intellectual property (IP) directors using cross-licensing as a valuable negotiation tool. This approach can help when competitors demand legal fees, or the company needs to pursue lawsuits against a competitor. By negotiating a cross-licensing agreement, the directors aim to find a mutually beneficial solution where both parties can emerge as winners (Azzam et al., 2017, p. 13).

Table 3 Offensive and defensive patenting strategies

	Offensive Strategy	Defensive Strategy
Philosophy	Patent is a "product" for commercialisation	Keep the monopoly position
	Creating markets	Patent infringements against imitation
	Improving R&D	Blocking the technology field
Patenting motifs	Generate financial revenue	Keep the monopoly power (both technological and commercial)
	Negotiation tool for cross-licensing or R&D collaboration	Protect against infringements and imitation
	Negotiation tool for economic collaborations	Barrier for new comers
	Create image of "innovation company"	Protect the image "innovation company"
	Access to new markets	Access to new markets
Exploitation	Internal use for strategic domains	Exclusively internal use
	Active external use of licensing, cross-licensing, cooperations and alliances	Licensing for standard setting or diffusion of technology only

Source: (Ayerbe & Mitkova, 2008; Xi & Mitkova, 2013)

1.3. Patent exploitation strategies

Once a patent is granted, the company may either store it for further usage, exploit it externally or decide to exploit it internally. The choice to keep inside for further use (stockage for a limited time), to exploit externally or to exploit internally are the choices a firm has to make to extract the maximum value from it (Mitkova, 2005, p. 63). The company may keep it for further usage; this decision is also called “storage”. This time, the storage will be for a limited time. A patent must be renewed every year, so keeping an unnecessary asset in the patent portfolio is costly.

Therefore, exploitation inside or outside the company is a must when considering an investment. Exploitation is the way to extend the exploitation of a patent (Mitkova, 2009)

In our study, we are aiming to discuss and put in evidence the exploitation modes of patents. Because of that, we find it appropriate to exclude the choice of stockage for further use from exploitation modes. Below, we will discuss the two remaining exploitation modes of patents.

1.3.1. Internal exploitation modes

Internal exploitation, as the first and natural consequence of patenting, involves retaining intellectual property within the company for internal product or process innovation purposes. However, the decision to pursue internal exploitation ultimately lies in the hands of the patent owner. This type of usage is generally considered strategic in leveraging the value of patents (Mitkova & Ayerbe, 2004). According to Lichtenthaler, internal exploitation encompasses various modes, such as internal knowledge accumulation, which refers to the organisation's storage and maintenance of knowledge over time. This practice is essential to prevent the loss of existing knowledge and competencies, ensuring the longevity and competitiveness of the business model(Lichtenthaler & Ernst, 2006, p. 373)

In his comparative study, Torrisi (2016) examined the internal utilization of patents. By analyzing survey data collected between 2003 and 2005 in Europe, Japan, and the United States, the author aimed to discern the distinctive characteristics between utilized and unused patents. Specifically, Torrisi investigated whether patents were strategically employed for internal purposes or left dormant for various reasons. The findings revealed that some patents remain unused for a strategic purpose to deter competition by signalling that the patent holder possesses valuable technology. This signal prompts potential new entrants to either obtain licensing from the patent holder or face imminent infringement issues - impeding their entry into the market while granting freedom of operation to the patent holder. Alternatively, unused patents may serve as bargaining chips during future cross-licensing agreements or be leveraged during infringement litigation (Shapiro, 2001). Also, Torrisi's study identified three distinct modes of patent usage: commercial use when actively exploited for economic gain; strategic non-use when deliberately left unutilized for strategic reasons; and sleeping patents which lay dormant.

Commercial utilization of patents can be achieved through two distinct methods: internal use for advancing products or processes and external use such as licensing, selling patents, or

establishing spin-off companies. The latter approach involves strategically withholding unused patents to impede market entry. This practice prevents other entities from obtaining patents within the same field, essentially acting as a protective barrier that grants the patent holder operational freedom. Research has shown that this strategy is most prevalent in the pharmaceutical industry. Furthermore, dormant patents are contingent upon three criteria: technological environment characteristics, patent value, and legal validity. The findings reveal that approximately 40% of all patents remain untapped, with 67% specifically filed for blocking purposes. However, the results vary between countries; EU countries and Japan exhibit more unused patents than the US. This implies that the US utilizes its patented inventions more extensively. The likelihood of strategically refraining from utilizing patents increases when competition levels are high and said patents serve defensive blocking purposes (Blind (2009)).

The latent existence of general-purpose patents persists due to the substantial cost associated with their implementation. Public policies could mitigate this adaptation cost and diminish dormant patents' prevalence. These inactive patents are typically prevalent in major corporations, indicating a potential transfer from established companies to nascent start-ups, where they can serve as a foundation for entrepreneurial endeavours. (Torrisei et al., 2016).

On the other hand, internal exploitation refers to the process through which a company assesses the value of its intellectual property to determine how it can be utilized for future growth and development. This evaluation can be carried out in various ways. However, two common approaches include utilizing the patent to develop a new product or implementing a new process that will positively impact production. By carefully considering these options, businesses can effectively leverage their intellectual assets to drive innovation and enhance their competitive advantage in the market.

Bianchi et al. (2014) conducted a study involving 733 Spanish companies to examine the influential factors of internal exploitation and external licensing. The researchers considered three key aspects: 1) manufacturing resources, encompassing production facilities, technical expertise, equipment, as well as internal and external technology utilization (Tripsas, 1997), 2) marketing resources including knowledge of customer preferences and needs, access to new distribution channels or sales networks that facilitate customer engagement (Song et al., 2005), and 3) relational resources that foster trust and reputation (Lichtenthaler & Ernst, 2007) by establishing both formal and informal connections with external entities such as customers,

suppliers, competitors, and universities (Dunning, 2003). This analysis shed light on the multifaceted dynamics within firms regarding resource utilization for growth strategies. The study's results reveal two distinct paths of exploitation in utilizing available resources: an internal path, where the performance of NPD is explained by utilizing internal resources, and an external path, where the effective utilization of marketing and relational resources explains the performance. Specifically, the performance of NPD is closely linked to the allocation and utilization of internal resources within an organization. On the other hand, when it comes to licensing performance, the study indicates that it is primarily associated with utilizing marketing and relational resources. These resources play a critical role in reducing uncertainty between partners and significantly increasing the chances of successful licensing activities (Bianchi et al., 2014).

1.3.2. External exploitation modes

External exploitation can be considered as the maximum use of a patent portfolio (Ayerbe & Mitkova, 2006, p. 8). Lichtenthaler define as “*external knowledge exploitation describes the commercialisation of disembodied knowledge, e.g. licensing out*” (Lichtenthaler & Ernst, 2006, p. 373). The patent application strategies are closely related to the patent exploitation strategies (Ayerbe & Mitkova, 2006, p. 8). The exploitation of the patents aim to extract the maximum profit. It can be done in different forms and for various reasons (Grzegorzczuk & Głowiński, 2019). We’ve tried to cite those strategies in the below section.

Selling, licensing or cross-licensing a patent

We use the external exploitation term to define the value extraction of the patent outside of the firm boundaries. In the external exploitation methods, the company will abandon, partly or wholly, the given rights (in that case, the so-called “*monopoly rights*” of the patent) either by licensing for a limited time or by selling the patents. (Ayerbe & Mitkova, 2006; Jeong et al., 2013, p. 254). This choice can be made under the conditions where a company cannot take advantage of the patent by itself, such as if the company doesn’t have enough resources to transform a patent into a tradable good or facilities to use it (Ayerbe & Mitkova, 2006) , or it can be related only to its business model which means that the licensing or patent selling is embedded to their company strategy for revenue generation or other reasons (Vanhaverbeke et al., 2008, p. 253).

Specifically, selling or licensing patents is the pecuniary outbound Open Innovation practice (Marcolin et al., 2017). Where selling patents is a way of waiver of rights of a patent, licensing provides the right to exploit and commercialize the patent. In return, the patent owner will receive licensing revenues during the licensing agreement contract. Hence, it is a temporary authorization that gives the right to use the patent under the control of an agreement (Ayerbe & Mitkova, 2006; Jeong et al., 2013). As a narrow definition, licensing is “*the transfer of patented information and know-how, including specifications, written documents, computer programs, and so forth, as well as information needed to sell a product or service, concerning a physical territory*” or shortly “*a tool for proactive market penetration*” (Kotabe 1996 in Johnson & Mottner, 2000). Accordingly, licensing is also defined as technology transfer when it is also the technology is transferred (Johnson & Mottner, 2000)

Licensing agreements define and limit the use of patent rights under some critical points, such as the use of territory (geographical limits), exclusivity (how many other companies can license the same patent), and the deadline of the contract (Mitkova & Ayerbe, 2004).

One of the important uses of licenses to create collaborations between companies is cross-licensing agreements. Another form of cross-licensing out of a very organised system is called *patent pool*. The patent pool system is attractive when companies have

attractive patent portfolios to offer (Ernst et al., 2016). Companies can have access by licensing their patents to each other. This kind of relationship may be the first step of a collaboration of companies in the long run, which will transform into a collaboration like joint R&D activities or joint patents (Mitkova & Ayerbe, 2004). Despite competing patents, the companies may continue their production activity. Also, reciprocal relations can give the possibility to a collaboration and also open the path to use the partner’s experience. Chaouat (1999) name this collaboration as “patent peace” (Ayerbe & Mitkova, 2006).

Joint-venture, M&A , and long-term alliances or R&D contracts

The joint venture is one of the external exploitation modes of patents. This kind of venture allows the use of patents independently according to joint-venture agreements (Hagedoorn & Sadowski, 1999; Mitkova & Ayerbe, 2004). Long-term alliances are categorized as joint development agreements, in which companies collaborate on innovative projects by pooling their resources (Hagedoorn & Sadowski, 1999). M&A, or mergers and acquisitions, involves the union of two companies to form a single entity. This can occur for economic purposes or through acquiring one company by another, resulting in the buyer company gaining ownership over the acquired entity (Hagedoorn & Sadowski, 1999).

The licensing-out (and, in return, licensing-in of the counterpart of this interaction) is a way to create new collaboration possibilities for both sides of this exchange. In the same vein, the R&D contracts and long-term alliances are also used as external exploitation ways of the patents. Hagedoorn et al. (2015) put in evidence this choice and studied the relationship between contracts and IPR. More specifically, the authors studied the factors affecting this choice and the relationship.

Using a mixed methodology comprising interviews and survey studies, it has been revealed that firms engaging in Open Innovation place significant importance on the legal aspect of contracts and the practicality of monitoring. The research findings indicate that contracts are a crucial legal control mechanism, ensuring that all parties adhere to their obligations. Furthermore, these contracts also play a pivotal role in monitoring the collaboration progress, allowing for effective performance evaluation. The study highlights contracts' vital role in facilitating Open Innovation and emphasizes the need for well-structured and comprehensive agreements.

Furthermore, the outcomes of the survey indicate several significant findings. Firstly, it reveals that intellectual property rights (IPR) facilitate knowledge-sharing among firms. When IPR safeguards knowledge, there is an increased willingness to share technology, and IPR enables selective technology exchange with specific partners. Secondly, if companies demonstrate a high level of openness regarding technology transfer, they also exhibit a higher utilization of IPR. The formal approach of these companies leads to an increased use of contracts and IPR as they seek to maintain control over their collaborations. The results demonstrate a strong correlation between company activity in competitive product markets and increased adoption of IPR measures. Lastly, a robust relationship exists between company openness, research and development (R&D) capabilities, and the choice to utilize IPR extensively. Companies that

possess open intentions coupled with high R&D capabilities tend towards intensive usage of intellectual property rights (Hagedoorn & Zobel, 2015).

Conclusion of Chapter 1

The Open innovation literature has yet to focus on China's patenting strategies (offensive or defensive) and patent exploitation forms. Our study aims to fill this gap by analysing China's patent strategies and exploitation practices. Therefore, the intellectual property and the protection of intellectual property by patents have a crucial role in our study. We dedicated this. In this chapter, we discuss in evidence the significance of intellectual property rights (IPR) and the various approaches and motivations for utilizing different patenting strategies.

As a starting point, we defined intellectual property rights and different protection forms of intellectual property. More specifically, we focus on industrial creations and the formal protection of this latter, the patents. Because the patents gave the patent holder a monopolistic power over their invention, the possibility to access new markets by protecting a new market and limiting competitors' entry in the market, protection against copying, and setting a standard by the patent holder, besides those protections, patents allow holders to negotiate during cross-licensing agreements. The patents provide detailed information about the patent holders' innovation capacity. It naturally provides previous technological knowledge and improved technology through a detailed application process description. A patent also improves the image of a company by showing the technological level of the company to third parties. The managers also use the patent application capacity as an internal performance measuring tool. It creates a reward mechanism inside the company and is used as a motivation tool for the R&D workers. Besides all those advantages, it is used to use government incentives. Table 4 shows the lecture grille of the patent application motivations.

Besides patents, design patents and utility models are considered the formal protection forms of an industrial invention. While design patents focus on protecting the aesthetic aspects of a product, utility models provide limited protection for small changes that make existing products and are much more in demand because of their cost advantage and the ease of obtention compared to invention patents.

The informal protection tool, secrecy or trade secrets, is also an essential protection tool that companies use as a complementary protection to patents. The literature shows that it is generally used in discrete technology areas such as pharmaceuticals, where the ingredients of a product are easy to distinguish. Trade secrets are confidential information not disclosed to others, such as proprietary formulas, unique methods, and innovative devices.

Table 4 Lecture grille of patenting motivations

Patenting motivations		Author
Access in new markets		(Arora, 1997; W. M. Cohen et al., 2002)
Prevention of copying & block competition & standard setting		
	Protection & prevention of copying	(Blind et al., 2006; Holgersson & Granstrand, 2017)
	Standard setting in the market	(Blind et al., 2006; Holgersson & Granstrand, 2017)
Negotiation & strong portfolio & X licensing		(Blind et al., 2006; Holgersson & Granstrand, 2017)
Improve image		(James et al., 2013; Pénin & Neicu, 2018)
Measuring tool of internal performance	Reward mechanism	(Blind et al., 2006; Holgersson & Granstrand, 2017)
Attract financial investors	Use gov incentives	(Blind et al., 2006; Holgersson & Granstrand, 2017)
Source of tech information		(Ayerbe, 2016, p. 93; James et al., 2013, p. 1130; Pitkethly, 2001, p. 432)

Our study focuses on using patents in open innovation processes and strategies. Without a doubt, the patenting strategy is related to the patenting motivation. Once the patent application decision is made, the patenting motivations become important. Depending on the patenting motivation, the patenting strategy became clearer (Ayerbe & Mitkova, 2006; Somaya, 2012). We dedicated the last sub-chapter to the internal and external patent strategies. We focus on the importance and use of patents inside and outside the company by studying the literature on offensive and defensive patenting strategies. The offensive and defensive strategy relies on exploiting the patents (Table 5) for different reasons. The offensive patenting strategy can be adopted to gain additional revenue from the patents and other drivers. A company can use their patents for marketing purposes, increasing its reputation and extending its patent portfolio to use in R&D collaborations or cross-licensing agreements. The offensive strategy can give the possibility to widen their market.

Table 5 Patenting strategy motivations

Offensive
Creating financial revenue
Using for marketing, negotiation tool for R&D collaborations
Having access to new markets
Creating reputation as innovation company
Defensive
Keep the monopolistic power in the market
Protect against infringement & imitation
Create a barrier for new comers
Protect image of innovation company
Access to new markets

Source : (Ayerbe & Mitkova, 2008)

The defensive strategy allows companies to protect themselves from competition and imitation. Companies seek to maintain their monopolistic power and protect themselves against imitation and infringement risks in the market. A patent may provide a natural barrier to the newcomer in the market and reinforce the company's image. Finally, a patent can provide the benefit of accessing a new market for the holder by using cross-licensing agreements and having access to new technologies and markets (Ayerbe & Mitkova, 2008). We first studied the different forms of IP protection.

The patent strategies are closely related to patent exploitation; the exploitation can be done internally or externally. In the third sub-section of this chapter, we studied the patent exploitation ways of a patent. Whether a company wants to exploit their patents, internally or externally, this choice always depends on extracting maximum value from the patent (Mitkova, 2005). Internal exploitation refers to the internal use of a patent inside the company, either for a product or production process innovation or for stocking for further use. A company may decide to stock their patents for further use or signal to the competitors that the company has valuable technology in their portfolio (Torrise et al., 2016) and to be used during cross-licensing agreements as a bargaining chip (Shapiro, 2001). The commercial use of internal exploitation can be made for new product development (NPD). In that case, the company use the patents for a new product and commercialize in the market (Bianchi et al., 2014).

The external exploitation of patents can be done directly by selling, licensing, or cross-licensing a patent, alternatively, by exploiting to establish a joint venture, M&A, or a long-term alliance agreement with a company. The direct exploitation of the patents provides additional revenue directly. Selling a patent gives all the rights to the buyer company. In contrast, licensing provides the right to exploit and commercialize the patent and also provides licensing revenue to the patent owner company (Marcolin et al., 2017).

In this first chapter of our study, we saw the offensive and defensive patenting strategies related to the patenting motivations. We also saw the two types of patent exploitation strategies, internal and external. Our research focuses on patent exploitation strategies in open innovation processes. To this end, in the following parts of our research, we will review the existing literature on open innovation and the place of patents in open innovation processes. Nevertheless, as an intermediary part of our study, we must first recall how open innovation came about and the previous literature on innovation. What is open innovation, and what are the important concepts of open innovation, namely absorptive capacity and the business model?

Chapter 2 Open Innovation Processes

From the beginning of human history, the population's behaviour has had different phases of the development of humanity. The history that we know of starts with the apparition of the writing. Nevertheless, before that, human beings found fire around 125.000 years ago, the wheel was around 3.500 BC, which made it more accessible for transportation and the displacement of people from one point to another. The earliest writing of Sumerian scripts appeared around 3.400 BC near the Persian Gulf, and afterwards, the Egyptians invented their hieroglyph writing. Chinese invented the compass (300 BC), paper (100 BC), and gunpowder (9th century). The invention of the printing machine in 1439 by the German Gutenberg changed history. It started a new era of the spread of knowledge. It contributed to the Reformation Era of Europe (Ratner, 2016) and the first innovation attempt in Europe because of the start of the mass production of books. Nevertheless, the innovation we understand today resulted from the Second Industrial Revolution. Schwab (2017), in his book "La quatrième révolution industrielle", aims to attract readers' attention to the global and fast-moving technological revolution and explain the new era of technological change from different perspectives. The author ranges the industrial revolutions into 4 phases. The first industrial phase, dated around 100,000 years ago, was the learning of agriculture and the passage of human life from the hunter-gatherer to adopting a sedentary life through the development of agriculture. The agricultural revolution gathers both animal and human forces for production. Accordingly, the alimentary production population volume and demographical concentration increased. The cities appear.

Industrial revolutions appeared in the second half of the 18th century. 1760-1840 is the first industrial revolution we know of as industrial development, the invention of the steam engine. It follows the railroad creations. The second industrial revolution was around the end of the 19th and beginning of the 20th century, with the invention and the use of electricity and the production in line, which increased the mass production volume.

The third industrial revolution, dated in the 1960s, is generally called Internet Technologies. The development of semiconductors first generated it, then by the invention of mainframe computers. In the mid-1970s, personal computers appeared and were met with the World Wide Web in the 1990s. As the author emphasises, we are in the age of the fourth industrial revolution, which enables the use of the internet in mobile devices; the gadgets are always

smaller than the previous version, the era of Artificial Intelligence and machine learning. The author highlights that the winner of this revolution is the consumer. However, the beneficiaries are the companies with high intellectual capital, like innovators or investors, which push them to innovate and collaborate to increase their inventive capacity (Schwab, 2017). As of today, the importance of technology and the speed of technological innovation are increasing exponentially compared to yesterday, which brings us to a comprehension of the importance of innovation and the dynamics of innovation. The companies seek new products or simply ideas to stay in the market. Moreover, the market is now much more influenced by the technological improvements.

In the following parts, we will explain the difference between invention and innovation. Then, we will explain “innovation” and its different uses in the literature and the differences that authors attribute to this term. We will then study different innovation models, the Open Innovation model, and its components.

The first sub-chapter is dedicated to the innovation and innovation models where we intend to introduce open innovation (sub-chapter 2.1). The second part of this chapter is dedicated to open innovation modalities and the importance of business models in this process (sub-chapter 2.2).

2.1. Innovation and Innovation models

The etymology of the word innovation leads us to the Latin word "innovare" which means "to renew, to renovate" (Oxford Latin dictionary, 1982). Innovation is recognized as a significant driver of long-term growth and an essential element of industrialization (Romer, 1989). Since the introduction of innovation into economic theory by Schumpeter, the term has undergone numerous definitions and attributions up to the present day (Akrich et al., 1988; S. J. Kline & Rosenberg, 1986; Schmookler, 1966) which limit us to join a de facto definition of this term. Rogers & Everett define innovation as “*an idea, practice, or object perceived as new by an individual or other unit of adoption*” (Rogers & Everett, 1983). Damanpour brings a broader approach and defines it as “*a new product or service, a new production process technology, a new structure or administrative system, or a new plan or program about organizational members*” (Damanpour, 1991). In the Oslo Manual(OECD, 2019a), innovation is defined as follows “*An innovation is a new or improved product or process (or combination thereof) that differs significantly from the previous products or processes*”. Another distinction is made by

Edquist et al. (2001). The author distinguishes the product innovation as “(*product innovations are*) *new or better products being produced and sold; it is a question of what is produced*” (Edquist et al., 2001, p. 12) where Schumpeter refers to a “*good which is not familiar to customers*”(Schumpeter, 1911). Again, Edquist (2001) states that technological process innovation is “the new goods that are used in the production process.” The author distinguishes technological process innovation as investment or intermediary goods such as IT equipment or production machines (Edquist et al., 2001, p. 15). In other words, the question is “how to produce” (Bauer & Leker, 2013). Fu (2015) defines innovation as introducing or adopting new products, new production processes, new ways of organization and management, new marketing methods, and business models. Hence, an innovation chain includes both the creation and commercialization of knowledge (Fu, 2015, p. 5).

This plurality of its definition expands the horizon of innovation research and brings a richness of coverage in different sciences (Damanpour, 1991; Temri, 2000).

When we took back the definition of innovation, we saw three different states of novelty. Navarre et al. (2022) explain those states of novelty as discovery, invention, and innovation. According to the authors, the discovery is related to a chance or a coincidence, whereas the invention does not need to be related to a coincidence but a deliberate action. Companies invest in inventions by making investments in R&D activities, for example. However, innovation differs from discovery and invention by its creation and use in the industry. The invention responds to a need. It is “*a process which allows developing a new solution to respond to the need*” (p:19). Innovation is the process of developing a product to its commercialisation (Gardoni et al., 2022). To define innovation and theoretical approaches, we find it appropriate to mark the difference between innovation and invention.

Invention

According to (Fagerberg et al., 2006), p:3), invention is creating a new idea for a product or process. It introduces something new to the science or context where it is generated (Temri, 2000). It is seen as a technical process of creating what did not exist or conceiving a new idea (Le Duff et al., 1999) and shown as a concept (Badawy, 2011). The invention is “*a new means for achieving some functions not obvious beforehand to someone skilled in the prior art*”(S. J. Kline & Rosenberg, 1986). It is the “*process of bringing new technology into being*”, and

innovation is “*the process of bringing the invention to use*” (Schon 1967 in (Chakrabarti, 1973).

Innovation

Innovation is a socioeconomic process; it is the saleable form of the invention (Roy and Wield, 1985; (Corbel, 2009). An invention is a discovery, and innovation is the commercialization of an invention (OECD, 2019a). Invention and innovation are terms that position themselves around the concept of “novelty”, whose framework of innovation calls for the application and realization of novelty (Badawy, 2011; Le Duff et al., 1999; Temri, 2000), whereas novelty brings change.

Schumpeter explains this situation of change as follows: “Innovation (is) a process of “destructive creation” which is part of the “process of industrial change that continuously revolutionizes the economic structure from within, continuously destroying the old elements and continuously creating new ones” (Schumpeter, 1942: 83). He defines the origin of innovation as a sequential and linear process with the “technology push” or “science push” model (Schumpeter, 1935) (Delacour & Larte, 2014). According to him, innovation takes place in five different areas: 1) innovation of new products; 2) innovation of production methods; 3) new sources of production; 4) exploitation of new markets, and 5) new ways of business organization (Fagerberg 2003 p: 18; (Corbel, 2009) p: 17). Parallel to Schumpeter’s idea, The Manuel of Oslo define four types of innovation (OECD, 2019a) respectively, the product innovation, process innovation, commercialization and organization.

However, the literature contains different perspectives on innovation as a concept and gives some definitions of innovation in three different layers (Delacour & Larte, 2014; Gardoni et al., 2022): the purpose of innovation (product vs process), the complex degree of innovation (incremental vs radical), the architectural level of innovation (architectural vs modular).

Table 6 The level of analysis of innovation concept

Level of Analysis	Type	Characteristic
The subject of innovation	Product innovation	Introduction of a new product
	Process innovation	A change of a production, distribution etc. process
The complexity degree	Radical (Disruptive)	New to the market
	Incremental (Progressive)	Progressive change of an existing product
Architectural level	Architectural innovation	Modification of one or more modules of a product which change the relationship between modules
	Modular innovation	Modification of one module without creating a change in the system

Source: (Corbel, 2009; Gardoni et al., 2022)

The purpose or subject of innovation:

The purpose of the innovation may differ according to the subject concerned. According to Delacour et al. (2014), the purpose of innovation can be

- product innovation : the introduction of a new product in the market
- process innovation: the change of a production process, or distribution process of a product

Product innovation is related to the innovation of a new product which responds to a need of the market components (customer or suppliers) or a product which brings a cost reduction of a product (Gardoni et al., 2022). According to its nature, Krzeminska et al. (2016) identified product and process innovation as the nature of the innovation in their research on product process innovation complementarities (Krzeminska & Eckert, 2016). The authors remind us that product and process innovations differ in three characteristics: the target of innovation, the amount of knowledge involved, and their success measures (Utterback & Abernathy, 1975).

Armbruster et al. bring a different angle; they consider innovation as a complex phenomenon, and they distinguish four types of innovation: 1) technical product innovation, 2) non-technical product innovation, 3) technological process innovation, and 4) non-technical process innovation or other words, organizational innovations (Armbruster et al., 2008) which we can consider as a differentiation of the product and process innovation.

Product innovation is defined as “*a new technology or combination of technologies introduced commercially to meet a user or a market need,*” and it is mainly related to the use of the product over time, according to the product performance, the product variety, and standardization

cost (Utterback & Abernathy, 1975, p. 642). In other words, a company may introduce an innovative product or wait for the competitors' inventions in the market to observe the actual trend. Utterback et al. (1975) call it *performance-maximizing* and staying ready for any product change or variations in order to adapt itself to the market trend. This attitude, which the authors call *sales-maximizing*, or waiting till the end of the concerned product life cycle when the market adapts itself and the company will be able to find a way to produce a simple and cheaper version of the same product, which the authors call *cost-minimizing* (Utterback & Abernathy, 1975, pp. 642–644).

However, process innovation is highly related to product innovation, and it is generally difficult to separate them. Process innovation generates a higher quality product but at a lower cost than the existing product (Simsit et al., 2014). According to this definition, innovation is conceived as a process by which the firm increases its production by decreasing the cost of production. The lower cost notion is also mentioned by (S. J. Kline & Rosenberg, 1986) in the four characteristics of innovation: 1) the new process of production, 2) substitution of cheaper raw material (which reduces the production cost), 3) reorganization of production and internal functions, distribution for better support to a given product or lower cost, 4) improvement in instruments or methods of doing innovation. It is also used to define the process of technological change as the creation of a new saleable or commercial product (Roy and Wield, 1985 in (Xue, 1997)p:68), (Corbel, 2009). Innovation for commercial purposes has two legs: *market factors and scientific (technological) progress*. However, both components must be satisfied by innovation (S. J. Kline & Rosenberg, 1986).

Utterback et al. (1975) explain the difference between product and process innovation through a model and define *production* as a system of process equipment, workforce, etc., to produce a product or service. It has an evolutionary nature, which Utterback et al. (1975) describe in three different stages: *uncoordinated* because the product and process change rates are high, and the relationship between the process elements needs to be better defined. *The segmental* sum of the subprocesses of production may be partially automated and rely upon manual work, etc. Therefore, the production process will be considered as a segmented nature. *Systemic*, when the process becomes integrated and well-established, it is not easy to create a change without interrupting other components. In other words, in a highly integrated process, even a small change requires changes in other elements as well (Utterback & Abernathy, 1975, p. 641).

The complexity degree of innovation:

The approaches to the innovation concept differ according to its radicalness degree and the intensity of the innovation process (Ayerbe, 1994). The authors have gathered these approaches and tried to classify innovation typologies (Damanpour, 1991; Forest, 2014; Gopalakrishnan & Damanpour, 1997; Temri, 2000) according to their intensity and apport from the nature of newness. The complexity degree of innovation is directly related to the product's complexity. The innovation of a product may have different complexities in its production process, which gave us a new distinction criteria, namely:

- radical (disruptive or rupture) : totally new to the market
- incremental innovation : a progressive change of an existing product. We can also identify the innovation according to the intensity of its process inside the company: radical vs incremental innovation.

The radical innovation attributed to an innovation of a product or a process entirely new, such as the first apparition of printing machines (Hurmelinna-Laukkanen et al., 2008). In other words, radical innovation creates a new demand for an entirely new product that the customer does not know previously. Accordingly, this new demand creates new industries. Hurmelinna et al. (2008) remind us that radical innovation is called differently by different authors (or called) *discontinuous innovation* (Anderson & Tushman 1990), *architectural innovation* (Abernaty & Clark 1984) or *Disruptive technology* (Christensen 2000) (Hurmelinna-Laukkanen et al., 2008, p. 279).

Today, we can broaden the scope of radical innovation by incorporating Gardoni et al. (2022) definition. According to their research, radical innovation refers to the introduction of a new product by a company aimed at a specific market segment that offers significant practical benefits and is priced lower than its competitors, thereby creating a competitive advantage for the company (Gardoni et al., 2022).

According to Corbel's (2009) research, the distinction between incremental and radical innovation is based on the extent of change compared to the existing product. Incremental innovation involves improving an already existing product in the market with an established customer base. The company needs to enhance or adapt the product to meet the market's and customers' demands to maintain competitiveness. This means that the company may add new

features or modify existing ones to meet customer requirements (Corbel, 2009; Gardoni et al., 2022).

Incremental innovation is progressive and does not create a general change but results from a progressive change and the companies' willingness to change.

The architectural level of innovation

The architectural level of the product brought us a new differentiation of the innovation at the product level, namely

-Architectural innovation (modifying one or more modules of a product, which changes the bounds between different parts of a product and helps to create a new product)

-Modular innovation (modification of one module of a product or a system without creating a change in the whole system)

Respectively, architectural innovation, according to Abernathy & Clark, is the innovation that significantly affects technology and the market. For example, a technological product, a computer, is composed of different products in one product. This composition is called the architecture of the product. When an innovation affects the architecture, that means that the innovation changes a part of the related components or the whole product (Corbel, 2009; Gardoni et al., 2022).

On the other hand, a modular innovation consists of changing a single part of a construct without changing the whole architecture of the product. We can consider a change of a part of a copoint in a computer (a new head of hard disk which increases the speed of the processor without touching any other part of the product and does not necessarily provide a change in other parts interacting with this part of the product) (Corbel, 2009; Delacour & Larte, 2014; Gardoni et al., 2022; Henkel et al., 2013)

The need to understand the innovation process brought different approaches to the literature. This chapter will show and discuss innovation theory's different approaches and models. The table below (Table 7) gives a summary of the innovation models in the literature.

Table 7 Innovation models

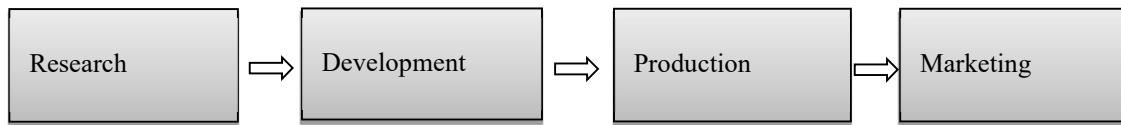
Model	Generation	Key specificities
Technology Push	First generation (1950-1960)	Linear model. R&D and science are important. The market receives the results of the R&D
Market Pull	Second generation (1960- 1970)	The market is the new sources of ideas, it is the driving force
Non-linear models Coupling & Chain linked	Third generation (1970-1980)	Interaction between R&D and Marketing, presence of feedback loops, cycling relationship
Interactive model Vortex model (<i>Tourbillonnaire</i>)	Fourth generation (1980- 1990)	The model of parallel lines, integration with the company, relationship with key suppliers and demanding customers, accentuation of links and alliances
Network model	Fifth generation (1990-2000)	Extensive, flexible and responsive system and network integration
Open Innovation	Sixth generation (2000- ...)	Open Innovation, the self-learning system

Source : Development of Innovation Models (Adapted from Hobday, 2005) Model (Simsit et al., 2014) p: 693, Koziol-Nadolna K, Świadek A, 2011, p: 169

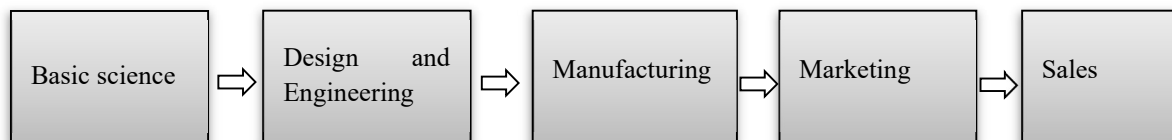
Consequently, innovation is considered not only the introduction, adoption, or creation of a product or a production process but also a new organizational or managerial approach and new marketing approaches and methods combined into new business models (Fu, 2015).

2.1.1. Linear models

The researchers try to understand the complex reality of the innovation process, which, by nature, is only sometimes evident. In that circumstance, modelling is a simplified representation of a complex reality, enabling the researchers to understand it (Forest, 2014). After the Second World War, in the 1950s, scientific improvements helped the market's recovery process. Industries such as the pharmaceuticals and semiconductor industries also recovered, respectively. The researchers considered the innovation process linear and hierarchical in the 1950s. The model is called linear because it comprises a succession of stages. Moreover, it is called hierarchical because it is assumed that the outputs of the stages compose the inputs of the other stages. One must wait for the end of one stage to start the other one (Forest, 2014); in other words, the sequences are perfectly predictable.

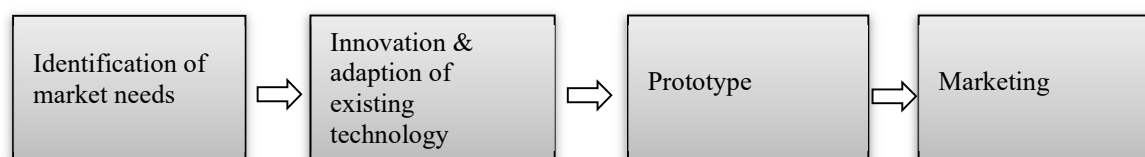
Figure 2 The conventional linear model (S. J. Kline & Rosenberg, 1986)

The linear model has also been described as a one-way street with research, development, production, and marketing steps (Kline and Rosenberg 1986). Nevertheless, the positive relationship between the R&D input and the new product output is viewed as if the input of R&D increases, the output of new products will be increased. In other words, when “science push,” innovation appears. (Rothwell 1994).

Figure 3 Science push model (Rothwell, 1994)

In the coming 1960s, companies which previously used R&D to increase their product range and capacity started to search the ways to increase their market share. The client became the preoccupation of the companies (Rothwell 1994).

Schmookler (1966) brought a new perspective to this new situation and identified four steps of innovation: (1) Identification of market needs; (2) Innovation and adaptation of existing technology; (3) Prototype; and (4) Marketing. This new linear model is called the “market-pull” model (Schmookler 1966).

Figure 4 Market pull model (Rothwell, 1994)

The main bemoal of the linear models, according to Kline and Rosenberg, was the lack of feedback process (Forest, 2014; S. J. Kline & Rosenberg, 1986). Accordingly, they have created a new model, which also opens the way for the creation of non-linear models.

The second was the perfect control on the “technical evolution,” whereas the previous research has proven the non-existence of a causal relationship between the number of researchers or the

R&D investment rate and the innovation output rate (Forest 2014). A firm's R&D expenditure is considered an important sign of internal innovation activities (Laursen and Salter 2004)

The third critique was the illustration as a black box of every step of the linear models, "*a system containing unknown components and processes*" (Kline and Rosenberg 1986). In other words, every sequence of the model is considered a black box where it happens an unknown process, and the result leads to the next step of the innovation process. Yet the economists devoted little attention to what happens inside the box and neglected the complex process by which certain inputs are transformed into certain outputs (Kline and Rosenberg 1986).

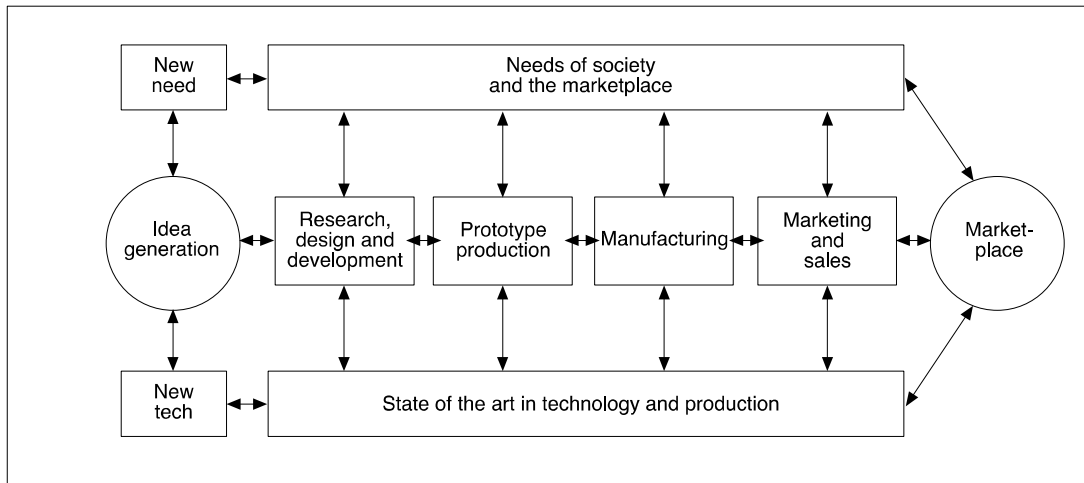
2.1.2. Non-linear models

The apparition of non-linear models is not related to the lack of feedback in the innovation process, as Kline and Rosenberg argued, but also a natural need of economic conditions. Rothwell emphasized that in the early to late 1970s, the oil crisis (the 1973 Yom-Kippur war and the 1979 revolution in Iran) resulted in a high inflation rate. Accordingly, market demand declined and went below the supply. During this period of time, studies on the innovation process were published (Cooper, 1980; Hayvaert, 1973; Langrish et al., 1972; Myers and Marquis, 1969; Rothwell et al., 1974; Rothwell, 1976; Rubenstein et al., 1976; Schock, 1974; Szakasits, 1974; Utterback, 1975 in (Rothwell 1994)). The results of these studies generally showed the insufficiency of the science-push and the market-pull models alone (Mowery and Rosenberg 1979). The interaction between the market demand and the technological (and the production) capabilities is illustrated in the "coupling model."

Coupling Model

Coupling is also considered a third-generation "interactive" model of innovation, putting together the needs of society and the marketplace, in other words, client needs, with the present technology and production capabilities. The model combines both "science-push" and "demand-pull" elements. Therefore, the relationship between different stages is not particularly continuous, and essentially, a sequential process appears but with the feedback circles.

Figure 5 Coupling model of Mowery & Rosenberg (1978)

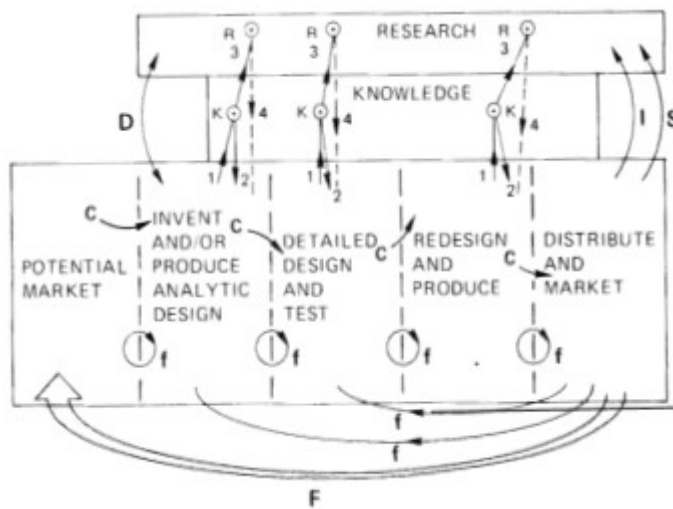


Source: Coupling model of Mowery & Rosenberg (1978) in (Rothwell, 1994)

1. Chain linked model

In this model, Kline & Rosenberg linked science to the development process, which they are separating science into two parts: science that we hear as the “pure science” and the “research.” Design is more important than research as the first step of innovation. They’ve created a new model composed of five paths, as seen below.

Figure 6 Chain linked model(S. J. Kline & Rosenberg, 1986)



In this model, C presents the central chain of innovation, “f” presents the feedback loops in the innovation process, and “F” presents the feedback particularly important.

K-R (knowledge and research) links through knowledge to research and return paths

D is the direct link between problems

I support of scientific research with instruments, machines, tools, etc

S is the support of research in sciences underlying product area to gain information directly and by monitoring outside the work.

1- Central chain of innovation(C): The central path which initially has to exist in a potential market begins with a design or a concept. The path continues through development, the third step of the chain. In this step, the last changes or the final design appears. Then it continues through the steps of production and marketing.

2- Feedback links (f and F): We distinguish two kinds of feedback lines in this model: The first one is the fastest one, the link between every step of the central chain of innovation (f links).

- It can occur between every single step of the central chain of innovation. It is fast and immediate

- Or, it can occur between different steps of the central chain of innovation without preceding immediately.

The second one is the F lines which link the perceived market needs and users' feedback for improvement.

- This can react to the process overall.

- It can be considered as a part of “the cooperation between the product specification, development, production processes, marketing, and service components of a product line”(Kline and Rosenberg 1986)

3- The links between scientific research and the central chain of innovation (K and R): The link between research and innovation is made by the biases of the knowledge. To understand this link, Kline and Rosenberg argued that the market need can only be filled if the technical problems are solved. However, the market pull or the science push models doesn't respond properly to these problems, and innovation is possible if there is a “knowledge accumulation”.

- The central innovation chain's first call is the present accumulated knowledge (K).

- When the knowledge is not responding properly to the needs of the central chain of innovation, the second call will be the scientific research (R)

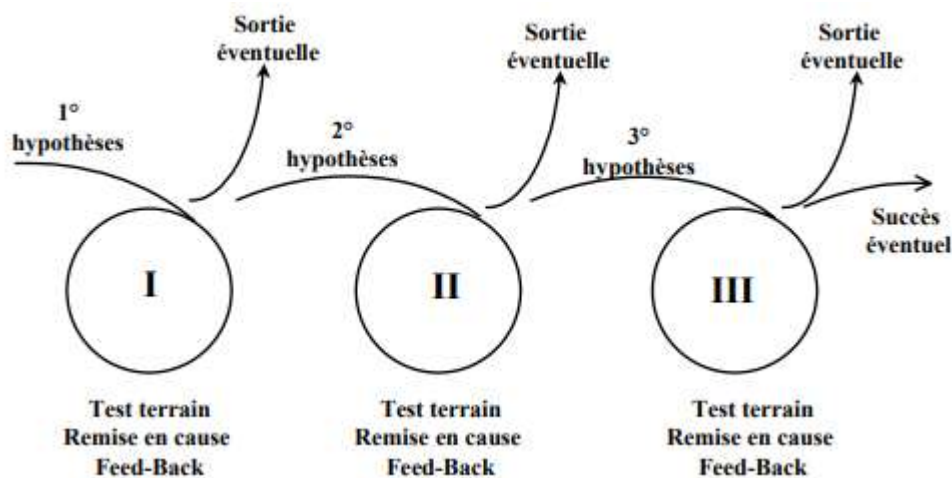
4- Direct links between the invention and scientific research (D): The authors also emphasize a direct link between the invention and the scientific research which also

gives the reason for the name “chain-linked model”. It is also the relationship in the radical innovation cases which creates a new industry, such as lasers or semiconductors. The links between scientific research and the products of innovation (I and S): The last path of the model is the reactions between the product of innovation and science. The product of innovation may be the first scientific research step of another product of innovation, namely, “without a microscope, Pasteur wouldn’t have his work, and without Pasteur’s works, there wouldn’t be the modern medicine”(Ayerbe, 1994; Forest, 2014; S. J. Kline & Rosenberg, 1986).

2. Vortex model (Tourbillonnaire)

It is with the innovation sociologies Akrich, Callon et Latour (1988) that the vortex model has been introduced in the literature (Akrich, Callon, and Latour 1988). The model shows the movements, like the effect of experiments and the confrontation between actors, as erratic movements, which leads the initial project to a successive innovation. The model took advantage of attention on the actors of innovation but not on the end product. They call the actors a technical-economic network (*réseau technique-économique*) (Callon 1994), which are some heterogeneous actors like laboratories, technical research centres, as well as the users. The interaction between those actors influences the appropriation process. The vortex model defenders think that the success of an innovation is highly dependent on the contribution of all the actors which has a role in this innovation process. Akrich (1988) define this collaboration as a collective process which allows the adoption of innovation.

Figure 7 Vortex model (Akrich, Callon, Latour (1988))

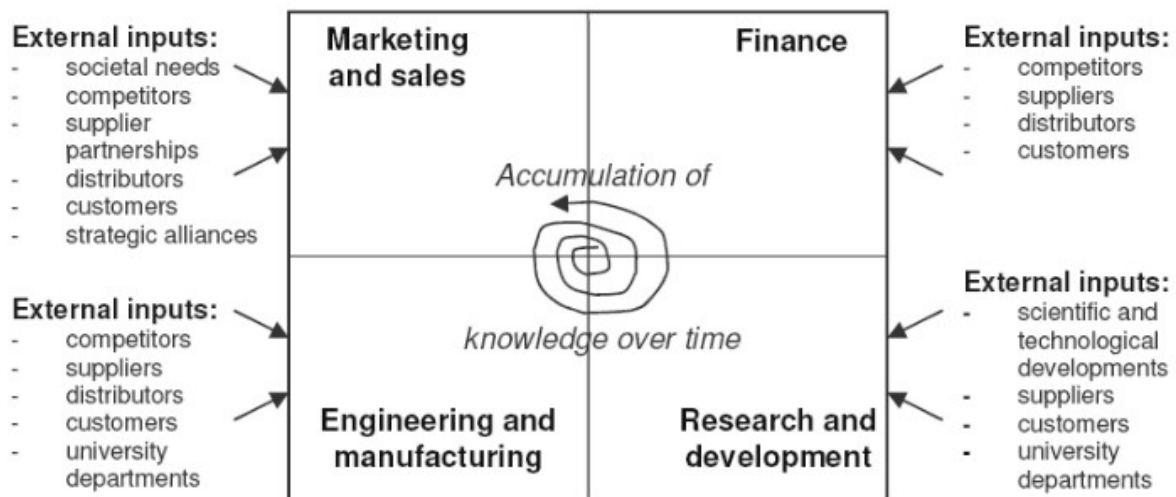


Source: (Millier, 2005)

3. Networking model

According to Rothwell, in the late 1990s, the fifth generation of the model of innovation emerged, namely, the networking model. It is described as a distributed networking process such as partnerships, corporate alliance joint ventures, or government funding. Not only have companies started to collaborate with each other and with the government, but also the collaboration possibilities with suppliers, consumers, and competitors (Simsit, Vayvay, and Öztürk 2014). Even though the name of this model sounds like an opening step for companies while networking, the companies and the innovation process remain closed. In other words, the companies generate develop and commercialize their own ideas (Chesbrough 2003c; Simsit, Vayvay, and Öztürk 2014), and it is not for sharing.

Figure 8 Networking model



Source: (du Preez & Louw, 2008)

4. Open Innovation model

As the sixth generation of innovation models, Open Innovation was introduced in the literature by Chesbrough in his book *Open Innovation: The New Imperative for Creating and Profiting from Technology* (2003). By the innovation model generation flow, by the end of the '90s, when previously networking model had previously emerged in the literature and the practitioners' world, the rate of collaboration and interaction between companies started to rise.

Chesbrough explains Open Innovation as follows: the knowledge of Innovation is widely spread in the economy. In other words, the smartest people are working for someone else, as quoted by Hayek (1945). Relying on this, the companies can use external ideas and

Table 8 Definitions of Open Innovation

Author	Definition
(Chesbrough, 2003)	Purposive inflows and outflows of knowledge
(Chesbrough and Bogers 2014)	Open Innovation is the combination of internal and external ideas into platforms, architectures, and systems and also uses business models which defines the requirements of these architectures or systems
(Chesbrough, 2003a, 2006b; Gassmann and Enkel, 2004; Dahlander and Gann, 2010; West and Bogers, 2014)	Open Innovation as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model.
(Chesbrough et al., 2006 Chesbrough, H.W., Crowther, A.K., 2006.)	The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively
(Lichtenthaler, 2011)	Open Innovation is defined as systematically performing knowledge exploration, retention, and exploitation inside and outside an organization's boundaries throughout the innovation process.
(Gianiodis et al., 2010)	Business model that is designed to purposefully allow and facilitate knowledge and technology transfers across organizational boundaries.
(Chesbrough et al., 2006)	Open Innovation is defined as systematically performing Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.
(Gassmann and Enkel, 2004)	Open Innovation means that the company needs to open up its solid boundaries to let valuable knowledge flow in from the outside in order to create opportunities for cooperative innovation processes with partners, customers and/or suppliers. It also includes the exploitation of ideas and IP in order to bring them to market faster than competitors can.
(Lichtenthaler, 2008)	An open-innovation approach refers to systematically relying on a firm's dynamic capabilities of internally and externally carrying out the major technology management tasks, i.e. technology acquisition and technology exploitation, along the innovation process.
(Dittrich and Duysters, 2007)	The system is referred to as open because the boundaries of the product development funnel are permeable. Some ideas from innovation projects are initiated by other parties before entering the internal funnel; other projects leave the funnel and are further developed by other parties.
(Perkmann and Walsh, 2007)	This means that innovation can be regarded as resulting from distributed inter-organizational networks, rather than from single firms.
(West et al., 2006)	We define Open Innovation as systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels.
(Terwiesch and Xu, 2008)	There exist a rapidly growing number of innovation processes that rely on the outside world to create opportunities and then select the best from among these alternatives for further development. This approach is often referred to as Open Innovation.

Source: (Gianiodis et al., 2010) extended by author

technologies in their own business and let go the unused internal ideas and technologies for others to use in their business area (Chesbrough and Bogers 2014). Somehow, the Open Innovation model put into question the closed innovation model, which is explained as “doing all inside the company.” However, Chesbrough names as “erosion factors” of the closed innovation model such as the mobility of workers in the business, universities' increased research capabilities for cooperation, the easy access of start-up firms to venture capital, and the rise of internet usage (and the social media) (Chesbrough 2003c; Chesbrough and Bogers 2014).

In this context, Chesbrough defines *Open Innovation* as “purposive inflows and outflows of knowledge”. Purposive inflows and outflows define the “purposive management” of spillovers; in other words, the exploitation of unused internal R&D research. Companies can create and develop processes to explore and transfer external knowledge or to exploit and create channels to move out the unutilized internal knowledge.

Figure 9 The Open Innovation model

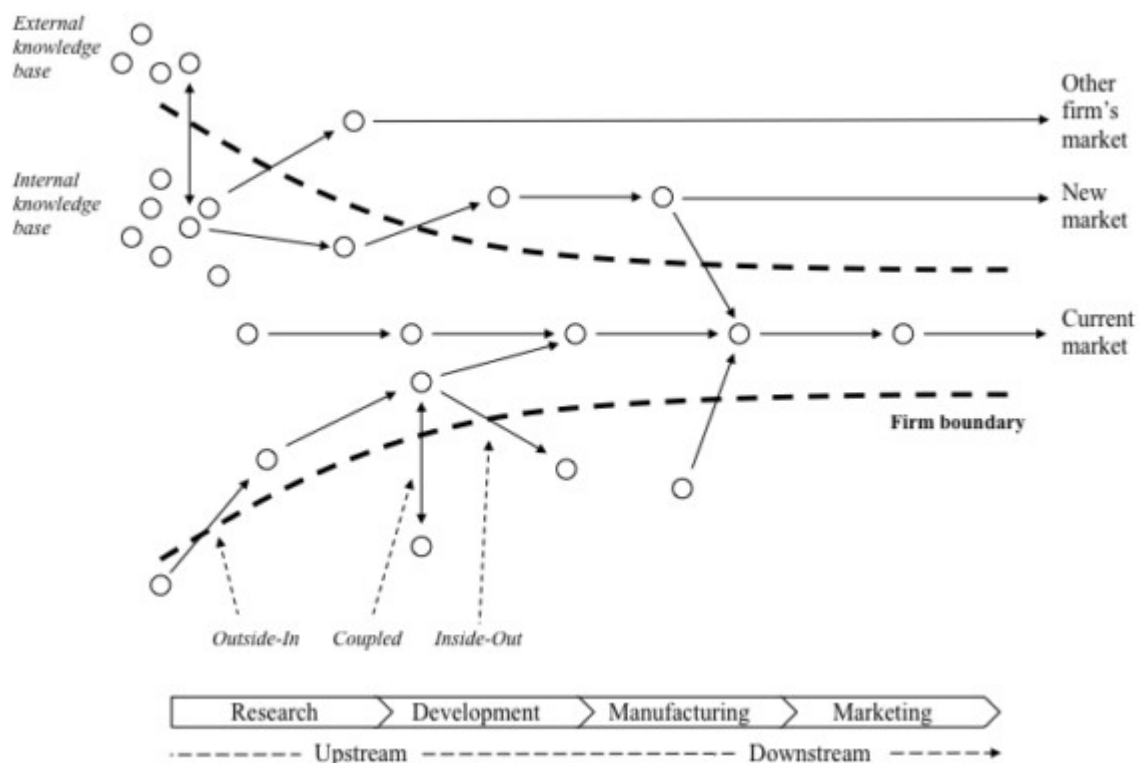


Figure 6: Open Innovation model (Chesbrough et al., 2014)

This exchange of knowledge can further be manageable in the Open Innovation model (Chesbrough and Bogers 2014). The exchange of knowledge, aligned with the business model of the company, can be realized in 3 ways (Chesbrough 2003c; Gassmann and Enkel 2004);

- Knowledge inflows (Outside-in & Inbound): Profiting from external knowledge using internal know-how
- Knowledge outflows (Inside-out & Outbound): Profiting from internal knowledge through external commercialization
- Knowledge inflows and outflows working together (Coupling): Realizing the two-exploitation process together

The researchers studied the details of the factors affecting the Open Innovation process within a company. How does a company decide to practice Open Innovation? What are the reasons or motivations of a company to open its internal R&D to other companies, or how can it accept the use of external knowledge in its innovation process? Those questions open different areas and industries to researchers, for seeking some responses and doing so, to enhance the understanding of the Open Innovation process. In the following section, we looked for the answers to those questions stated in the literature.

2.2. Open Innovation

While introduced by Chesbrough in 2003, the Open Innovation model opened a fruitful area, which increased the quantity of research in the literature. After his seminal book *Open Innovation: The New Imperative for Creating and Profiting From Technology* (Chesbrough 2003c), the number of several special issues in academic journals has risen (Lichtenthaler 2011; Stanko, Fisher, and Bogers 2017).

However, it also attracts some critics, emphasizing that companies have already used Open Innovation practices for a long time (Trott and Hartmann 2009). For the idea of the commercialization of internal ideas outside the company or inversely using external ideas to improve the internal process by the influence of absorptive capacity (Cohen and Levinthal 1990) and considering knowledge as a complementary asset (Teece 1986), the network model of Innovation (Rothwell 1994) or even networking and using customer ideas for internal innovation (von Hippel 1986).

Open innovation encompasses various pre-existing innovation and management concepts, consolidating them under one umbrella term. However, before Chesbrough's influential book,

people had yet to dare to formulate these advancements within the innovation literature. Contrary to the critique by Trott and Hartmann (2009), who dismiss Open Innovation as a rehashed concept, we view it as a new paradigm in management studies that draws upon established technology transfer concepts (Trott & Hartmann, 2009). In this regard, we acknowledge the significance of concepts such as absorptive capacity, networking, and user contribution as they pave the way towards Open Innovation. Therefore, we aim to refresh our readers' memory on these essential concepts.

2.2.1. Open Innovation Concepts

One may ask about the existing concepts subject to the Open Innovation Model. We should state: 1) Knowledge inflows and outflows, 2) Firm boundaries permeability, 3) Adoption practices of the firm, and 4) Factors of successful OI adoption (Gianiodis, Ellis, and Secchi 2010). In the same vein, Penin (2013) proposes an equation of causes to explain Open Innovation. The author emphasises the increased codified knowledge, which enables standardisation in the concerned industries. This codification and standardisation make its diffusion and transfer, collaboration, and exchanges between companies easier. It reduces costs and creates a labour division in the innovation process. Secondly, it changes the financing of R&D by creating start-ups, spin-offs, or venture capital firms, reducing one's financial burden. The labour division in the innovation process allows those new firms to specialise in some technologies and become the innovation providers of manufacturing firms. The last component of this equation is the reinforcement of IP rights. It promotes those start-ups and spin-off companies to continue to innovate and share their intellectual property through licensing agreements or patent sharing (Pénin et al. 2013, p. 19).

Codification (standardisation) of knowledge + External sources reducing finance of innovation + IPR reinforcement = Rise of Open Innovation

Once more, according to Huizing's research, the concept of Open Innovation encompasses various opportunities for collaboration, thereby expanding a company's innovation process. These opportunities can be classified into three main categories: inbound, outbound, and coupled (Dahlander and Gann 2010; Gassmann and Enkel 2004; Huizingh 2011). However, this model's most significant and beneficial aspect lies in its ability to facilitate and somewhat standardize technology transfer. In our study, we will specifically concentrate on this particular concept.

Technology transfer is transferring technical knowledge or know-how from one organization to another through various mechanisms. In his study, Amaldi (1999) highlighted three key mechanisms for technology transfer:

- Transfer through procurement, which involves collaboration with research and development institutes
- Joint development projects
- Transfer through patents represents a direct and codified approach to technology transfer.

These mechanisms facilitate knowledge exchange and promote innovation across different organizations. Through collaboration and utilizing these mechanisms, organizations can effectively transfer technical knowledge and enhance their capabilities in a rapidly evolving technological landscape. Technology transfer is essential for fostering progress and ensuring technological advancements benefit a wider audience. (Amaldi, 1999; Scarrà & Piccaluga, 2022; Sonmezturk Bolatan et al., 2022). In the realm of technology transfer, embracing the concept of open innovation proves to be an invaluable asset. Using open innovation tools facilitates the smooth transfer of technology and presents an effective solution to navigate the challenges posed by budget reductions in this domain (Scarrà & Piccaluga, 2022). However, it is important to note that reaping the benefits of open innovation requires a certain level of openness within the company. This entails cultivating a corporate culture that values collaboration, information sharing, and cooperation with external stakeholders. By fostering an environment of openness, companies can create the conditions for effectively utilizing open innovation tools and strategies. Open innovation catalyzes technology transfer within companies, helping them navigate budget constraints and tap into a broader pool of knowledge. Nevertheless, companies must recognize the significance of cultivating a culture of openness to embrace the opportunities presented by the open innovation paradigm fully. By doing so, organizations can position themselves at the forefront of innovation, driving growth and success in an increasingly competitive landscape.

As a concept, open innovation has garnered significant attention in academic circles. The level of openness, a crucial aspect of this concept, has been extensively discussed and examined from various perspectives. In the existing literature, researchers have taken different approaches to determine the level of openness. Some studies have focused on organizational forms of acquisitions, the number and intensity of partners, collaborations with universities,

other companies, or competitors, and the formation of collaboration agreements (Carmona-Lavado et al. 2021; Lazzarotti and Manzini 2009). Additionally, researchers have explored the extent of R&D exploration (Cassiman and Valentini 2016; Michelino et al. 2015; Popa, Soto-Acosta, and Martinez-Conesa 2017) and exploitation (Cassiman and Valentini 2016; Masucci, Brusoni, and Cennamo 2020) as important indicators of openness. These academic studies contribute to our understanding of open innovation and its implications for organizations by delving into these various dimensions of openness. (Cammarano, Michelino, et al. 2017; Carmona-Lavado et al. 2021).

Open innovation is a complex process that involves various factors, and one of the key components is the company's complementary assets. According to extensive research, these assets play a crucial role in facilitating open innovation adoption. Intangible assets, in particular, have been identified by several authors as generating a significant impact on the open innovation literature. Grimaldi et al. (2017) conducted a study and found that organizational characteristics such as absorptive and desorptive capacity (Cohen and Levinthal 1990; Zobel 2017), human resources, and intangible assets all have an influential role in the open innovation process. These findings highlight the importance of considering tangible and intangible assets in the context of open innovation. In our research, we are particularly interested in technology transfer technology within the open innovation framework. We aim to better understand how technology transfer can contribute to open innovation practices by focusing on this specific area. This research will contribute to the existing academic discourse on open innovation and provide valuable insights for organizations seeking to enhance their innovation capabilities.

For a successful technology transfer, countries (in a macro level analysis) usually learn at an early stage that the importation of foreign technologies requires some level of technological skills, not only to modify and adapt the foreign technology to local needs but also to provide basic knowledge to be able to make an intelligent choice between the available external technologies. From an academic perspective, it becomes imperative to understand the intricate dynamics of technology transfer, as it involves exchanging knowledge, skills, and resources between different entities. This process requires a deep understanding of the technological aspects and a comprehensive analysis of the local needs and the available external technologies. Hence, countries must invest in developing the necessary technological skills in order to ensure a successful technology transfer. By doing so, they can effectively modify and adapt foreign

technologies to suit their specific requirements while making informed decisions regarding the selection of the most suitable external technologies (Rosenberg, 1983).

Lichtenthaler (2011) defines *absorptive capacity* as the ability to explore and assimilate external knowledge within an organization (Lichtenthaler, 2011, p. 1319). In their seminal research, Cohen and Levinthal (1990) provided insights into why companies continue to invest in internal research and development (R&D) even when external ideas are available. They argued that investing in R&D helps enhance the organization's ability to learn and effectively utilize external knowledge, referred to as "absorptive capacity" (W. Cohen & Levinthal, 1990). Building on this concept, Zahra and George (2002) conducted a comprehensive literature review and referred to absorptive capacity as ACAP (absorptive capacity abbreviation). They proposed a four-step model, including *acquisition*, *assimilation*, *transformation*, and *exploitation*, to understand this process better (Zahra & George, 2002). Absorptive capacity is essential for effectively extracting external knowledge (Zahra & George, 2002).

Similarly, Rosenberg highlights the significance of companies investing in internal research and development to enhance their ability to leverage external knowledge (Rosenberg, 1990). Recent studies have demonstrated that absorptive capacity plays a crucial role in facilitating inbound technology transfer, and there is a positive correlation between a company's absorptive capacity level and its technology transfer practices (Danquah et al., 2018). Absorptive capacity plays a crucial role in learning and educational advancement. Essentially, companies that possess a strong absorptive capacity will actively seek and incorporate external knowledge into their operations (Lichtenthaler & Ernst, 2006, p. 376)

Returning to the definition of Zahra et al. (2002), Zobel (2017) explains the components of absorptive capacity: *acquisition*, *assimilation*, *transformation*, and *exploitation*. These components are crucial to an organization's ability to utilize external knowledge effectively. *Acquisition* refers to the capability of finding, identifying, and acquiring external knowledge, while *assimilation* involves the analyzing, interpreting, and understanding of such knowledge. *Transformation*, conversely, pertains to the process of combining the newly acquired knowledge with the existing knowledge within the organization. Lastly, *exploitation* represents the organizational capability to analyze, refine, extend, and leverage the acquired knowledge. By breaking down absorptive capacity into these distinct components, Zobel (2017) provides a comprehensive framework for understanding how organizations can enhance their capacity to absorb and utilize external knowledge (Zobel,

2017). In addition to absorptive capacity, Zobel's definition introduces the concept of "desorptive capacity," which refers to an organization's ability to unlearn outdated knowledge. The author defines absorptive capacity by breaking it down into its key components. The author identifies three main concepts – *recognition*, *assimilation*, and *exploitation* – as the fundamental elements of absorptive capacity. *Recognizing* the importance of both absorptive and desorptive capacities highlights the dynamic nature of knowledge management within organizations. It emphasizes the need for organizations to acquire and *assimilate* new knowledge and continuously update their knowledge base by letting go of outdated or irrelevant information. By considering both absorptive and desorptive capacities, organizations can remain adaptable and responsive in an ever-evolving business landscape.

An appropriate example of these steps is the Japanese textile industry in the early 1900s. The Japanese companies, known for their absorptive capacity, embarked on a strategic initiative to search for and invest in old, second-hand textile machines from Lancashire in England. These machines were then meticulously installed and upgraded by leveraging local knowledge and expertise, ultimately enhancing their performance and enabling them to work longer hours. This remarkable assimilation capacity allowed the Japanese textile industry to thrive and grow exponentially. Over time, as the Japanese companies built their textile machines, they leveraged their desorptive capacity to innovate and improve upon the original designs. This involved substituting wooden parts with iron wherever possible on the machines, thus further enhancing their efficiency and durability. This example showcases the Japanese textile industry's remarkable absorptive and desorptive capacities, which played a crucial role in their journey towards becoming a global leader in the textile industry (Rosenberg, 1983).

In the realm of knowledge utilization in technology transfer, absorptive capacity refers to the capability of an entity to seek, obtain, and apply external knowledge. On the other hand, desorptive capacity is the term used to describe the process of releasing or removing absorbed knowledge, representing the opposite of absorption (Zytner, 1992) (Lichtenthaler & Lichtenthaler, 2009). The concept discussed here is a company's ability to effectively utilize external knowledge to enhance its knowledge exploration efforts. This capability allows the company to identify and exploit external knowledge exploitation opportunities, such as licensing or collaboration. However, the imperfect nature of the knowledge market poses challenges for companies in finding suitable buyers for their knowledge (Fosfuri, 2006). Organizations must possess familiarity or prior understanding to effectively manage this to

recognize potential collaborative partners (van Doren et al., 2021). This concept can be divided into two components: *Exploratory desorptive capacity* and *Exploitive desorptive capacity*. The authors examine the concept of desorptive capacity, as defined by Lichtenthaler et al. (2010), highlighting that it is more than just a simple process of exploiting external knowledge to find buyers for technology. Instead, it involves identifying opportunities for exploitation, exploring and exploiting them, and ultimately transferring the technology. (Lichtenthaler & Lichtenthaler, 2010). In other words, *explorative desorptive capacity* involves seeking and finding appropriate technology opportunities, understanding the technological needs of external parties, and presenting the technology to third parties. *Exploitive desorptive capacity* focuses on capitalizing on these opportunities, deepening the understanding of potential collaboration partners by interacting with customers, and extracting the right value from the technology. It also involves organizing and coordinating the knowledge transfer process. (van Doren et al., 2021, p. 3).

With a necessary absorptive and desorptive capacity, companies can solicit Open Innovation by different processes. In the next paragraph, we aim to show the different modes of Open Innovation. In the field of Open Innovation, companies have recognized the importance of both absorptive and desorptive capacities. These capacities enable organizations to effectively acquire external knowledge and technologies and effectively disseminate and integrate their own internal knowledge and technologies with external partners. By harnessing absorptive and desorptive capacities, companies can engage in various modes of Open Innovation, such as technology licensing, strategic alliances, joint ventures, and collaborative research and development efforts. These modes allow companies to tap into the expertise and resources of external entities, fostering innovation and enhancing competitiveness in today's dynamic business landscape. Hence, companies must develop and nurture both absorptive and desorptive capacities, as they serve as the foundation for successful Open Innovation initiatives.

2.2.2. Business Model

In many research on innovation and technological progress, technology transfer constitutes a vital part, even if it is not emphasized but accepted as a sine qua non-factor of technological progress. The technology transfer is not a new concept. One can say that the traders of Silk Rode have made the transfer of gunpowder, or one can say that it has been transferred during the wars. In every case, once the technology is transferred, it is either used in a similar way or

progressively changes its initial usage and becomes a part of a new invention. This macro-level view can be reflected in micro level, to a firm level analysis.

From that point, the technology transfer represents an important part of the Open Innovation model. By definition, the opening-up process is to start using external knowledge and ideas to improve technologies in their own business and let go of the unused internal ideas and technologies for others to use in their business area (Chesbrough & Bogers, 2014), which implies and put in the core of the model the technology transfer.

Besides the deep body of knowledge of the company, the Open Innovation adoption depends also some internal and external factors. We would like to remind those adoption factors which can affect the Open Innovation adoption decision of the company.

Based on the research in this area, the business model concept increased the attention of managers and researchers since 1995 (Zott et al., 2011). As Teece pointed out, the “idea” of a business model is not recently created but has already been a part of economic behaviour. When it became a systematic and similar logic which delivers value to customers and covers payments to profits, then the business model concept became a real research area for researchers (D. Teece, 2010). When Peter Drucker (1954) asked these questions, he was also giving a frame of the business model: “Who is the customer? And what does the customer value? How does the company try to make money?” (Magretta, 2002) in (Ouakrat, 2012). In order to respond to these questions, a business model seeks to respond to what and how the customer needs and how much they are ready to pay.

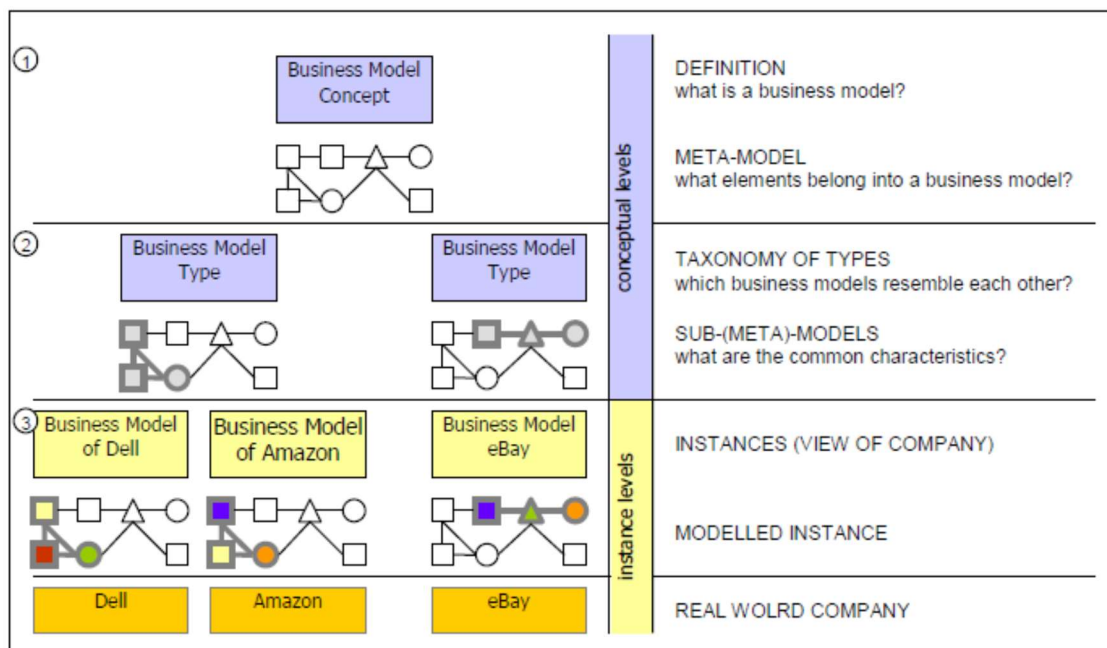
After 1995, the usage of the Internet and e-commerce, which facilitates long-distance transactions, increased. The latter and the ICT (Information and communication technologies) opened new opportunities for organizing new business activities; in other words, a new logic of value creation started. As a consequence of that, the e-business model approach emerged, and scholars started to use and explore the term business model more often. Science and technological innovations in post-industrial technologies emerge, such as business model innovations, semiconductor industry or electronics. (Massa & Tucci, 2014).

However, we are unable to find a single definition for this term in the literature (Massa & Tucci, 2014; Zott et al., 2011). The lack of a common definition attracted first Zott et al. (2001) and Osterwalder et al. (2005). In every context or research area, the researchers bring a different definition according to their research angle. Osterwalder et al. (2005) explain these viewpoint

differences because of the differences between businesses which are subject to the research. In order to bring a panoramic view of this concept, the authors classified the research out of three-step hierarchical categories, which are not necessarily linked to each other;

- 1- Authors that describe the business model as a concept which describes the real business world: Definitions give the idea of what is a business model, on the other hand meta-model's gives a definition of the composing elements of a business model (Chesbrough & Rosenbloom, 2002; Osterwalder et al., 2005)
- 2- Authors that describes different types of BM but classified out of some common characteristics as taxonomies: the taxonomies can be specific for specific business areas
- 3- Authors presenting some aspects or concepts of the real world: this type of presentation consists of real companies' case studies or representations and conceptualisation in order to analyse their business model perspective (Chesbrough, 2003a; Jason Dedrick, et al., 2000)

Figure 10 Business model overview



Source: (Osterwalder et al., 2005) p:9

Massa et al.(2017) emphasize the importance of business model as a concept that increases competitiveness (Chesbrough, 2003a), fosters product, process and organizational innovation, and, at a macro level, the improvement of internet technologies and globalization, which lover

the entry barriers, gives opportunities to improve new business models in order to increase the profitability of the firm (Massa et al., 2017; Zott et al., 2011; Amit & Zott 2001).

Massa and Tucci advance this approach and make an in-depth literature search about this three-dimensional definition to the business model (Massa et al., 2017) as follows.

1. Business model as attributes of real firms; answering the question of “how does a firm do business- the set of activities, how are they competing in the market and, what is the outcome of the firm- value created / value captured
2. Business model as a cognitive/linguistic schema: How do the firm’s organizational members see and interpret the firm’s doing business? How is it communicated between the organizational members? It is also called like manager’s thinking pattern and can be considered a dominant logic of the firm (Prahalad & Bettis, 1986). This approach describes a narrative linguistic schema. According to the authors, the narrative dynamics create a shared understanding, allow communication between organizational members, and internally operate the social order, rules, organizational structures, hierarchy and meaning-making. These narratives of the business model can be constructed by managers or entrepreneurs and can be used as a communication device for persuading the external audience and creating a sense of legitimacy.
3. Business model as a formal, conceptual representation, a simplified representation of fundamental components of the business model: the simple definition of this representation is: how could it be presented symbolic, mathematic or graphic depictions, how does the business function, and how does the firm is proposing to achieve its goals? In order to do this, a conceptual approach formally describes and helps to understand and communicate the world around us. Appeal to a conceptual model is to simplify a complex phenomenon and escape from the dominant logic trap by raising awareness and escaping from dominant logic assumptions (Chesbrough, 2010). The authors, in this vein, presented the business model accordingly: 1- out of different levels of abstractions (e.g., Business model canvas (see above) (Osterwalder et al., 2005)), 2- out of a content list, such as different components of the business model (Chesbrough, 2010), 3-out of semantics, such as set of constructs, symbols or rules (e.g: e3- value ontology modelling language, which helps to model how an economic value is created and exchanged within the actors of the company (Gordjin and Akkermans (2003) in (Massa et al., 2017))

Ayerbe et al. (2011) focus on the utilization of intellectual property in open innovation and emphasize its significance in open business models (OMB) (Ayerbe & Chanal, 2011). Chesbrough defines the open business models as “(Open models) create value by leveraging many more ideas, due to their inclusion of a variety of external concepts. Open models can also enable greater value capture by using a key asset, a resource, or position, not only in the company’s own business but also in other companies’ businesses,” referring to external technological knowledge (Chesbrough, 2003a). Ayerbe et al. (2011) highlight that managing intellectual property rights involves utilizing licenses for existing patents in the patent portfolio. In this process, management’s primary task is to discover new application methods for existing technologies, which presents a fresh challenge for them.

In regard to the conceptual presentation of business models, the authors highlight the distinction among scholars due to their disagreement regarding the essential aspects of a business model. Despite discussing similar elements in principle, they employ different terminology, which leads to varying interpretations of what constitutes a business model.

The business model literature in the innovation domain shows us two important roles of the business model in the company: Firstly, commercialising new ideas and technologies where the business model mediates between technology and economic value creation (Chesbrough & Rosenbloom, 2002), and secondly, the business model can also be a source of superior performance and innovation which bring a competitive advantage even in mature industries (Jason Dedrick, et al., 2000; Massa & Tucci, 2014).

Chesbrough et Rosenbloom (2002) give the example of the Xerox 914 printing machine as an example of this mediation between technology and economic value creation. Xerox 914 created a difference in the market by using standard plain paper instead of special paper and copying supplies like other competitors in the printing machine industry. Also, it brought a higher copying capacity than the existing machines in the market. However, the production cost of this machine was much higher than the existing products. The rise of this expensive machine in the copying/ printing market came with a different business model: leasing and distributing the cost of the product at the time of lease and charging 2cent for each copy as an additional leasing cost of this high printing capacity instead of selling and charging a high price in one

Table 9 Definitions of Business Model (BM)

Author	Definition
(Afuah and Tucci, 2001, Osterwalder, Pigneur, and Tucci, 2005, Zott et al., 2011)	These considerations suggest that, at first glance, the BM may be conceptualized as depicting the rationale of how an organization (a firm or other type of organization) creates, delivers, and captures value (economic, social, or other forms of value) in relationship with a network of exchange partners (Afuah and Tucci, 2001; Osterwalder, Pigneur, and Tucci, 2005; Zott et al., 2011).
(Afuah & Tucci 2001 , (Zott et al., 2011)	“The method by which a firm builds and uses its resources to offer its customer better value and to make money in doing so”
(Baden-Fuller & Haefliger, 2013)	We define the business model as a system that solves the problem of identifying who is (or are) the customer(s), engaging with their needs, delivering satisfaction, and monetizing the value
(Chesbrough, 2007b)	In essence, a business model performs two important functions: It creates value, and it captures a portion of that value. The first function requires the defining of a series of activities (from raw materials through to the final customer) that will yield a new product or service, with value being added throughout the various activities. The second function requires the establishing of a unique resource, asset or position within that series of activities in which the firm uses a competitive advantage.
(Chesbrough, 2007a)	A better business model often will beat a better idea or technology
(Chesbrough & Rosenbloom, 2002)	The business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs. The business model is thus conceived as a focusing device that mediates between technology development and economic value creation
(Doganova & Eyquem-Renault, 2009)	(We found) that business models can be fruitfully analysed as “market devices” (Callon et al., 2007)—one among the many intermediaries that circulate in the techno-economic net-works of innovation. (...) the business model works as both a calculative and a narrative device. It allows entrepreneurs to explore a market and to bring their innovation – a new product, a new venture and the network that supports it – into existence.
(Osterwalder et al., 2005)	A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams.
(Teece, 2007, p. 1329)	(...)a business model is a plan for the organizational and financial ‘architecture’ of a business. This model makes assumptions about the behavior of revenues and costs, and likely customer and competitor behavior. It outlines the contours of the solution required to earn a profit, if a profit is available to be earned. Once adopted it defines the way the enterprise ‘goes to market.’
(Timmers P. 1998)	A business model includes an architecture for the product, or service, an information flow, a description of the benefits for the business actors involved, and a description of the sources of revenue.
(Zott et al., 2011)	The BM is a systemic and conceptually rich construct, involving multiple components, several actors (boundary spanning) and complex interdependencies and dynamics.

Source: (Massa et al., 2017) synthesized and ameliorate by author

They became the leader of the copying industry until the intervention of the Federal Trade Commission to license its technology and offer the machines to sales and the lease. Massa and

Tucci (2014) emphasised that the business model's second important role is bringing a competitive advantage in the market and superior performance. Several definitions of a business model are provided in the Table 9.

example, Dedrick et al. (2000) studied the computer manufacturer Dell's success, which relies on their direct sales and built-to-order business model (Jason Dedrick, et al., 2000). In this example, the well-known PC company Dell as one of the biggest computer producers brought a different business model which requests direct sales to the customer (instead of distribution channels) and builds a direct customer relationship, which helps Dell for the customer segmentation and service (namely; relationship customers-key customers, transaction customers- SME's, and public/international customers). As for the built-to-order production system, Dell creates (1) a lead time advantage by using high-quality components which they can use in different computer models accordingly can reduce the inventory cost and offer the latest technology to the customer, (2) keep the necessary components in hand and require to do the same to its suppliers, (3) facilitate the order and manufacturing process by using the internet and (4) eliminates the inventory in the channel and offers a high-quality customised service to the customer.

In both approaches, we can observe the role of the business model basically out of the value creation (D. Teece, 2010; Zott et al., 2011) and value capture roles. In our work, we are going to take into consideration the business model definition of Chesbrough et al. (2002), which is putting together the technological innovation and value creation/ value capture logic in the business through patents, like the patents have an inherent strategic value (Ayerbe & Chanal, 2010a, p. 100; Elmquist et al., 2009). In other words, the business model in Open Innovation is for generating value from IP (Ayerbe, 2016; Chesbrough, 2003c).

According to Chesbrough (2003), firms can create and capture value from their (new) technology by (1) using/incorporating the new technology into the existing business, (2) licensing the technology to external companies, and (3) launching new ventures by exploiting the new technology in new business areas. (Chesbrough, 2003a). In order to extract value from technology, one must commercialise it through a business model (Chesbrough, 2003a, p. 156)

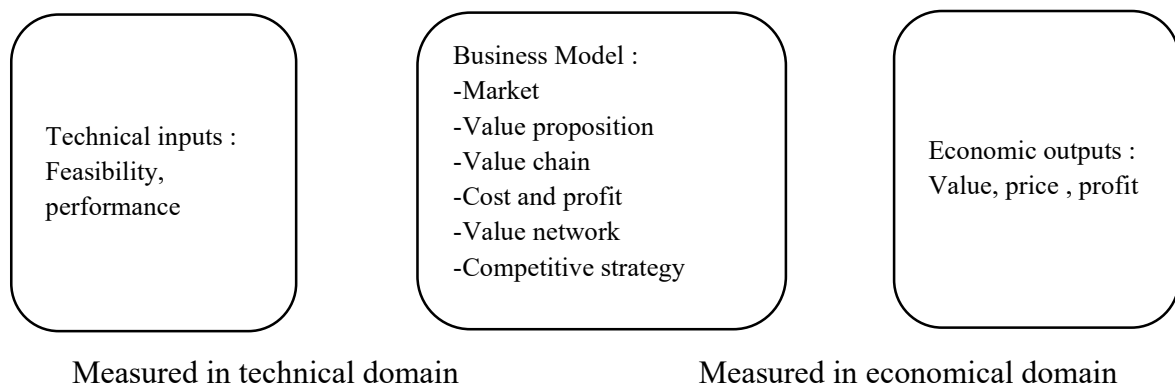
Rosenbloom and Chesbrough (2002, p:533) propose a set of functions to describe the business model as follows:

- Value proposition: articulate the value proposition, i.e. the value created for users by the offering based on the technology;

- Target market: identify a market segment, i.e. the users to whom the technology is useful and for what purpose, and specify the revenue generation mechanism(s) for the firm;
- Value chain: define the structure of the value chain within the firm required to create and distribute the offering, and determine the complementary assets needed to support the firm’s position in this chain;
- Revenue mechanism: estimate the cost structure and profit potential of producing the offering, given the value proposition and value chain structure chosen;
- Value network or ecosystem: describe the position of the firm within the value network linking suppliers and customers, including identification of potential complementors and competitors;
- Competitive strategy: Formulate the competitive strategy by which the innovating firm will gain and hold an advantage over rivals.

These functions serve to justify the financial capital needed to realize the new business and serve to define the business path; value creation and value capture (Chesbrough, 2007a).

Figure 11 Mediation of Business model between technical and economical domains



Source: (Chesbrough & Rosenbloom, 2002)

Chesbrough (2007) describe different types of business models as set of framework, namely Business Model Framework (BMF). Accordingly, the author synthetize the possible business model approaches by companies.(Table 9)

Table 10 Business Model Framework

Business model type	Definition	Example
Undifferentiated business model	Selling “commodities” and competing between price and available stock of the product	Restaurants, Café, Barber shop
Differentiated business model	Targeting a selective customer and sell a less crowded market segment. The trap: “one hit product” and no other product	Technology start-up companies
Segmented business model	Competing in two different market segment in the same time; One provide high volume sell, in a price sensitive market Second provide high profit margin sale, generally using distributors in niche markets.	ERP system which is connected to the business process, however have some problems to work with other software systems
Externally aware business model	Opening to external ideas, technologies which allow to company to use a large set of resources from outside. Internal roadmaps are sharing with suppliers and customers which enables both parties to plan their activities and to share ideas.	Companies that share a real-time information with their suppliers
Integrating innovation process with the business model	Business model has an integrative role in the company. Relationship between customer/ company and supplier are more formalized and company can respond to customers’ future requirements.	Take the time to understand the supply chain needs, look for technical improvements and cost cutting options as well as alternative options to understand more the customer and its needs. Companies they are switching from product offering to service offering, and bringing external technologies
Adaptive (integrative) form business model	This form of business model adoption requires a previous experience of one of those business models. Using joint ventures to commercialize technologies outside of their business model or creating internal incubators to find new ideas. The company enters in a relationship of sharing technical and business risks with key suppliers and customers. Company integrate its business model to their key customers.	Intel Microsoft Value chain impact: expanding the value of the platform without consuming extra investment (PC, Phone or video game accessories producers contribute indirectly to PC and phone platforms value chain)

Source: (Chesbrough, 2007a)

We can say that most of the time, companies adopting Open Innovation practices are changing their business model in the first place, IBM, Xerox, and P&G (Chesbrough, 2003a, 2007b; Jason Dedrick, et al., 2000). When we take into consideration how companies can capture value from innovation, in other words, the exploitation of the intellectual property inside or outside of the company must be considered as an important part of the business model research (Chesbrough, 2007a; Chesbrough & Rosenbloom, 2002). Similarly, Chesbrough (2003) emphasizes the importance of IP management by a suitable business model. The author advocates that the technology alone does not hold an inherent value unless it is commercialized by a proper business model (Chesbrough, 2003c). In our research, we will adopt and explore this reinforced and comprehensive point of view regarding the business model, as it allows for the strategic implementation of valuable and essential intellectual property. This approach emphasizes the significance of intellectual property exploitation, specifically focusing on patents, which drives success and growth in the business realm. Through this enhanced understanding of the business model, we aim to uncover innovative and effective strategies that harness the potential of intellectual property and its inherent value.

For example, Ayerbe (2016) showed the importance of patents in the Open Innovation process. A company can have different reasons to patent an invention, which we will discuss in the next chapter. However, in Open Innovation, patents give the company to create value around the patents (Chesbrough, 2003a, p. 162). Ayerbe (2016) emphasize that *value creation* is made through the inbound Open Innovation process.

A company can enlarge their patent portfolio and technological capabilities through external patent acquisition (Dahlander & Gann, 2010). On the other hand, the *value captured* through patents in the Open Innovation process is associated with the outbound Open Innovation process (Ayerbe, 2016, p. 90). Internal exploitation plays a crucial role in determining the financial worth of patents within a company. Internal exploitation plays a crucial role in determining the financial worth of patents within a company. The act of selling or licensing out patents and creating spin-offs through new company formations serves as a significant pathway for generating financial value through patents. Hence, it becomes evident that the importance of patents extends beyond mere interest from the R&D department, as they are also viewed as invaluable assets within a company's business model. From an academic perspective, understanding the internal exploitation of patents can provide valuable insights into the financial implications and strategic decision-making processes related to patent

management. Internal exploitation is a crucial aspect when assessing patents' financial value creation potential. In addition to being of interest to the R&D department, patents are also recognized as valuable business model assets for companies. This highlights the significance of selling or revealing patents and licensing them out or creating new companies based on patented ideas as ways to generate financial value through patents. Hence, it is evident that internal exploitation plays a pivotal role in determining the importance and impact of patents on a company's overall business strategy (Chesbrough & Bogers, 2014, p. 17).

Conclusion of Chapter 2

In our research, we are focusing on the concept of patent exploitation in open innovation. Therefore, in this section, our study centres around open innovation. However, before diving into the specifics of open innovation processes, we explored previous innovation models discussed in the existing literature. It is important to note that these models include technology push model in 1950-1960 (Kline & Rosenberg, 1986) and science push model (Schmookler, 1966). Market pull model in 1960-1970 (Kline & Rosenberg 1986), Coupling model in 1970-1980 (Mowery & Rosenberg 1978), Chain linked model in 1980-1990 (Kline & Rosenberg, 1986), Network model in 1990-2000 (du Preez, Louw 2008).

The open innovation model, considered the 6th generation of innovation models and introduced by Chesbrough in his influential work in 2003, has gained significant attention. According to Chesbrough (2006), the smartest people work in different places. Therefore, instead of working inside the company to develop a new product or a process, a company can profit from external ideas and technologies. Similarly, a company can let go of unused internal knowledge and technologies (Chesbrough & Bogers, 2014). In this way of doing business, the open innovation model puts the closed innovation model into question, which is explained as “doing all by themselves, inside the company”. However, the mobility of workers from one company to another, increasing collaboration capabilities of the universities, the increasing number of start-up firms, and the rise of internet usage destroy the closed innovation model by increasing number of knowledge exchange and technology transfer through outside of the company (Chesbrough, 2003a, 2003c; Chesbrough & Bogers, 2014). In this context, Chesbrough defines the open innovation processes as the exploitation of unused internal R&D research and the exploration and transfer of external technologies as “*purposive inflows and outflows of knowledge*”(Chesbrough, 2003a; Chesbrough & Bogers, 2014). This exchange through the boundaries of the company can be done in 3 ways (Chesbrough, 2003c; Gassmann & Enkel, 2004):

- Knowledge inflows (outside-in & inbound): profiting from external knowledge or technology inside the company by acquisition of external technology
- Knowledge outflows (inside-out & outbound): profiting from internal knowledge or technology outside the company through external commercialization

- Knowledge inflows and outflows working together (coupling): realizing the two exploitation processes together.

In the second sub-chapter of this section, we have studied different concepts related to open innovation.

Technology transfer through patents is vital in facilitating knowledge exchange and promoting innovation because the patent is the codified knowledge. In this process, the open innovation tools (inbound and outbound transfer through licensing) facilitate the transfer (Scarrà & Piccaluga, 2022). However, profiting from open innovation is also related to a certain level of openness of the company. The openness level is studied from different angles in the literature. Carmona et al. (2021) studied collaboration intensity with other entities (Carmona-Lavado et al. 2021; Lazzarotti and Manzini 2009), Cassiman et al. (2016) studied the extent of R&D exploration (Cassiman and Valentini 2016; Michelino et al. 2015; Popa, Soto-Acosta, and Martinez-Conesa 2017) and exploitation (Cassiman and Valentini 2016; Masucci, Brusoni, and Cennamo 2020) as important indicators of openness.

Besides the openness, a company has to have a necessary absorptive capacity to assimilate, transform and exploit the acquired knowledge (W. Cohen & Levinthal, 1990; Lichtenthaler & Lichtenthaler, 2010; Zobel, 2017) but also has to have necessary desorptive capacity, ability to unlearn the outdated knowledge and replace it with the new one (Zobel, 2017). All those features help the company to profit from the open innovation.

Finally, the company's business model facilitates profiting from open innovation. The literature put in evidence two important roles of the business model: commercializing new ideas and technologies where the business model mediates between technology and economic value creation (Chesbrough & Rosenbloom, 2002), and generates a superior performance and innovation which brings competitive advantage (Jason Dedrick, et al., 2000; Massa & Tucci, 2014). According to Chesbrough, open business models can generate value by incorporating various external ideas. These models also allow for increased value capture by utilizing key assets, resources, or positions within a company's business operations and in other companies' operations. This includes using external technological knowledge as well (Chesbrough, 2003a). Ayerbe et al. (2011) emphasize that effectively managing intellectual property rights entails utilizing licenses for existing patents within a patent portfolio. In this process, management is tasked with discovering new application methods for existing technologies, presenting them with fresh challenges (Ayerbe & Chanal, 2011). In open business models, patents are utilized

in many ways to enable patent exploitation within this process. The following chapter will delve deeper into the intricate methods of exploiting patents throughout the open innovation process. By exploring the various lanes of patent exploitation, we can uncover new insights into how intellectual property rights contribute to the success of open business models. This exploration will highlight the strategic significance of patents within open innovation and their potential for fostering collaboration and knowledge sharing.

Chapter 3 The place of patents in Open Innovation processes

This chapter is dedicated to the literature review of Open Innovation processes and the use of patents in these processes in detail. Therefore, we have started to delve into the importance of patents in the open innovation processes in the first sub-chapter (sub-chapter 3.1) as an introduction to this part of our research.

Then, we dedicated the second sub-chapter (sub-chapter 3.2) to using patents in the inbound open innovation processes by purchasing patents or licenses from external partners. Then we explain a company's motivations for inbound licensing or patenting, such as access to a new invention, blocking rivals, access to complementary technology to increasing the portfolio for cross-licensing, reducing the time to market, reducing uncertainty by using existing technology, entering in a foreign market, and working as a subcontractor for the licensor company.

The third sub-part of this chapter is dedicated to the use of patents in outbound open innovation processes (sub-chapter 3.3). This part explained the patent selling and licensing-out activities in outbound open innovation processes. Also, we explained a company's motivation for outbound licensing, such as stopping the related activity and selling the patents, acquiring a new company and selling unused patents, having additional revenue, company strategy, cross-licensing, standard setting, blocking rivals, and access in new markets.

The final sub-chapter (sub-chapter 3.4) is dedicated to the identification ways of the partners and the typology of partners.

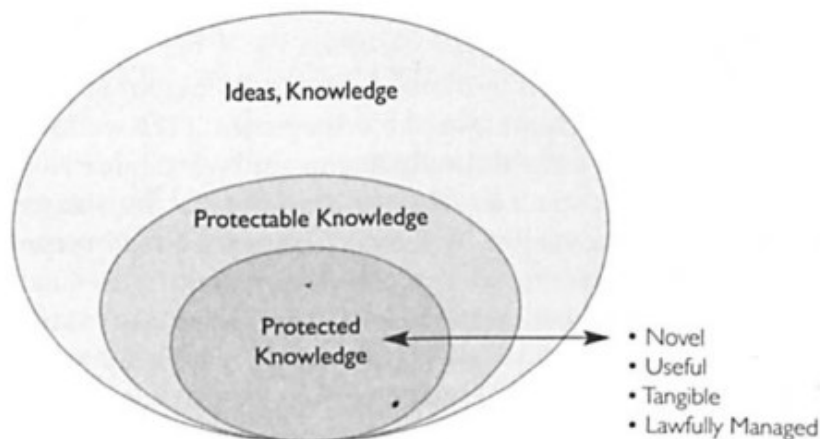
3.1. Patent management and Open Innovation Model

The competition in the global market has significantly intensified in recent years, leading to a rapid pace of innovation diffusion and shorter product innovation cycles. As a result, companies are compelled to shorten their market launch time in order to stay competitive. In this fiercely competitive environment, it is crucial for a product to not only be attractive but also offer something new and unique to the customers, enabling it to differentiate itself from its competitors and establish a strong presence in the market. However, achieving sustainability in the market requires more than just product differentiation; it demands a solid position and

the ability to continuously innovate. Moreover, in light of the intense competition on a global scale, companies must take measures to protect their inventions and intellectual property from competitors. This necessitates the adoption of various exploitation forms to safeguard their innovative ideas and maintain a competitive edge in the market. By leveraging these exploitation forms, companies can effectively capitalize on their inventions, ensuring their long-term success and growth in the marketplace.

The innovation diffusion has witnessed a significant increase in recent times, primarily due to the intensifying global competition. In today's fast-paced world, the ability to develop highly innovative products at a low cost and within a short timeframe has become a paramount concern. It is in this context that intellectual property (IP) plays a crucial role in fostering open innovation (Gassmann et al., 2010; Van De Vrande, de Jong, et al., 2009). The exchange of protected intellectual property has facilitated the mobility of knowledge, allowing it to flow from one portfolio to another or even out of licensing agreements (Gassmann, 2006). Among various forms of IP, patents stand out as the leading source of trade (Chesbrough, 2003a, p. 157). As stated by Chesbrough (2003a), it is essential to recognize that not all ideas can be protected due to their inherent nature. However, for ideas to be eligible for intellectual property protection, they must satisfy certain criteria. These criteria include novelty, usefulness, transformation into tangible form, and adherence to legal regulations. Exploiting different forms of intellectual property plays a pivotal role in driving innovation and ensuring compliance with IP laws (Chesbrough, 2003a).

Figure 12 Ideas and intellectual property



Source:

(Chesbrough, 2003a, p. 157)

As described in Figure 12, the importance of IP became clearer when we studied the Open Innovation process closely. The inbound process, very closely associated with the exploration of new knowledge, is also related to the amelioration of the absorptive capacity of the company (Mortara & Minshall, 2011), but also to increase the internal knowledge capacity by the acquisition of knowledge from external partners such as research centres, suppliers, competitors (Aloini, Lazzarotti, et al., 2017a). In this process, the pecuniary activities, as described previously by (Dahlander & Gann, 2010), are presumed as the transfer of IP in the form of licensing-in or patent acquisition and non-pecuniary activities (Dahlander & Gann, 2010) are creating partnerships with suppliers, research centres, or customers (Mignon et al., 2020). The outbound process which also very closely associated with the “openness” of the company and consists of the ways of commercialisation of the internal knowledge of the company in the form of pecuniary or non-pecuniary activities (Dahlander & Gann, 2010). The pecuniary activities of outbound Open Innovation are selling the IP in the form of IP licensing-out or patent selling. The non-pecuniary form of outbound Open Innovation involves exploiting the knowledge without an immediate financial return, such as standard setting (Mignon et al., 2020).

Open Innovation emphasises the importance of external knowledge exploration and exploitation. The *purposive outflows of technology* that is also called technology exploitation refers to the leveraging of a company’s technological potential capabilities outside of the organization and creating new profit areas for the internally developed technology (Chesbrough & Crowther, 2006; Van De Vrande, de Jong, et al., 2009). The *purposive inflows* or technology exploration refers to the seeking and capturing of external technology in order to improve the internal technological capabilities to enable the company to acquire new technologies from outside (Toma et al., 2016; Van De Vrande, de Jong et al., 2009). Firms may also combine technology exploration and exploitation activities called coupled processes (Gassmann & Enkel, 2004). Hence, we can resume the Open Innovation process by the initial three processes: 1) Outside-in process, 2) Inside-out process, and 3) Coupled process, which gathers those two processes (Gassmann & Enkel, 2004).

Our research will focus mostly on the pecuniary activities of Open Innovation, specifically on patenting and licensing activities.

Dahlander et al. (2010) reveal an important division of inbound and outbound activities by their financial return characteristics, namely pecuniary and non-pecuniary characteristics

(Dahlander & Gann, 2010). The authors reveal four types of characteristics: 1) Inbound / pecuniary activities (Acquisition), 2) Inbound / non-pecuniary activities (Sourcing), 3) Outbound/pecuniary activities (Selling), 4) Outbound / non-pecuniary activities (Revealing). The Acquisition activity is the acquisition of external expertise or licensing-in activities of a firm, which brings the advantage of gaining access to resources and knowledge of partners. The Sourcing activity is the non-monetary form of inbound activities, which includes extracting external ideas from customers, suppliers, universities, etc., without including any monetary exchange. The Selling activity refers to commercialising internal inventions and technology through monetary returns such as licensing-out or patent selling. Finally, the Revealing activity refers to opening internal resources without immediate financial return but instead looking for indirect benefits to the focal company.

We've tried to put in evidence different forms or different approaches of Open Innovation adoption factors from different angles in the literature.

Table 11 Pecuniary and non-pecuniary activities

OI Dimensions	Pecuniary activities	Non pecuniary activities
INBOUND	Acquiring	Sourcing
	University research grants	Customer & consumer co-creation
	Contracting of external R&D service providers	Informal networking
	Idea and start-up competitions	Publicly funded R&D consortia
	IP licensing-in – Patent buying (Gassman & Enkel 2004)	Crowdsourcing (unknown problem solvers)
	Supplier innovation awards	Cross-licensing
	Specialized OI intermediaries	
OUTBOUND	Selling	Revealing
	Spin-offs	Joint-venture activities
	Corporate business incubation	Participation in standardization (public standards)
	IP licensing-out or patent selling (Grzegorzczuk, 2019)	Donations to commons or nonprofits
		Patent pools & Cross-licensing (Grzegorzczuk, 2019)
COUPLED	Combining inbound & outbound activities	Co-conception
	Collaboration for patent pool	Co-development
	R&D collaborations and joint ventures (Holgersson & Granstrand, 2017)	Open source activities (Gassman & Enkel 2004)

Source: (Chesbrough & Brunswicker, 2013; Gassmann & Enkel, 2004; Grzegorzczuk & Głowiński, 2019; Holgersson & Granstrand, 2017)

Inbound processes

Based on (West & Bogers, 2014) research, the inbound process includes obtaining, integrating and commercializing the external knowledge. This will remind us of the absorptive capacity definition. However, the absorptive capacity is related to the company's ability to find, acquire and use external knowledge for inbound technology transfer. In contrast, the inbound technology transfer is the organizational process strongly related to the company's business model.

Table 12 Inbound Open Innovation activities

Inbound pecuniary activities	Inbound Non-pecuniary activities
IP licensing-in – Patent buying (Gassman & Enkel 2004) (Laursen et al., 2010; Bianchi and Lejarraga, 2016).	Customer & Consumer co-creation Supplier integration (Gassman & Enkel 2004 ; (Brunswicker & Vanhaverbeke, 2015); Dell’Era et al., 2018, Randhawa et al., 2019)
Contracted R&D services Specialized Open Innovation intermediaries (Brunswicker & Vanhaverbeke, 2015)	Crowdsourcing Publicly funded R&D consortia Informal Networking (Brunswicker & Vanhaverbeke, 2015); Deschamps et al., 2013).
Idea & start-up competitions Supplier innovation awards – supplier integration (Gassman & Enkel 2004)	Outsourcing R&D : Buying R&D services from other organizations, such as universities, public research organizations, commercial engineers or suppliers.(D’Angelo & Baroncelli, 2020; Van De Vrande, de Jong, et al., 2009)
University research grants	
Acquisition of innovative firms (Holgersson & Granstrand, 2017); (Brunswicker & Vanhaverbeke, 2015)	Both alliances and networking may take place across industries (Chesbrough and Schwartz, 2007; Enkel and Gassmann, 2010)
Corporate venture capital (Wadhwa et al., 2016; Mortara and Minshall, 2011).	Involve some form of competition (Cassiman et al., 2009; Bouncken et al., 2015)
	Establishing a separate business entity with an external partner through a joint venture is another way to implement inbound OI. It incorporates the knowledge of the external partner into the new business entity, thus merging it with the capabilities of the firm (Dittrich and Duysters, 2007; Chesbrough and Brunswicker, 2013; Pinarello et al., 2022)

Source: (Brunswicker & Chesbrough, 2018; Gassmann & Enkel, 2004; Holgersson & Granstrand, 2017, p. 1268; Pénin et al., 2013)

Outbound processes

We can cite outsourcing methods of Open Innovation as follows: 1) direct contact with the innovation provider, 2) organizing a contest in the market, 3) using an intermediary (or an agent) between the innovation seeker and provider parties (Saur-Amaral and Amaral, 2008) in (Gianiodis et al., 2010), 4) Strategic alliances (enable to reach new technologies and complementary assets) (Markman et al 2009), 5) M&A (broaden the market scope), 6) SME acquisitions (Oliveira et al, 2003)in(Gianiodis et al., 2010). This can be venturing, outward licensing and the employee involvement (Van De Vrande, de Jong, et al., 2009).

Table 13 Outbound Open Innovation activities

Outbound pecuniary activities	Outbound Non-pecuniary activities
Spin-offs (Spin-out)	Joint-venture activities
Corporate business incubation	Participation in standardization (public standards)
Divestment of the company	Donations to commons or non-profits
Licensing-out	Strategic alliances
Patent selling	Patent pools
	Cross-licensing

Source: (Brunswick & Chesbrough, 2018; Gassmann & Enkel, 2004; Grzegorzczuk & Głowiński, 2019; Holgersson & Granstrand, 2017; Lichtenthaler, 2005)

Coupled Open Innovation

The coupled Open Innovation pools knowledge and co-creation (Enkel et al., 2009). Many firms are also practising both inbound and outbound Open Innovation activities (Gassmann et al., 2010; Gassmann & Enkel, 2004; Van De Vrande, de Jong, et al., 2009). This type of Open Innovation practice involves combining inbound and outbound activities in order to develop or/and commercialize an innovation collaboratively. Coupled Open Innovation process involves two or more parties managing their mutual knowledge exchange across organizational boundaries (Chesbrough & Bogers, 2014). Accordingly, it may include both inbound and outbound activities and collaboratively developed or commercialized innovation activities (Chesbrough & Bogers, 2014, p. 19). This mode of Open Innovation allows the partners to organize joint invention and commercializing activities such as patent pools, which allows

licencing to the third parties the patents of the union (Ayerbe, 2016, p. 91), but also allows co-development, and joint projects, alliances, consortiums, or R&D cooperations (Mignon et al., 2020).

Table 14 Coupled Open Innovation activities

Company characteristics focusing coupled activities	Coupled activities
Standard setting	Combining inbound and outbound activities
Increasing returns	Collaboration for patent pool
Alliance with complementary partners	R&D collaborations and joint ventures
Complementary products with critical interfaces	Co-conception
	Co-development
Relational view of the firm	Open source activities

Source: (Gassmann & Enkel, 2004; Holgersson & Granstrand, 2017; Pénin et al., 2013)

The coupled process gathers both exploration and exploitation activities. This is explained by the term ambidexterity by March (1991)

Ambidexterity and extroverted companies adopt more coupling activities (Mortara & Minshall, 2011). A successful technology transfer requires previous knowledge to understand, manipulate and use it, which is called absorptive and desorptive capacity as complementary capacity.

3.2. Patent use in Inbound Open Innovation Process

In order to explain the inbound process, West et al. (2014) use an integrative linear model. According to this model, the inbound Open Innovation process consists of three steps: Obtaining innovation from external sources, integrating innovation, commercializing innovation, and in addition, interaction mechanisms which can occur between the phases (West & Bogers, 2014).

Inter-firm relationship involvement is an important determinant for the explorative performance of the company. It allows firms to search and look beyond their organizational and technological areas. External technology searching and sourcing enable firms to increase their internal R&D capacities for better technology adoption. One can consider external

technology sourcing as an important tool to access a better or superior resource and ensure corporate renewal (Vanhaverbeke & Duysters, 2011; Vanhaverbeke & Peeters, 2005).

In the same vein, Aloini et al.(2017) identified the inbound Open Innovation process in three steps: 1- obtaining phase, which includes two sub-phases, namely (1) technology scouting, (2) external knowledge sourcing, 2- integrating phase which includes collaboration establishment as a sub-phase, and 3- managing phase (Aloini, Farina, et al., 2017).

The obtaining phase tries to answer the needs like “What are the firm’s needed resources? which ones should be developed internally or found externally? How can the firm find external sources of technology in order to fulfil the firm’s needs? Dahlander and Gann (2010) point out that companies may find solutions to those questions (Dahlander & Gann, 2010; Gassmann & Enkel, 2004)

3.2.1. Patent purchase and licensing-in Inbound Open Innovation

It has long researched the complementarity nature of internal R&D and inbound activities in the literature. For example, Cassiman et al. (2006) created a model to prove the complementary nature between internal R&D and inbound technology transfer. Their survey of Belgian manufacturing companies showed the positive relationship between internal R&D and inbound Open Innovation.

Similarly, Arora et al. (1990) mentioned the complementarity between inbound activities. The authors show the complementary relationship between four inbound activities in the biotechnology firms. Using a sample composed of US, European, and Japanese large firms, and previously identified four most common inbound activities of biotechnology firms, namely, agreements between other companies and universities, acquisition of new -small-companies, and capital investments on new -small- companies shows the complementarity between the acquisition of small companies by large firms and the scientific knowledge of universities(Arora & Gambardella, 1990).

Secondly, new is not always easy to accept. It needs time and practice to adapt. This is why opening up the process needs time and practice. The companies familiarize themselves with an exchange of knowledge by acquiring external knowledge. Therefore, we can consider inbound innovation activities as a first step to opening up the process, outsourcing the R&D to reduce costs and risks, and using complementary assets to feed the company’s internal growth (Gassmann et al., 2010). Chesbrough defines inbound Open Innovation as *the practice of*

leveraging the discoveries of others(Chesbrough & Crowther, 2006). If we bring further this definition, the outside-in process implies the integration of external technologies from external R&D. It involves opening up a company's innovation process to different kinds of external inputs and contributions. The choice of the form of external knowledge integration is generally determined according to the business model choice of the company (Chesbrough & Bogers, 2014). This integration may be realized in both transactional (pecuniary) or non-transactional/indirect benefits(non-pecuniary)(Dahlander & Gann, 2010) forms, such as acquisition and collaboration activities (Which is also seen in SMEs (Brunswicker & Vanhaverbeke, 2015)). In the pecuniary mode of Open Innovation, there is an immediate financial return related to the knowledge flow, whereas in the non-pecuniary mode of Open Innovation, the financial return takes time (Dahlander & Gann, 2010). Acquisitions are based on spin-in or licensing-in via the acquisition of IPR, while collaborations consist of establishing links with partners to improve internal developments (Aloini, Lazzarotti, et al., 2017; Dahlander & Gann, 2010; Huizingh, 2011; Lichtenthaler, 2011).

While classifying Open Innovation activities in the literature, Brunswicker and Chesbrough have introduced practitioners inbound and outbound activities from a financial exploitation perspective which Gassmann and Enkel (2004) emphasized as pecuniary and non-pecuniary activities (Brunswicker & Chesbrough, 2018). Authors emphasized the interest of large firms mostly in inbound-non pecuniary activities and defined the large firms as *takers of knowledge* while inbound activities are considered.

3.2.2. Motivations for patent use in the inbound Open Innovation

When a company decide to invest in an inbound Open Innovation process, it is heard that the company is willing to integrate external knowledge inside the company. This knowledge integration can be done by different channels such as customer (von Hippel 1986)and supplier integration (Brunswicker & Chesbrough, 2018; Teece, 2007), using or integrating in innovation clusters (Carayannis & Campbell, 2006), and using intensively intellectual property for external technology transfer (Ziegler et al., 2013). In our research, we will be focusing on external technology transfer. Therefore, we must focus on using intellectual property forms such as buying patents and/or licensing-in.

For companies with a large patent portfolio, technological knowledge is more important than for companies with a small patent portfolio; those firms aim to keep their knowledge higher than other firms and use it as a competitive advantage. Therefore, the patenting and licensing activities, all types of technological knowledge transaction activities, has an important part of corporate strategies(Chesbrough, 2003a).

The literature shows that depending on their needs, the company's inbound patenting or licensing motives differ. Respectively, we can cite the motives as follow: access to a new invention (quickly) (Gassmann et al., 2018), blocking rivals (Grimpe & Hassinger, 2008; Holgersson & Grandstand, 2017), having a big portfolio (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016), having access to a complementary technology (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016), making cross-licensing agreements (Davis, 2008), reduce R&D expenses (Gassmann et al., 2018; Gassmann & Enkel, 2004), to gain access to new technology (Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994), to use a proved technology (Chesbrough & Crowther, 2006), to enter in a foreign market (Greul et al., 2018; Harhoff et al., 2014), subcontract the licensor (Azzam et al., 2017; Gassmann & Enkel, 2004).

Table 15 Inbound Open Innovation motives

Motive	Author
Access to a new invention	(Gassmann et al., 2018; Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994)
Blocking rivals	(Grimpe & Hussinger, 2008; Holgersson & Granstrand, 2017)
Access to complementary technology	(Gassmann et al., 2018; Gassmann & Enkel, 2004; Spithoven et al., 2013) (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016)
Increase the portfolio	(Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016)
Cross-licensing	(Davis, 2008)
Reduce cost	(Gassmann et al., 2018; Gassmann & Enkel, 2004)
Reduce time to market	(Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994)
Have access to an already approved technology	(Chesbrough & Crowther, 2006)
Enter in a new (or foreign) market	(Greul et al., 2018; Harhoff et al., 2014)
Subcontract the licensor	(Azzam et al., 2017; Gassmann & Enkel, 2004)

In the below section, we have tried to explain those motives which enhance the inbound Open Innovation adoption by the companies

Access to a new invention

Taking the study of Gassmann et al. (2018), the authors show that licensing-in is the preferable way for the companies to reduce the uncertainty of a new invention and give access to a new invention easily (Gassmann et al., 2018) also acquire new knowledge (Van De Vrande, de Jong, et al., 2009)

Blocking rivals

Blocking rivals is one of the most current motivations used by companies. When a company decides to share or sell knowledge or technology, there is a risk that the partner company will create and patent a similar technology, which will block the patentee company. Therefore, companies may use patenting technology to block competitors from certain technology areas (Holgersson & Granstrand, 2017). The same reason can also be a motivation factor for inbound Open Innovation for the buyer company to block rivals and to have unique access to a certain specific technology area (Grimpe & Hussinger, 2008; Holgersson & Granstrand, 2017).

Access to complementary technology

Previous research shows that research cooperation has a positive impact on companies to access to complementary technologies (Caviggioli & Ughetto, 2013; Gassmann et al., 2018; Gassmann & Enkel, 2004; Lichtenthaler, 2010; Spithoven et al., 2013; Toma et al., 2016). For this purpose, Gassmann (2018) put evidence in their pharmaceutical industry research that inbound licensing is a common tool to fill the gap in the company's development pipeline. The author argues that inbound licensing is a tool that creates a win-win equilibrium, where the license seller company generates revenue that they use to finance further research. On the other hand, the licensor company (and in their research, the licensor companies are the big pharmaceutical companies) is a source of new products that they can add to their portfolio besides in-house R&D and other collaborations such as R&D alliances or M&A agreements. The author also put in evidence that the inbound licensing, besides reducing the time-to-market, licensing late stage research which is not yet presented in the market and will be finished with inhouse R&D, and a positive effect on return-on-investment, also provides a complementary technology to the in-house R&D projects (Gassmann et al., 2018, p. 91)

Increase the patent portfolio

Licensing-in enriches or complements the patent portfolio of the company as well. Inbound licensing or patenting is the safest way to create or increase a patent or license portfolio. Again, Gassman (2018) put in evidence that the companies are using inbound licensing is also a tool to expand the patent portfolio without having any risk of failing in the research and without a research cost of new drug development with in-house R&D (Flor et al., 2021, p. 3; Gassmann et al., 2018, p. 91).

Cross-licensing

Cross-licensing is a tool where companies use their licenses as an exchange tool with other companies. Ayerbe et al. (2010) explain that cross-licensing is a tool in Open Innovation used in extreme cases where companies feel threatened and blocked by a concurrent company. In that case, both companies use their patent portfolio as an exchange tool to regain the steady state position in the business (Ayerbe & Chanal, 2010, p. 11). The AT&T cross-licensing agreements between 1940-1984 can be considered as an example. Since AT&T has a monopolistic position in the telecommunication industry and has key patents, the company started to use their patents in cross-licensing agreements when the first semiconductor technology appeared with the transition's invention. Therefore, the company realized that other players in the market might also create their own technology to invent-around the existing patents. In that case, AT&T started to use cross-licensing agreements to block the invent-around effect (Grindley & Teece, 1997, p. 13)

Later, the researchers put in evidence that the cross-licensing is not just used in extreme cases as an exchange tool but also it is used to create collaborations to create greater innovation performance (Cheng & Huizingh, 2014, p. 1238).

Reduce the time to market and have access to a proved technology.

Inbound IP acquisition helps companies to gain time to launch new products in the market, as they concurrent do. Accordingly, one motivation factor for inbound Open Innovation adoption is to reduce time to market (Van De Vrande, de Jong, et al., 2009). In the same vein, an early stage licensing-in is preferable for some industries, specifically for pharmaceuticals. As studied by Gassmann et al. (2018), in order to reduce the time-to-market and also to use a substance or a mid-product (a product at the mid-stage of development) which is not discovered internally,

minimize the risk of failure of the initial product which will be developed internally (Chesbrough & Crowther, 2006; Gassmann et al., 2018).

Enter in a foreign market

As in the previous reason, inbound knowledge flow for a company will reduce product failures and increase the time to enter the market. This will increase a company's market position for entering the market (Greul et al., 2018). Companies may also use inbound Open Innovation to adapt their existing products for a new market entry. Harhoff et al. (2014) find evidence that German companies benefit from inbound technology sourcing through R&D collaboration or customer involvement in foreign countries where international German companies work actively. From a panel data analysis of a patent database in the US, the authors find that the German manufacturing firms in the US are using R&D cooperation with suppliers to increase technology sourcing from the host country. Cooperation with competitors also increases productivity for those companies while reducing R&D costs (Harhoff et al., 2014)

Working as a manufacturer for the licensor company

Ayerbe et al. (2017) show that inbound licensing is a part of ecosystem management in the aerospace industry. The authors put in evidence three management activities which constitute the posture of ecosystem management, namely 1) managing knowledge mobility, 2) managing innovation appropriation, and 3) managing relationship stability in order to state the sustainability of the ecosystem. In this framework, patent management is considered a strategy tool that helps sustain and develop the ecosystem. However, the inbound licensing for subcontracting companies around the aerospace firms is considered as a traditional subcontractor-purchaser relationship approach, where the licenses are granted exclusively for the related industrial activities (Azzam et al., 2017).

Cost reduction for R&D expenses

In their study of the pharmaceutical industry, Gasmann et al. (2018) put evidence that one of the inbound motivations of pharmaceutical companies is to reduce R&D expenditures by inbound Open Innovation activities (Gassmann et al., 2018; Spithoven et al., 2013). Reducing the fixed cost of R&D can also help the company to increase their control of R&D budgets (Flor et al., 2021).

3.3. Patent use in Outbound Open Innovation Process

How does the outbound Open Innovation realize? The outbound Open Innovation process involves two phases: 1) Opportunity identification (including the exploration of markets and technologies and assessment of technology portfolio), and 2) external technology transfer, including three sub-steps, namely (1) market and technology exploration, (2) technology portfolio assessment, (3) technology transfer (Aloini et al., 2019; Aloini, Farina, et al., 2017).

The opportunity identification involves exploring the market and existing technologies to find possible applications of the focal firm's technology. The firm seeks to answer some questions to separate their technology from actual use, see the technology itself concretely, and define it as "for sale technology." The questions can be like: What value proposition will be created by our intellectual property? Who can be interested in our intellectual property? What are the needs of our potential customers, and how do they perceive the value? What information do we need, and from whom can we get it? (Newey, 2010, p. 726). The company can solicit formal and informal sources to respond to those questions. The informal sources can be professionals or consulting companies in the field of IP evaluation and commercialization or researchers and scientific networks such as individuals (users, managers, experts), groups of people (peer communities), organizations (associations, universities)(Aloini, Farina, et al., 2017). Besides the informal sources, there are formal information sources for deepening the research. The formal sources can be patent analyses and trend studies (such as S curve or lifecycle trend). It is a valuable approach which provides information on a particular industry or technology for forecasting. Daim (2006) stated that in the early stages of a technology, the number of patents related to this technology will be limited. When the technology reaches a fast-growing period, the patent number will increase and reach a stable level. This trend itself and the patents carry some useful information about the overall technology and its forecasting in the long run (Daim et al., 2006). The lifecycle trend of the technology enables the decision to invest in the technology (Jones et al., 2001). Similarly, the S-curve of technology analysis gives a similar insight for investment decisions. In addition, data mining consists of an information database providing reliable information (Aloini, Farina, et al., 2017).

The company need to set a commercial value to their patent portfolio. The objective of this step is to establish a way for technology transfer. Innovation characteristics, the buyer

characteristics such as their bargaining power or legal aspects, can influence the assessment of the portfolio (Aloini, Farina, et al., 2017). Once the assessment occurs, the company can proceed to the technology transfer phase.

In this step, the company can either sell all the rights of the technology by transferring the ownership or they can only give the right to use it. The ownership transfer consists of all types of business transactions without any restriction of use, whereas the transfer of the right to use consists of a limited right to use the assets such as licensing agreements (Aloini, Farina, et al., 2017, p. 30).

3.3.1. Patent selling and licensing-out in Outbound Open Innovation

We find two ways of external commercialization of technology and technological knowledge in the literature: formal and informal. The formal commercialization of technology can be done in three ways: 1) In the form of collaboration as joint ventures or strategic alliances 2) Commercializing the IP in two ways: licensing out the technology or selling patents, 3) Selling some units of the company as divestment, including the technological knowledge inside

On the other hand, informal commercialization or knowledge leakage can be realized by the firms' employees (Lichtenthaler, 2005). According to von Hippel (1987) and Schrader (1991), knowledge transfer by employees can be profitable if the employees respect what to exchange (Schrader, 1991, p. 5; von Hippel, 1987, p. 300). The informal knowledge transfer is a preferable solution when the knowledge exists in some member of the trading network, and the value of the traded module is relatively small to be a subject of licensing activity (von Hippel, 1987, p. 300).

However, as Gopalakrishnan (2004) advocated in their study, technology and knowledge transfer have significant differences. The authors associate those differences in six dimensions respectively: 1) The construct: The construct of technology transfer is narrow and specific compared to knowledge transfer, which has a broader construct. Technology transfer can be considered a specific tool for changing the environment. In contrast, knowledge transfer generally leans on cause and effect relationships. 2) Observability: Technology transfer remains tangible and precise, while knowledge transfer remains less tangible and vague. 3) Overarching characteristics: Technology transfer is codified and includes explicit knowledge which's purpose is to be used as a blueprint or manual, whereas knowledge transfer remains more individual and requires learning by doing. It cannot be stored for general use because it

is saved in the knowledge owner's head. 4) Management phase of most consequence: Technology transfer is done in the post-competitive phase of developing new technology. The knowledge transfer requires management during the pre- and post-competitive phases. 5) Organizational learning: Technology transfer includes controlled experiments and simulations, and knowledge transfer relies on trials and errors. 6) Nature of interactions: In the technology transfer, the organizational interactions (both inter and intra) are subject to operational issues, while knowledge transfer is subject to strategic issues or trying to find responses to the questions "how things work the way they do" (Gopalakrishnan & Santoro, 2004, pp. 58–59). In light of this comparison, we find it useful to remind our reader that our research is subject to technology transfer modes rather than knowledge transfer. This is why we will focus on the formal commercialization forms of technology.

When the outbound Open Innovation concerns the "exploitation" of technology outside the company, one should remember that externalising the technology does not always bring financial revenue in the short term. In a wide literature review on Open Innovation activities, Dahlander et al. (2010) reveal an important difference between Open Innovation modes regarding financial return, namely, pecuniary and non-pecuniary. The main pecuniary activities can be cited as IP licensing or patent selling (Lichtenthaler, 2005, 2009b), spin-off companies which are created to commercialize one or more discoveries outside the main business of the firm (Chesbrough, 2003b, p. 404), corporate business incubation or venture capital to invest and capture value from new start-up, and divestment of a part of the company to capture value (Lichtenthaler, 2005). Some non-pecuniary activities are joint venture activities, participation in standardization, donation to non-profit organizations, strategic alliances, patent pools and cross-licensing.

In our research, we will focus on one specific pecuniary activity, IP commercialization, and we will give a detailed review of this forms of commercialization in the next chapter of our research.

3.3.2. Motives for Outbound Open Innovation

Outbound Open Innovation is defined as outward technology transfer. It suggests an active external technology commercialisation of technology or technological knowledge in two ways: exclusively commercialising or commercialising in addition to the internal application (Lichtenthaler, 2009b). In the literature, there are different explanations of driving forces and

objectives (Gassmann & Enkel, 2004; Lichtenthaler, 2005), methods (Fosfuri, 2006; Lichtenthaler & Ernst, 2009), or modes (Masucci et al., 2020) of outbound Open Innovation Masucci et al. (2020) gather the strategic objectives of outbound Open Innovation as follows; IP sharing, Free/selective revealing, Technology licensing-out and open collaboration platforms (Masucci et al., 2020, pp. 2–3)

The outbound Open Innovation allows companies to determine used, unused and under-used ideas or assets and allows sending outside the company, either by selling or revealing the knowledge or the technology. Chesbrough defines outbound Open Innovation as *looking for external organizations with business models better suited to commercialise a given technology rather than relying entirely on internal paths to the market* (Chesbrough & Crowther, 2006). Outbound Open Innovation is the inside-out process the *knowledge exploitation*. *External knowledge exploitation* refers to the commercialisation of technological knowledge (Brunswick & Chesbrough, 2018; Lichtenthaler, 2011). Reciprocally, outsiders profit from this knowledge according to their needs and their business model (Chesbrough & Bogers, 2014). A company may decide to commercialise its technology for different reasons. In his empirical research, Lichtenthaler (2005) emphasize two basic driving forces of external commercialisation: 1) the knowledge push effect and 2) the market pull effect. When the technological product components' life cycles get shorter and the competition in the market increases, companies prefer to commercialise their technology externally in order to capture value before the end of the lifecycle of the technology. Most of the time, external commercialisation is also influenced positively by the strong IPR regimes in the country. Another reason is the increase in private venture capital numbers. Venture capital is a facilitator factor for corporate researchers to create their start-ups if they leave their company. In the same vein, when corporate researchers have a discovery that cannot be valued inside the company, exploitation outside the company becomes a good option for those willing to exit and form a new company. At that point, venture capital companies are the potential investors for the new and unused discovery. We should add that not only do venture capital firms promote the spin-off effect, but the large company also can promote the spin-off of researchers by venturing them (Van De Vrande, de Jong et al., 2009, p. 424). Finally, the legal protection of IP promotes companies for patenting (Chesbrough, 2003c; Lichtenthaler, 2005).

Besides the push and pull factors, the firms prefer to use outbound Open Innovation for monetary and strategic objectives. We can cite the main objectives of outbound Open

Innovation as follows: Generating revenues, having knowledge access to other companies by outsourcing (both acquisition of know-how and licensing of technologies of a second party (Gassmann & Enkel, 2004)), setting industry standards, profiting from patent infringements, realising learning effects and having the freedom to operate in the market (Gassmann & Enkel, 2004; Lichtenthaler, 2005).

Generating revenues is the most important financial aspect of outbound activities. Outbound activities, in the same (Koruna, 2004, p. 244) or in different industries (cross industries like in the example of Viagra -Pfizer or Botox- Pfizer, which merged with Allergan, who initially holding the Botox formula) can increase the revenues drastically (Gassmann & Enkel, 2004). On the other hand, when outbound activities occur in the same industry, such as licensing out, the decision of a firm depends on the profit-dissipation effect and the anticipated revenue from this transaction (Fosfuri, 2006). This transaction generates additional revenue for the firm; however, it can create a diminution of the current revenues if the licensed technology is used by competitors product in the same market. As emphasised by (Lichtenthaler and Ernst, 2007), they were searching for the reputation effect on the licensing-out, and they found evidence that companies which build a strong reputation as a “knowledge provider” in the market can dramatically enhance both financial and strategic performance. Accordingly, licensing-out for this type of company is not a revenue-reducing obstacle. On the contrary, it increases the revenue and supports profit from IP in other ways like licensing payments. This way, companies can set industry standards by licensing their technology to competitors and can have the liberty to focus on other activities and research in different fields. However, (Brunswick & Chesbrough, 2018) stated that large firms are willing to keep control of their licenced IP around 65% of the licenced portfolio, which explains the companies’ willingness to guarantee their leadership in the market.

The patent infringements can also be considered a second way of generating financial revenues from external commercialisation. However, companies generally prefer to use this as an opportunity to access other firms’ patent portfolios or force them to make licensing agreements. Koruna (2004) defines patent infringements as a defensive aspect of external commercialisation (Koruna, 2004, p. 243). Chesbrough (2003) emphasises that companies prefer to settle licensing, cross-licensing or a royalty payment demand instead of litigation. This way, the company can generate access to the patent portfolio of the infringer company (Chesbrough, 2003c).

Having knowledge and access to other companies and outsourcing bring benefits to the company. In the example of DaimlerChrysler, outsourcing of varnishing of their cars offers the advantage of benefiting from the latest chemical/ varnishing technology of BASF at that time (Gassmann & Enkel, 2004). In the same vein, cross-licensing may be the only way to access other companies' IP portfolios (Grindley & Teece, 1997).

Industry standard setting by licensing is an important motive for companies to adopt outbound Open Innovation. Technology standards refer to a solution which the industry's key players accept as a "de-facto" problem solving solution to a particular problem. Usually, these standards are related to the dominant design, but a company can also attempt to influence those standards, specifically when related to their technology. Companies can shape standards by licensing technology to companies in the same field, even to competitors. By doing this, they gain the power to create their own technology standard by technology transfer to other firms (Lichtenthaler, 2012, p. 852). This way, the company can guarantee its product commercialisation (Lichtenthaler, 2005).

Realising learning effects can occur when the external commercialisation has a return from the other party. More specifically, if it is a joint venture or a cross-licensing, the recipient company may develop an idea to improve the technology. However, if the sender company doesn't have the necessary absorptive capacity to process and learn from this feedback, the learning effect cannot be realised (Koruna, 2004).

Having the freedom to operate concerns a specific cross-licensing agreement that uses the IPR as a bargaining chip without any technology transfer (Lichtenthaler, 2005). As Koruna (2004) emphasised, this is also a defensive motive of outbound Open Innovation (Koruna, 2004). Companies which are willing to protect their large patent portfolio prefer to use such agreements in order to protect themselves (e.g.: semiconductors, electronics) (Grindley & Teece, 1997)

The literature put in evidence that the importance of those objectives may change according to the business model or market conditions (Brunswicker & Chesbrough, 2018; Chesbrough & Brunswicker, 2013; Lichtenthaler, 2007) however, they remain the same in every condition.

Table 16 Outbound Open Innovation motives

Motive	Author
Stop related activity	(Caviggioli & Ughetto, 2013; Monk, 2009; Zuniga & Guellec, 2009)
Acquiring a new company and selling unused patents	(Caviggioli & Ughetto, 2013; Monk, 2009)
Strategy (BM)	(Caviggioli & Ughetto, 2013; Kutvonen, 2011)
Make money	(Gassmann & Enkel, 2004; Lichtenthaler, 2007; Zuniga & Guellec, 2009)
Increase reputation	(Lichtenthaler, 2007; Lichtenthaler & Ernst, 2007; Van De Vrande, de Jong, et al., 2009)
Cross-licensing	(Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009)
Creating alliances	(Kutvonen, 2011),
Standard setting	(Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009)
Subcontractor	(Gassmann & Enkel, 2004),
Blocking rivals	(Bianchi et al., 2014; Caviggioli & Ughetto, 2013)
Access to a new market	(Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007)
Strategy	(Kutvonen, 2011)

In the below section, we have tried to explain those motives which enhance the outbound Open Innovation adoption by the companies

Stop related activity

Considered as a firm-specific reason if a company abandon a certain research trajectory or decides to stop the production of a product or in a specific industry. As an example, while Siemens decided to stop their phone production and retreat from the mobile phone market, they decided to sell more than 1000 patents to BenQ (Caviggioli & Ughetto, 2013)

They may consider to sell them in order to reduce the patent costs and also to create an additional revenue.

Acquiring a new company and selling unused patents

Phene et al. put evidence that companies prefer to accelerate their core competencies and innovate cumulatively. Accordingly, exploitation of the patent portfolio of the acquired firm is the most common behaviour of the acquirer companies (Phene et al., 2012).

Part of our strategy (BM)

Outbound licensing may also be seen as a company strategy for some companies. Granstrand et al. (1992) put in evidence that with the rapidly changing technology and internationalisation of the companies, both by exploration and implementation in foreign countries, the need for external knowledge acquisition became important for the companies to catch up with the recent technology. Again, in the late 1980's, the technology acquisition flow was from Japan through eastern countries. The increase in this demand created a natural offer from innovator companies, and the technology acquisition became a part of the companies' business strategy (Granstrand et al., 1992). In progress in time, the technology exploitation increased and became a business strategy as well. Lichtenthaler (2006) define it as a “keep or sell” decision which enables the company to set the objectives and organization of technology exploitation activities, regulate the timing, and search for potential customers (Lichtenthaler & Ernst, 2006). Not only pecuniary but also non-pecuniary exploitation also can be a part of the company's business model (Lichtenthaler, 2008b). However, some companies, either because of their limited production capacity or other obstacles that don't allow the internal exploitation of the invention (Lichtenthaler & Ernst, 2009), choose to generate an important part of their profits from technology exploitation, specifically licensing their patents. Hence, those companies are considered as companies which are using outbound Open Innovation as a core business model (Kutvonen, 2011).

Additional revenue

The first opportunity when thinking about outbound Open Innovation is the monetary achievement that a company can make in the first place. Then, the other strategic opportunities come (Lichtenthaler, 2009b).

Gassmann et Enkel (2004) define this as commercialising ideas in different industries. The authors also underline that the inside-out process aims to earn profits by bringing new ideas to the market, commercialising the IP and transferring new ideas (Gassmann & Enkel, 2004, pp. 6–10). This can quickly increase revenues (Gassmann & Enkel, 2004; Koruna, 2004; Van De Vrande, de Jong, et al., 2009). Therefore, making additional profits is an important driver for the outbound Open Innovation process.

Increase reputation

The outbound open innovation process is also an important show-up for the licensee company while the reputation is in question. First, outbound licensing may help the company increase

its reputation in the market as a *technology provider*. Second, its licenced technology can create a well-known company image in the market. This can also create a facilitator for further licencing agreements with the same or with new companies (Lichtenthaler & Ernst, 2007; Mandard, 2018; Van De Vrande, de Jong, et al., 2009).

Cross-licensing and creating alliances

Companies prefer to exploit their IP to generate revenues and guarantee freedom to operate by creating cross-licensing agreements with other companies or organizations (Koruna, 2004; Van De Vrande, de Jong, et al., 2009). More specifically, in some industries where the product has multiple patentable technologies, it is sometimes difficult to identify if the company is threatening some other companies' patents. In such cases, mostly in the semiconductor industry, companies prefer to cross-licence their invention to create a freedom to operate in the market without infringing others' patents and protect their technology from competitors (Koruna, 2004).

Cross-licensing is also a way to create strategic alliances with companies (Kutvonen, 2011). Besides previous advantages, strategic alliances increase the company's learning capacities and innovation capabilities. Koruna (2004) put in evidence that, with a high absorptive capacity, companies use alliances to speed up their mutual R&D learning abilities. More specifically, when a company shares their knowledge with a partner, preferably with a high absorptive capacity, it will be quickly absorbed. Yet, when used inside the company, it will transform and become new knowledge. In that case, if the initial company employees will be able to absorb this new knowledge created by the second (receiver) company, then the alliances will increase and speed up the R&D capacities of the knowledge sender company (Koruna, 2004).

Standard setting

One of the adoption reasons for the outbound Open Innovation model is to set the industry standard in the market and use that power for those companies. For customers and producers, having a standard in the market is important for different reasons. Creating technology standards in the market creates a dominant design and enables networking with other companies (Caviggioli & Ughetto, 2013). Also, standardisation creates interoperability and compatibility in complex technologies such as 5G telecommunication. This also helps the modularisation of the product and the development of complementing products within an ecosystem (Teece, 2018).

On the other hand, standardisation is important for the customers. They are seeking a product which will not become incompatible in the short term with emerging standards (Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009). Companies prefer to exploit their IP to generate revenues and guarantee freedom to operate by creating cross-licensing agreements with other companies or organizations (Koruna, 2004; Van De Vrande, de Jong, et al., 2009). More specifically, in some industries where the product has multiple patentable technologies, it is sometimes difficult to identify if the company is threatening some other companies' patents. In such cases, mostly in the semiconductor industry, companies prefer to cross-licence their invention to create a freedom to operate in the market without infringing others' patents and protect their technology from competitors (Koruna, 2004).

Cross-licensing is also a way to create strategic alliances with companies (Kutvonen, 2011). Besides previous advantages, strategic alliances increase the company's learning and innovation capabilities. Koruna (2004) put in evidence that, with a high absorptive capacity, companies use alliances to speed up their mutual R&D learning abilities. More specifically, when a company shares their knowledge with a partner, preferably with a high absorptive capacity, it will be quickly absorbed. Yet, when used inside the company, it will transform and become new knowledge. In that case, if the initial company employees can absorb this new knowledge created by the second (receiver) company, then the alliances will increase and speed up the R&D capacities of the knowledge sender company (Koruna, 2004).

Subcontract the licensee

Supplier integration in the production process may benefit both parts, as Gassman et al. (2004) mentioned. The suppliers' integration by their innovation capabilities for NPD can benefit both parties. First, for the producer, it will increase their know-how as well as innovation capabilities, and for the buyer, it will also reduce the cost of R&D and risk of uncertainty (Gassmann & Enkel, 2004)

Blocking rivals

Licensing its technology can also create a dissuasion effect for the competitors by reducing competition. This is the case of Betamax and VHS, where VHS gave the licenses for free in the domestic market and sold the licenses abroad. By doing so, it has created an environment where its technology became more accessible and dispersed, but at the same time, it blocked its

rival Betamax from increasing its market share (Koruna, 2004; Lichtenthaler, 2012). Licensing is an effective way to protect the business from competitors by maintaining leadership in the market, which also keeps safe from rivals the business (Bianchi et al., 2014).

Access to new markets

The outbound Open Innovation process enables the outbound company to access new areas of knowledge in new markets. As an old example, Botox was initially invented as a nerve toxin, but it finished its journey in the beauty industry and was used as a wrinkle therapy product (Gassmann & Enkel, 2004).

In the same vein, access to new markets is also to have access to new foreign markets. In their research, Lichtenthaler (2007) put in evidence that it is important to have access to new foreign markets when a company chooses to sell or licence their IP (Lichtenthaler, 2007) for creating and using a new market share. Besides, Koruna (2004), in his empirical study, remind us that, outbound licensing and cross-licensing allow licensor company to access external technology and also increase their patent portfolio (Koruna, 2004, p. 243).

3.4. Typology of partners

3.4.1. Type of companies & partner

The literature presents various criteria that companies consider when selecting their partners. In this section of our study, we aim to provide an overview of the existing literature on the decision-making process involved in this aspect.

Patent pool company

Companies may face a “patent thickets” problem, which can be defined as an excessive patenting of companies to protect themselves in the market (Shapiro, 2001). Shapiro (2001) argues that the first solution to overcome a patent thicket problem is the cross-licensing. In this system, companies first negotiate about the partner’s patents and use each other’s patents without royalties and fear of infringements. They license each other their patents. It guarantees both parties to freely use the technology in the same field without having any conflict or a litigation problems. A patent pool is a contract which gathers more than one patent of two or more parties for cross-licensing concerning a specific technology and allows them to license the patents to anyone by a royalty fee (SaiSruthi, 2018; Shapiro, 2001). The patent pool licensing revenues are distributed according to their pre-set contract. The patent pools appeared

in the second half of the 19th century. However, due to antitrust regulations, patent pools declined in the second half of the 20th century. Nevertheless, they rise again with the increase of technological change and needs in the high-tech industry (Bao et al., 2006). Therefore, companies may prefer to license from patent pool, which will be less costly and less complicated for them.

Universities and R&D institutes

The role of universities in the Open Innovation process has been a subject of interest among researchers. In his influential book, Chesbrough (2003) emphasizes the significance of university spin-offs. The author examines the relationship between universities and industries in the early 20th century, particularly in the decentralized university system of the United States. Industries such as mining, farming, and engineering have greatly benefited from the scientific knowledge generated by public universities. This progress can be attributed to two key developments. Firstly, the federal government's establishment of the "land-grant" program provided financial support to state universities, including many of today's top 10 universities. Secondly, the government invested in agriculture, increasing productivity through hybrid seeds, crop rotation, and pest control. Thanks to federal-state funding, universities could invest in engineering disciplines, which played a crucial role in sustaining the economic and scientific standing of the United States during World War 2. After the war, the government continued to engage universities as subcontractor labs, resulting in more college and post-graduate graduates and an overall elevation of societal knowledge. This paved the way for new research labs such as IBM, HP, and Xerox PARC. According to Chesbrough (2003), this period was called the golden age of internal research and development (R&D), characterized by companies investing heavily in their R&D efforts and keeping everything within their organization, also known as the closed innovation model. However, even before World War 2, universities' rise and utilization as external research centres played a crucial role in promoting Open Innovation. Subsequently, the increase in highly educated engineers and private companies further accelerated the adoption of Open Innovation and the collaboration between universities and private enterprises. (Chesbrough, 2003a).

According to a study conducted by Cohen et al. (2002), it was found that public research, particularly universities and government R&D labs, plays a significant role in industrial R&D. The study highlights the crucial role of public research as a source of research and development for the manufacturing industry. The company benefits from various collaboration channels

with universities, including patents and licenses, informal information exchange, publications, meetings, joint or cooperative research, consulting, and temporary personnel exchange. (W. M. Cohen, Nelson, et al., 2002). Similarly, Fu et al. (2016) have presented evidence highlighting the significance of universities and research and development (R&D) institutes as key contributors to company innovation. Their empirical study on Chinese innovation policy demonstrated that government initiatives promoting collaboration with R&D institutes and universities effectively enhance the companies' absorptive and innovation capacities. (Brunswick & Vanhaverbeke, 2015; Fu et al., 2016)

Table 17 University- Industry links

Collaboration type	Collaboration scope
Research partnership	Inter-organizational arrangements for pursuing collaborative R&D
Research services	Activities commissioned by industrial clients including contract research and consulting
Human research transfer	Multi-context learning mechanisms such as training of employees, postgraduate training in industry etc
Informal interaction	Formation of social relationships during conferences etc
Commercialization of IP	Transfer of university generated IP (patents or licenses) to firms
Scientific publications	Use of codified scientific knowledge within industry

Source: (Perkmann & Walsh, 2007)

The potential for collaboration between universities and private companies is a crucial aspect of the research and development (R&D) process. Perkmann et al. (2007) conducted empirical research to categorize the collaborative relationship between universities and industries, providing an extensive overview of the connections between these two entities (Perkmann & Walsh, 2007).

Independent companies and consulting companies

Besides other independent companies, the companies can seek consultancy when doing inbound patenting or inbound licensing. Cohen et al. (2002), in their survey of the manufacturing industry, put in evidence that the companies also solicit consulting companies as information sources (W. M. Cohen, Nelson, et al., 2002). Laursen et al. (2006), when studied how companies search widely and deeply for external knowledge within manufacturing firms in England, put in evidence that besides other sources such as clients, suppliers, R&D labs, or competitors, consulting companies also considered as information sources for external knowledge exploration (Laursen & Salter, 2006).

Since then, the consulting companies' presence has increased in the Open Innovation process. Bianchi et al. (2016) showed the increasing presence of consultants in Open Innovation. A longitudinal analysis between 1999-2007 in Spanish manufacturing firms put into evidence the increasing involvement of consultants during inbound Open Innovation. The authors argue that one of the failing reasons for the R&D collaborations is the problems that companies faced while implementing and managing the collaboration contract. More specifically, opportunistic behaviours like coping with commitments became more visible when the new knowledge was transferred to the focal company. In order to avoid these problems, the informal approach of consultants can ensure that the transferred technology doesn't stay in the contractual parts but also includes tacit knowledge, which will be transferred from the workers' minds to the focal firm by the consultants. Their analysis shows that the consultant involvement increases the inbound Open Innovation performance (Bianchi et al., 2016).

Table 18 Consulting company involvement benefits

Capabilities that are influenced by the involvement of external consultants in R&D activities	Scouting and identifying potential valuable providers of R&D outsourcing services
	Creating a trustworthy relationship with the external contractor
	Effectively negotiating the terms of the R&D outsourcing agreement
	Amplifying the transfer of knowledge during the collaboration with the external contractor, including both tacit and codified aspects

Source: (Bianchi et al., 2016)

Spin-off company

A spin-off company refers to a new organization or the creation of an independent company created by a split from a mother company (Wallin, 2012). Chesbrough (2003) specifies that the technology spin-off company was created for a specific purpose: commercialising technological discoveries outside of the mother company. Also, the author addresses the spillover effect. In other words, the creation of unintended outputs, or new inventions from internal research of the mother company, is the primary source of spin-off companies creation (Chesbrough, 2003b). Hence, the spin-off company creation is considered as outbound Open Innovation by multiple authors and also is seen as important as a license agreement (Brunswick & Chesbrough, 2018; Chesbrough, 2003b; Fu et al., 2016; Gentile-Lüdecke et al., 2020; Lichtenthaler, 2005), and can be considered as a reliable licensor as a partner for the companies in the market.

3.4.2. Selection criteria of partners

We asked to the companies following “partner” criteria while licensing-in and licensing-out

Relevance of the licence seller companies technology and technology level of the firm

While Cassiman et al. (2006) studied the complementarity question between internal R&D and external knowledge acquisition in Belgian manufacturing companies, the authors stress the *make or buy decision*. The authors argue that the *buy* decision is relatively more logical for companies in the same industry which have “*relevant state-of-art technology*” (Cassiman & Veugelers, 2006, p. 77). In other words, for inbound licensing or patenting, companies will be looking for the company's technology level. However, it can be challenging for the licensee company, mostly for foreign technologies. It is not easy to identify the relevant technology, verify its value, and develop a new one relative to the purchased technology (Y. Wang & Li-Ying, 2015). The challenge will remain for local licensing activities because seeking the relevant technology can also create a barrier for the licensor. Fear of losing their competitive advantage or selling a technology which can strengthen the competitor’s market position can create a not sold here attitude in the licensor company (Lichtenthaler & Lichtenthaler, 2010). However, the technology transfer can only be profitable if the transferred technology can be understood and well-placed for use within the licensee’s R&D department. Therefore, the technology level of the company equilibrium is important for the inbound Open Innovation profitability.

Reputation of the company

As mentioned earlier, reputation is an important motivation for companies while outbound licensing or patenting. Companies seek to increase their reputation as technology providers while exploiting their inventions (Lichtenthaler & Ernst, 2007; Van De Vrande, de Jong, et al., 2009). Reciprocally, the reputation of the licensor company plays a role in the licensee company's inbound Open Innovation process.

Reputation is an important factor in the inbound and outbound Open Innovation process. As mentioned earlier, reputation is an important motivation for companies while outbound licensing or patenting. Companies seek to increase their reputation as technology providers while exploiting their inventions (Lichtenthaler & Ernst, 2007; Van De Vrande, de Jong, et al., 2009). While Lichtenthaler et al. (2007) put in evidence the importance of reputation to reduce the uncertainty for the inbound licensor, Barchi et al.,(2018) put in evidence from a large

literature review the importance of trust while creating alliances. The authors put in evidence the importance of trust while creating alliances. Accordingly, one of the important tool for companies to have an opinion about the potential partner is the “second-hand” experiences of other firms, in other words, the reputation of the counterparts (Barchi & Greco, 2018, p. 360).

Potential R&D collaboration

Inbound Open Innovation, in our case, inbound licensing or patenting, may create opportunities for the companies to know the partner company and may create opportunities to start R&D collaboration. In order to see the effects of licensing-in on Chinese companies, Wang et al. (2013) focused on the Chinese companies' inbound licensing activities. In their research, the authors focused on the learning and relational effect of inbound licensing. They show that inbound licensing has several positive effects on licensee firms. First, the licensee company increase their knowledge, according to their absorptive capacity level, and learns how to solve new problems. The authors call it “learning-by-using” effect. Second, generally, the licensed technology requires R&D effort, which pushes the company to recruit new engineers or adapt their licensed technology to its own application line. Therefore, the authors consider inbound licensing as a tool which promotes local capabilities. Third, the licensed technology increases the knowledge capacity of the company and allows the licensee to find new combinations of the existing and new knowledge. The fourth effect of inbound licensing in emerging countries is the “learning-by-connecting” effect. The authors stressed the licensing agreement, which can be seen as a long-term relationship formation between licensor and licensee, which also can be a potential R&D collaboration. During the licensing agreement terms, the licensee will also have access to the tacit knowledge of the licensor company and can increase their knowledge about the using channels of the licensed technology such as developing manufacturing and marketing of the new product. Both parties will share time and exchange this during regular meetings and will exchange this knowledge (Y. Wang et al., 2013; Y. Wang & Li-ying, 2015).

Outbound licensing or patenting is also a way to create the first relationship experience with the partner company. Same as the previous section, companies learn by experience, and the uncertainty in the market changes or partners are important hindering factors for collaboration (Sampson, 2005).

Transactional cost

The transaction cost of the license is an important factor in the licensing agreement's success. Fosfuri (2006) argues that the licensing decision is related to transaction cost theory. According to this theory, in ceteris paribus conditions, from the licensor's side, the licensing is intended to capture a direct value from the company's intellectual assets. If it is not only for strategic reasons, like using market standards, the licensing decision is highly related to the licensor's profit dissipation and revenue effects (Arora, 2003). The profit dissipation effect is the diminution of the licensor's profit, related to the creation of new competitors in the market because of the licensing. The revenue effect is the revenues that licensor generates from their licenses (Fosfuri, 2006). From the licensee's side, the licensing has other costs that should be considered. The transaction cost is related to the searching and negotiating. Therefore, the search cost of inbound licensing decreases when companies have previous inbound activity. Those companies are more open to inbound licensing because of the learning effect (Cassiman & Valentini, 2016). However, the negotiation and the opportunistic behaviour of the licensor firm remain an important issue for the licensee company (Arora & Gambardella, 2010).

The patent citation considered as a value indicator of a patent

Patent citations define the citations of other patents referred to a patent. The citation can be backward or forward. The backward citations refer to the earlier patents or applications cited in the patent. The forward citation refers to the later patent filings of applications affected by the patent in question (Oldham, 2022). In other words, a backward citation is the information about the technological antecedents of the invention, and the forward citation is the citation received by the new invention means that the new invention is the descendant of the cited patent. Therefore, the patent citation is a useful indicator to tell the nature of the invention, the antecedents and the novelty of the invention. It is also a tool that can give the patent's technological impact and economic value (Jaffe & De Rassenfosse, 2017).

As an example, Blind et al. (2009) used the patent citation analysis in order to find the strategic motives of patenting and the influence of this on the patent portfolio of the companies. The authors conducted database research from German companies' patent portfolios to understand their patenting strategies. Their research showed that the patent portfolio characteristics are an important determinant for companies' further patenting moves, such as offensive or defensive strategies. If the companies keep their patents for defensive purposes in the company, their

patents are very much cited by other patent applicants. If the patent is used for offensive blocking purposes, in that case, the authors find that the patents are used for opposition. Finally, when patents are used for cross-licensing as bargaining chips, neither oppositions nor citations are observed (Blind et al., 2009).

Company affiliation

A survey conducted by Giuri et al. (2007) showed some characteristics of patented inventions and their inventors. The authors searched for the patent's knowledge sources, collaborations, motivations, and economic value in this research. Using the Pat-Val survey data provided by EPO (European Patent Office) from the companies in France, Germany, Italy, Netherlands, Spain, and the UK, the authors studied the inventors' value and characteristics. Their analysis showed that geographical proximity is important for companies to access external knowledge and create clusters. When deepening the analysis of the knowledge exchange promoters, besides the geographical proximity, the authors find that organizational proximity, in other words, company affiliation, has a positive impact on the knowledge exchange. The organizational proximity allows the parties to interact with the people already known in the same organization. The familiarity with the people in the inventor's company became more important when the scientific content of the invention was high (Giuri et al., 2007). Also, it is an important factor which gave the image of a powerful and reliable company. Firstly, the affiliation of a group influence highly its behaviour toward other actors or third parties. It is also an information source for third parties about the likely behaviour of the firm in a network (Gulati, 1998, pp. 296–297).

Market size of the company

The market size of the buyer company may also be an important factor for portfolio managers to understand the dimension of the coverage zone of the potential license. In other words, it's a tool for market research. Kestner et al. (2011) approach to portfolio management and investigate the company's three step decision making processes as follows “*cross-functional collaboration, practices of critical thinking, and market immersion*”. Respectively, cross-functional collaboration combines both formal and informal aspects of collaboration inside the company from different departments. Critical thinking is having a critical approach to the portfolio decision risks. In other words, using factual evidence and working on data before making the final decision. Finally, the market immersion means simply market research

activities, including market size, to understand customer needs and NPD opportunities (Kester et al., 2011, p. 652). Also, licensing competitors in large markets or granting free licences can create a competitive advantage and increase the company's market share (Pitkethly, 2001, p. 439). As an example, VHS, which was technologically inferior to Sony's Betamax at that time, took Sony's leadership in the recording market and became the market leader. The reason why VHS became the leader was their licensing strategy. The company followed a strategy where domestic competitors could have the licenses free, whilst the European competitors had to pay royalties (Koruna, 2004, p. 251), which increase their spread in the market and became the most used type of VCR. Hence, the market size is an important market research information which helps while entering into a partnership with other companies, and understanding the potential size of the use of their licence.

Technology level and absorptive capacity of the company

The firm's technology level and relevant technology follow the price as inbound licensing criteria (Cassiman & Veugelers, 2006; Chesbrough & Crowther, 2006). This means that the companies are seeking the same technology level from the seller, which is in line with the theory that companies in the same industry are more likely to choose the relevant technology from their licensor (Cassiman & Veugelers, 2006)

Van de Vrande (2013) showed the importance of technological capabilities. The author shows that relative technological proximity has a positive effect on innovation performance; however, after a certain level, it reduces the innovation performance (inverted U shape) (Van de Vrande, 2013, p. 611). In other words, the buyer's absorptive capacity is important to adapt the external knowledge to internal needs (Cesaroni, 2004; W. M. Cohen & Levinthal, 1989). When the technology level of the partner is much more important for inbound licensors, it is also important for outbound licensor company in order to maintain a significant level of usage of the exploited technology.

The importance of partner contact activities

Partner contact activities are “activities aiming towards the successful commercialisation of a technology or knowledge asset, either internally or externally, that are performed prior to the actual active commercialisation phase” (Kutvonen et al., 2010). These include preliminary studies on technology viability in commercial terms preceding contact with actual clients, organizational and strategic steps taken to secure successful commercialisation and so forth.

Partner contact activities are also always the responsibility of the technology developer, and for a large part, they are undertaken already during technological development. In the external exploitation process model, some critical activities in the planning, intelligence, and control stages may be understood as partner contact efforts (see Figure 1). Partner contact stage activities seem to play a critical role in the success of external knowledge exploitation. Even though, according to Lichtenthaler (2007b), all process phases are critical to success, in most cases, the determinants of external exploitation success can be found especially in planning, negotiation and control, of which planning and control are partner contact activities.

Furthermore, companies are especially experiencing difficulty handling the planning, intelligence and control phases, all where partner contact activities take place. Acknowledging the importance of Partner contact can significantly boost the success of companies' external knowledge exploitation efforts, ultimately improving their innovation returns and securing possible organizational learning benefits. Possible Partner contact phase activities to respond to the challenges faced by firms include, e.g. involving knowledge brokers and cultivating technology network relationships (intelligence), conducting a careful exploitation of the technology in preparation for the negotiations (planning and negotiation), and integrating exploitation to corporate strategy, to methodically leverage external exploitation of knowledge assets (planning) (Kutvonen et al., 2010). Active engagement in outbound Open Innovation in the Partner contact phase is also found in practice. An example is the bio-pharmaceutical industry, where exploitation efforts may start before the pre-clinical tests (Chiaroni et al., 2009). Also, in the fuzzy front end, Open Innovation practices need not and should not be limited to pursuing short-term monetary benefits. In the modern landscape of innovative competition, knowledge is a highly valuable commodity that can also be leveraged to provide longer-term strategic benefits. Complete integration of the Open Innovation perspective into the technology strategy would entail opening the New Concept Development process in the Fuzzy Front End (Koen et al., 2001). Proactively managing knowledge in and outflows in the earliest phases of product and technology development allows the company to leverage many new strategic options strategically and balance external and internal exploitation optimally. (Kutvonen, 2011).

How to contact partner

- Using commercials for reaching the partner

Commercials can be used as an information diffusion channel for the market (Landry et al., 2013, p. 447). As in the case of P&G's diaper becoming the market leader, the company show their ability in innovation and patented technology (Dodgson et al., 2006). So, the commercials can create a simple but efficient marketing channel for a company's potential outbound portfolio. The companies put in third position the commercials as a marketing tool. Using seminars for reaching the partner

Seminars or conferences are the gathering places of different researchers in a same topic. In the ordinary conditions, R&D workers are generally in touch with their external alter ego's in a formal way, where they cannot share very much, beside formal topics, and sometimes with the rival companies R&D workers (W. M. Cohen et al., 2002). However, seminars create an occasion to chat and exchange for the R&D workers in an informal way. Accordingly, it can create a smooth "marketing" channel (Kutvonen et al., 2010; Landry et al., 2013, p. 447; Laursen & Salter, 2006). According to the companies, the seminars are the second best option for communication of their outbound portfolio

- Hiring new R&D staff for having information

Cassiman et al. (2006) put in evidence that if a company want to be active in the external technology market, they can use different channels, such as licensing, contracting a technology or an advisor for technology, a company can acquire other companies for their technology, or hire new R&D staff (Cassiman & Veugelers, 2006). This, however, will increase the innovation capabilities of a company for outbound innovation. In the same vein, Arora et al. (2016) surveyed 6000 American manufacturing and service sector companies to find the external source of innovations. The author put in evidence that one of the ways of commercialisation the innovation was to invest in new technology specialists with distinctive skills or new equipment (Arora et al., 2016).

- Directly contacting the partner

Entering direct contact with the potential buyer company (Landry et al., 2013, p. 447) or using an intermediate for understanding the potential buyer (F. Hochleitner et al., 2020; Ziegler et al., 2013) are relatively the least options for the companies while communicating outbound Open Innovation possibilities. Using an intermediate or agent is also a way to find a new partner (F. Hochleitner et al., 2020)

Conclusion of Chapter 3

The significant increase in innovation diffusion and intense global competition drive companies to quickly innovate products at a low cost. Intellectual property and patents are crucial for fostering open innovation processes in this context. The exchange of protected intellectual property by patents has facilitated the mobility of technology and knowledge. This section is dedicated to studying patent exploitation in open innovation processes.

The open innovation process reveals three processes: inbound, outbound and coupled (Gassmann & Enkel, 2004). The inbound process is closely related to the exploration of new knowledge amelioration of absorptive capacity (Mortara & Minshall, 2011) by the acquisition of knowledge from external partners such as research centres, suppliers, competitors (Aloini, Lazzarotti, et al., 2017a). The inbound processes include licensing-in and patent (Dahlander & Gann, 2010) and the creation of partnerships with research centres, suppliers, or customers (Mignon et al., 2020). Various methods can be used for knowledge integration, including customer and supplier integration, innovation clusters, and the intensive use of intellectual property for external technology transfer. This study will focus on external technology transfer, specifically the acquisition of patents or licensing-in as forms of intellectual property utilization.

The outbound processes are generally associated with the firm's openness, the commercialization of the company's internal knowledge out of license selling or patent selling activities (Dahlander & Gann, 2010), and joint venture and M&A activities. The company must assign a monetary value to their collection of patents. The primary goal of this stage is to establish a method for technology transfer. Various factors, including the characteristics of innovation and the buyer's attributes, such as their bargaining power or legal considerations, can impact the valuation of the patent portfolio (Aloini, Farina et al., 2017). After completing the assessment process, the company can proceed to the technology transfer phase. During this phase, there are two options available to the company. They can either sell all rights associated with the technology by transferring ownership or grant only a usage right. Ownership transfer encompasses any business transaction without limitations on use while granting usage rights involves limited access through licensing agreements (Aloini, Farina et al., 2017; p.30).

Both inbound and outbound processes facilitate technology transfer in various ways, from external sources to a company or vice versa.

The coupled open innovation is the use of exploration and exploitation activities combining inbound and outbound activities for collaboration with an entity, collaborating mutually, and exchanging the knowledge and commercializing the innovation (Gassmann et al., 2010; Gassmann & Enkel, 2004; Van De Vrande, de Jong, et al., 2009). The coupled processes include joint projects like co-development, co-conception, collaboration for patent pool, and R&D collaborations (Gassmann & Enkel, 2004; Holgersson & Granstrand, 2017; Pénin et al., 2013).

However, companies may have different motivations when engaging in inbound or outbound activities. Specifically, licensing-in or patent acquisition in inbound activities can be driven by aims such as gaining access to new inventions (Gassmann et al., 2018; Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994), creating barriers for competitors (Grimpe & Hussinger, 2008; Holgersson & Granstrand, 2017), acquiring complementary technologies (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016) to enhance their portfolio (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016) for cross-licensing purposes (Davis, 2008), expediting time-to-market strategies (Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994), mitigating uncertainty through utilization of existing technologies (Chesbrough & Crowther, 2006), expanding into foreign markets (Greul et al., 2018; Harhoff et al., 2014) and operating as subcontractors (Azzam et al., 2017; Gassmann & Enkel, 2004) on behalf of the licensor company.

A company may choose to license out their patents for various reasons, such as selling unused patents (Caviggioli & Ughetto, 2013; Monk, 2009; Zuniga & Guellec, 2009), acquiring a new company and selling their excess patents (Caviggioli & Ughetto, 2013; Monk, 2009), generating additional revenue (Gassmann & Enkel, 2004; Lichtenthaler, 2007; Zuniga & Guellec, 2009), implementing a company strategy (Caviggioli & Ughetto, 2013; Kutvonen, 2011), engaging in cross-licensing agreements (Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009), standard setting (Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009), impeding competition from rivals (Bianchi et al., 2014; Caviggioli & Ughetto, 2013), and gaining access to new markets (Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007).

In both procedures, selecting a partner is a crucial decision. Organizations can establish a partnership through consultants (Bianchi et al., 2016) as intermediaries or by directly reaching

out to potential partners. Simultaneously, choosing the right partner holds strategic significance as it can lead to long-term collaborations, enhance knowledge exchange through interaction, or even expand market share by leveraging the partners' network.

However, implementing open innovation is contingent upon various variables, including the permeability of organizational boundaries, practices associated with adopting open innovation, the inflow and outflow of knowledge, and the factors contributing to the successful adoption of open innovation (Gianiodis et al., 2010). In the following chapters, we aim to clarify those elements, the open innovation adoption factors and the open innovation adoption barriers.

Chapter 4 Open Innovation adoption decision

This chapter focuses on exploring the decision-making process of adopting Open Innovation within a company. The literature on open innovation categorizes the factors influencing adoption into two main categories: internal and external factors. In the first sub-chapter (sub-chapter 4.1) we delve into the internal factors that pertain to specific components of a company, including its size, age, organizational structure, corporate culture, level of management involvement in open innovation processes, knowledge exchange capabilities and core competences, geographical position in relation to other companies' technologies, significance of product strategy, patent activity and R&D intensity. Additionally, we also consider the nature of existing technology as well as product complexity and modularity in our study.

In this section, we will discuss the external factors that contribute to the adoption of open innovation, in addition to the internal factors. These external factors encompass environmental considerations, market volatility (also known as market turbulence), the rate of technological change (referred to as technological turbulence), competition levels within the industry, political influences such as government policies, globalization trends, and patent protection standards specific to each country.

In the following sub-chapter (sub-chapter 4.2), we present the barriers that hinder the adoption of open innovation. Similar to the previous section, we examine these barriers from two perspectives: inbound open innovation barriers and outbound open innovation barriers.

The barriers to inbound open innovation can be attributed to several factors. One of these is the "not invented here" syndrome (NIH), which refers to the resistance towards external ideas or technologies. Additionally, negative previous experiences, lack of government incentives, lengthy negotiation times, inability to find suitable technological offerings for the company's needs, and high prices for available technologies can all impede the inbound innovation process.

On the other hand, outbound open innovation also faces its own set of barriers. The "not sold here" syndrome (NSH) is one such obstacle that arises from a reluctance to embrace external innovations for commercialization purposes. Furthermore, complexities surrounding intellectual property rights (IPR) and contracts pose challenges. If the existing technology is not sufficiently developed for sale or if license selling does not align with company strategies,

finding buyers becomes difficult. Inadequate experience in outbound open innovation or past negative experiences can also hinder this process.

4.1. Factors of the Open Innovation adoption decision

In the Open Innovation literature, authors identified the reasons for the implementation of Open Innovation in UK firms (Keupp & Gassmann, 2009), in Swiss firms (Laursen & Salter, 2006), in familial firms (Kotlar et al., 2013), in SMEs (Brunswicker & Vanhaverbeke, 2015; Chanaron & Paper, 2017; Lee et al., 2010; Spithoven et al., 2013; Van De Vrande, de Jong, et al., 2009) in large firms (Brunswicker & Chesbrough, 2018; Chesbrough & Brunswicker, 2013; Minshall et al., 2014; Mortara & Minshall, 2011; Spithoven et al., 2013) in online government services in Germany (Mergel, 2018), in high-tech companies (Chesbrough & Crowther, 2006; Chiesa & Frattini, 2011; Dziurski & Sopińska, 2020). One can say that the barriers to innovation like the lack of information, expertise or willingness to reduce the research investment cost and creating a shortcut to the market by sharing the risk of a new product launch (Mortara & Minshall, 2011), or the increasing labour mobility, abundant venture capital and dispersed knowledge lead (mostly the large companies) to engage alternative innovation practices; in other words, companies are willing to employ both internal and external technologies and knowledge (Van De Vrande, de Jong, et al., 2009).

Previous research shows that Open Innovation is widely adopted in high-tech manufacturing industries, wholesale and retail. The researchers classify high-tech and low-tech industries according to the R&D intensity in the literature. For example, (Kirner et al., 2009) use the classification of industrial R&D expenditure as a benchmark. Accordingly, the low-tech industries are the industries which have a less than 2,5% share of R&D expenditures in turnover, medium-tech industries have an R&D expenditure share which is between a range of 2,5% to 7%, and high-tech industries have more than 7% share of R&D expenditures in turnover. Similar differentiation is used by (Reboud et al., 2014) similarly to the innovation intensity defined by the annual R&D expenditure in turnover. Companies with an annual turnover investment on R&D of less than 5% are classified as low to mid-tech industries, while if it is more than 5%, it is classified as high-tech. In the same vein, OECD has a similar but simpler approach to the classification of high-tech industries which is chosen by direct or indirect R&D expenditure, and by the end product approach as a supplement of R&D

expenditure classification (Hatzichronoglou, 1997) which bring a breakdown of four categories, namely; “1) *High-tech industries: Aircraft and spacecraft, pharmaceuticals, office-accounting and computing machinery, Radio-TV and communications equipment, medical-precision and optical instruments*, 2) *Medium-High-tech industries: electrical machinery and apparatus, Motor vehicles, Chemicals excluding pharmaceuticals, Railroad equipment and transport equipment, Machinery and equipment*, 3) *Medium-Low-tech industries: Building and repairing of ships and boats, Rubber and plastic products, Coke refined petroleum products and nuclear fuel, Other non-metallic mineral products, Basic metals and fabricated metal products*, 4) *Low-tech industries: Manufacturing-Recycling, Wood-pulp-paper products-printing and publishing, Food products-beverages and tobacco, Textiles-textile products-leather and footwear*”(OECD, 2011).

Especially high tech industries are much more intended to adopt OI because of the R&D concentration of this industry (Chesbrough & Brunswicker, 2013; Gianiodis et al., 2010). (Cammarano, Caputo, et al., 2017) review this as a natural result of the innovation management strategies of the company. The technical knowledge evolution of the company will eventually come to a level where Open Innovation responds to their needs (Dodgson et al., 2006). When it comes to the factors facilitating or creating barriers to its adoption, different authors contextualize from different angles and different case studies. Researchers previously studied the Open Innovation adoption factors in 3 main categories: *firm characteristics, technology considerations, and external environmental conditions* (Gassmann & Enkel, 2004; Gianiodis et al., 2010). In order to simplify our approach, we would like to group these factors into two main categories: internal (endogenous) and external (exogenous) factors.

4.1.1. Internal factors

The internal factors are the components of the companies. These components includes demographics and strategies of the firm (Huizingh, 2011; Verbano et al., 2015). Demographics include the number of employees, employee characteristics sales and profits, age, location, market share or ownership type belonging to the firm's internal components. Strategies include strategic orientation, innovation strategy etc of the firm.

The size of the company

The size of the company is the most obvious and attractive characteristic, which has been studied most often in the literature entered by the literature by Schumpeterian hypothesis that

large firms tend to innovate more than smaller ones (Peeters & van Pottelsberghe de la Potterie, 2006). Companies have to transform the opportunities created by technology and the demand to investment in research and development, in other words, innovation. The investment is conditioned by the firm characteristics, among which the literature identifies the internal organization and size of the company as the most important. However, a long debate exists about its impact on the companies' innovation performance. Firstly, the companies have to finance their research activities by themselves, and big companies generally have the necessary funds to finance their R&D activities (W. M. Cohen & Levinthal, 1989). The uncertainty risk of the innovation is much more affordable and not seen at first sight when the firm is big and has enough financial resources compared to a small firm. Secondly, in economies of scale, large R&D departments or laboratories gather different researchers with different specialities. It is much more productive when the laboratories have larger and diversified talents. Third, some inventions that aim to be used for a purpose may have a completely different result, even unexpected, like Coca-Cola, Viagra, Botox or Erythropoietin (EPO). The famous beverage was first produced out of coca leaves and alcohol to treat headaches and relieve anxiety for patients who are suffering from addiction; became the world's most famous brand after having some changes in the recipe (sweetened, carbonated, etc.) (Keyser & Edwards, 2015) so the large companies can find easily other applications to initiate the invention in the market (because of their diversified facilities). Viagra initially aimed to threaten cardiovascular illness, and blood pressure started to be used as a sexual aid, one of its side effects. Initially developed as a nerve toxin, Botox has become an essential product for reducing wrinkles. Finally, Erythropoietin (EPO) is now used in cancer therapy and, as a doping material in cycling, was initially developed as a blood diluent medicine (Gassmann & Enkel, 2004).

Finally, large companies already have a market to easily reflect and finance the R&D costs (Guellec, 2017a). However, there are some controversial arguments in the Open Innovation model, one that we've cited above.

In different cases, the authors find different responses to the size factor ;

For the first argument, the researches show that the bureaucratisation in the big laboratories, with multiple layer hierarchy and a large number of researchers is difficult to manage comparing to a small laboratory of a small firm where the researchers and workers share the responsibility of the companies survival (Guellec, 2017a). In some cases, authors find that small companies with a limited financial and marketing resources can benefit from Open

Innovation by commercialising their intellectual property to other companies in respect to their business model, in order to take benefit from their innovative activities (Dahlander & Gann, 2010; Gassmann & Enkel, 2004; Keupp & Gassmann, 2009; Lee et al., 2010; Spithoven et al., 2013) Small companies, have an advantage over large firms in terms of decision (organizational) flexibility with a less bureaucracy, easy response to the market needs (Guellec, 2017a; Spithoven et al., 2013). However, we cannot generalise this behaviour of SMEs as unique. Some research also unveiled the exploration and inbound activities of SMEs in order to access innovation networks (Gianiodis et al., 2010).

For the second argument, we will remember Chesbrough's citation "not all smart people work for us. We need to work with smart people inside and outside of the company" (Chesbrough, 2003a, p. xxvi). Therefore, even the large companies have the financial flexibility and in some cases, have a monopoly power that gives them the possibility to invest more in internal R&D, and these companies can use their financial resources to explore external knowledge and to invest mostly in inbound activities (Brunswicker & Chesbrough, 2018; Chesbrough & Bogers, 2014; Chesbrough & Brunswicker, 2013; Lichtenthaler, 2009b). When it comes to outbound activities, large companies seem to stay reluctant (Brunswicker & Chesbrough, 2018; Lazzarotti & Manzini, 2009; Verbano et al., 2015). However, Van de vrande (2009) put in evidence that medium enterprises are more likely to adopt both inbound and outbound Open Innovation than small enterprises (Van De Vrande, de Jong, et al., 2009, p. 430) whereas Lichtenthaler argued that the size does not have an important impact on inbound activities (Lichtenthaler, 2008).

According to the research of Greco et al. (2017), where the authors put in evidence the relationship between public subsidies and Open Innovation efficiency, their results show a positive relationship between Open Innovation efficiency and the public subsidy of small firms. In the same vein, national public subsidies and Open Innovation efficiency are positively related for small and medium size enterprises (Greco et al., 2017).

The age

The age of the company is part of its characteristics and is used as a control variable in several researches as the company size (Berchicci, 2013; Brunswicker & Vanhaverbeke, 2015; Hsieh et al., 2016; Michelino et al., 2015). The relationship between age and innovativeness also attracts attention in the literature.

Huergo et al. (2005) first searched for the effect of the company age while introducing innovation. The authors arrive at the conclusion that the probability of the introduction of an innovation varies across industries. The size is an important element which influences the innovation probability. When coming to age, the authors find a nonlinear relation between innovation and age. According to their research, young companies tend to work on process innovation more than the existing (or relatively old) companies in the market. Until 18-20 years in the market, new companies innovate and invest in innovation very much. Firms above intermediate ages (20-36 years in the market) invest in process innovation as much as new entrants but invest more in product innovation than new entrants. Old companies, however, tend to invest less in innovation (Huergo & Jaumandreu, 2004).

While Basol et al. (2005) surveyed software companies, age's effect on organizational effectiveness was tested. The results show that the organizational age positively affects organization size and centralization. The authors explain this relationship as follows: if there is a decrease in organizational effectiveness because of the increasing age of the company, then the company will be obliged to create or find new business opportunities to survive in the market. However, the new business opportunities will also create new hiring in the organization, increasing the company's size. However, centralization depends on managerial decisions. Controlling the degree of centralization depends on managerial control and effectiveness (Basol & Dogerlioglu, 2014).

Nevertheless, in the biotechnology industry, Michelino et al. (2015), in their research on the biopharmaceutical companies' openness degree, but evidence that the younger biotechnology companies are more open than the pharmaceutical companies. The authors also believe this difference may be related to industrial differences but not the age difference (Michelino et al., 2015, p. 22).

However, the researches shows no significant evidence of the importance of age on Open Innovation adoption when it is considered between multi-industry data results (Gassmann & Enkel, 2004; Keupp & Gassmann, 2009).

The organizational structure and corporate culture

The organizational structure and corporate culture are facilitator factors for Open Innovation adoption. The positive effect of corporate culture for change is important in the Open Innovation adoption (Mortara et al., 2010). (Kratzer et al., 2017) synthesise the features of an

innovative culture as follows: 1) Risk feature: early stages of innovation always have a failure risk. The management support to provide risky projects is a part of corporate culture to motivate the employees for innovative activities. 2) Belief feature: Innovation projects require strong beliefs. In this case, management encouragement is also important to feed the company's innovativeness. 3) Exchange and share: The tacit knowledge exchange and sharing is essential for the sustainability of innovative activities in the company. When it is done voluntarily without a management order, it is effective. 4) Governance feature: The company's dedicated councils (or boards) often develop innovation strategies. In the Open Innovation process, these councils must welcome third parties for decision-making, such as experts or external companies. 5) Partner feature: In the Open Innovation process, external resources involvement is inevitable (e.g., researchers, engineers, experts, third parties etc.). This involvement requires a shift in external partner management. 6) Training feature: It is about the HR (human resources department) involvement to educate the employees further. (The results of their research show that the management-encouraging attitude through employees and focusing on a broad range of internal and external knowledge is important). When it is to the realisation of an innovation culture, (Denham & Kaberon, 2012) stated four essential elements of organizational culture: 1) value-driven leadership in order to keep the existing customers attached to the brand (e.g.: P&G's Pampers and Tide (Dodgson et al., 2006)) and to keep the leader position in the market, 2) physical and social environment: using physical environment for the good of the company, 3) talent: Bringing together different skilled persons and create formal/ informal collaboration to share knowledge or experience, 4) transparency and sufficiency of process: Developing a mindset of collaboration.

Gentile-Lüdecke et al. put forward this approach and gathered with the evolutionary theory of organizations to find the impact of the organizational dimensions effect on Open Innovation practice in SMEs. According to this theory, a firm's behaviour depends on firm-related habits or "*routines*" (in Gentile-Lüdecke et al., 2020). Those habits help and guide the organization members while doing their duties. In other words, organizational routines are not only the keys for researchers to understand the dynamics within the organizations, but they are also the unit of analysis that captures change and drivers of an organization at a micro level (Becker et al., 2005, p. 775). Gentile-Lüdecke et al. focus on three dimensions, which are considered key structure dimensions in the literature: formalisation, centralisation, and specialisation. The authors define those concepts as a reminder of the literature as follows:

1) formalisation, which indicates the “*amount of written principles, policies, procedures, and rules for managing business and relations among employees*” (Pertusa-Ortega et al., 2010). It defines the labour standards, written or non-written rules, procedures, or protocols in order to define and regulate employee behaviour (Caruana et al. 1998 in Gentile-Lüdecke et al., 2020)

2) centralisation is “*the concentration of decision-making authority, either a person or a department in an organization*” (Schminke et al., 2002) in (Basol & Dogerlioglu, 2014, p. 4), and

3) specialisation is “*the division and distribution of organizational assignments into small pieces of work*” (Mintzberg, 1989 in Basol & Dogerlioglu, 2014, p. 5). Specialisation can reduce hesitation

And increase the investment in knowledge according to evolutionary theory (Gentile-Lüdecke et al., 2020)

The authors surveyed the senior manager level of 156 companies in different industries but SMEs in China. Their research shows that specialization and centralization positively relate to inbound and outbound Open Innovation activities. On the other hand, formalization is positively related to inbound activities but negatively related to outbound activities in China. In other words, the results indicate that organizational structure may facilitate Open Innovation activities such as formalization and specialization, reducing hesitation and uncertainty and increasing knowledge. On the other hand, while considering the centralization, the CEO influence in the SMEs is significant in this research area. This shows the importance of decision-making by a central authority (the CEO), which pushes the organization for Open Innovation practice (Gentile-Lüdecke et al., 2020).

The management involvement

The management involvement in the Open Innovation process has a significant effect to avoid barriers through Open Innovation implementation, especially on not invented here syndrome (NIH). A clear communication with the Open Innovation process participants (employees, engineers, different departments e.g. marketing, quality control, production etc) has a positive effect on Open Innovation implementation. In this process, organizational structures play an intermediary communication role between the individuals and contribute to the implementation process by dramatically avoiding the possible barriers created by participants (Lichtenthaler & Ernst, 2006).

Barlatier et al. (2010) study the difference between bottom-up and to-down approaches in Open Innovation implementation process with case studies. (Barlatier & Dupouët, 2010)

The knowledge exchange capabilities

The knowledge exchange capabilities are an important factor for Open Innovation adoption. (Dodgson et al., 2006) shows how information and communication technologies facilitate knowledge exchange within the firm and how they can contribute to Open Innovation adoption. In this study, the authors put into evidence the conception and development of P&G's *Organisation 2005* growth strategy through the stimulation of internal innovation. To do that, P&G mobilised a new strategy to improve communication within the firm and with external collaborators. It is a part of the company's organizational culture that the top management wants to improve. They called the "Connect and Develop" (C&D) department their R&D, which emphasised the aim of knowledge exchange and connection. Also, during the expo *Innovation 2000*, P&G introduced 5000 of its researchers and invited its employees and external suppliers to contribute via cell phones (this latter is done by P&G again). As a result, the increase in knowledge exchange capabilities created a positive effect on the Open Innovation practice of the company, collecting around 2200 new ideas, which return to the innovation of new products.

The core competencies

The core competencies are important for Open Innovation adoption. Prahalad and Hamel liken the corporation to a large tree, and the core competencies are the nourishing sources of this system. "*The trunk and major limbs are core products; the smaller branches are business units; the leaves, flowers, and fruit are end products. The core competence is the root system that provides nourishment, sustenance, and stability. You can miss the strength of competitors by looking only at their end products, in the same way you miss the strength of a tree if you look only at its leaves*"(Prahalad & Hamel, 1990). They define core competencies as: 1) A collective learning process which provides the knowledge of coordination and integration of different production skills (Sony's core competence is to minimise the components for their products. To do that, Sony must provide a common language and understanding of engineers and R&D workers with the customers and customer needs) , 2) A communication skill which requires to work across organizational boundaries, involving different levels of people (involving different parties like universities or research institutes without having a major

impact on the business) 3) An asset which has to be nurtured and protected by new knowledge but never deteriorate over time like physical assets, 4) As a glue which binds existing business and a catalyser for new business areas. In other words, if a company give up its core competencies , like 3M invested in adhesives and coatings, which constitute their core competencies, instead of perceiving these components, their products know 3M as “scotch, post-it” (Prahalad & Hamel, 1990). The in-house core competency development is important for the continuity of the business. If we take Chrysler, they gave up one of core competencies, the engine and power train production. They started to outsource from Hyundai and Mitsubishi during 1985-87, and they became dependent on its suppliers. From the point of view of the suppliers, it was fruitful because this alliance created a learning opportunity for the South Korean and Japanese companies. However, it also put Chrysler in a risky position in some ways: 1) it gives the suppliers the possibility to become a competitor if they decided to enter the market or if the technology undergoes a radical innovation because Chrysler already reduced its engine production line, 2) Outsourcing a core product which is used to produce end product, reduce the know-how of this component progressively (Prahalad & Hamel, 1990). Even the Chrysler example remains marginal, the increasing technological opportunities promote the companies to use external sources in parallel to their core competencies. Large companies (Prahalad & Hamel, 1990) use their core competencies as a sort of absorptive capacity that permits coordination and benefit from external knowledge (Christensen, 2006).

The geographical area

The geographical area is a facilitator factor of Open Innovation adoption. Guellec (2017) state that “(the) innovation activities are geographically concentrated (and) they are more concentrated than production activities. Some cities, and regions are more innovative than others, such as Silicon Valley near Stanford University or specialized regions like Toulouse in aeronautics and Grenoble in electronics and nanotechnology” and also asks what factors explain this geographical specialization (Guellec, 2017b, p. 51). Several studies show that geographical proximity positively affects collaboration, in and outbound Open Innovation practices (Kapetaniou & Lee, 2019; Liu, 2012; Triguero & Fernández, 2018). According to the Oslo Manuel, the spatial and locational factors “define the firm’s jurisdictional location and its proximity to product and labour markets. These factors can influence costs and awareness of consumer demand.” (OECD, 2019a), and the geographical proximity in a very analytical and restricted meaning of the word, refers to “the spatial or physical distance between economic

actors”(Boschma, 2005). Consequently, while the short distances bring people together and facilitate the tacit knowledge exchange, the long distance between these economic agents makes it difficult to exchange tacit knowledge face to face (Boschma, 2005; Harhoff et al., 2014). The proximity can promote knowledge transfer by facilitating the face-to-face contacts. Personal contact is particularly important when it is a question of stability of an environment where the information is quickly changing, imperfect and not easily codified(Liu, 2012). Some empirical studies emphasize also the existence of a geographical concentration of innovative activities; We can give a company-university proximity example and for that, Chesbrough’s PARC study will be highly explicative as the very much proximity to Stanford University and Palo Alto Research Center of Xerox company (Chesbrough, 2003a). The long distance of a knowledge source may force the companies to create a local presence in the proximity of this source such as R&D centres in different counties of Huawei Corp (Mitkova & Wang, 2015). In order to resume the factors which may affect on the importance of geographical proximity, we would like to call Guellec’s (2017) approach again. The author explains the advantages related to the geographical proximity (which the author calls “agglomeration advantages”) in two fold; 1) First fold is based on common infrastructures which facilitate the scientific research such as proximity to R&D centres or special tools (particle accelerators), hospitals for clinical researches, or large companies (STMicroelectronics) and also soft infrastructures such as venture capitals, financial or legal consultancy companies etc.; which require a high cost of investment, and cannot be separated from this cost. These infrastructures create a spin-off effect in terms of creation of new companies and new ideas. This first fold attracts the innovators by nature. 2) The second fold is composed of the knowledge externalities; the formal (in conferences, collaborations etc) or informal (socializations, random meetings etc) interactions between scientists increase the possibilities of new idea creations. Then, the knowledge exchange via electronic data exchange, internet, database access, online meetings, or some travel so the exchange is not always dependent on proximity directly. However, the proximity provides a social proximity which fosters trust and increases the density and quality of communication (Balland et al., 2015).

The familiarity with other firm’s technology

Familiarity with other firm’s technology facilitates the external knowledge learning and adaptation process. In the literature, this process is observed mostly in M&A activities(Gulati, 1995; Higgins & Rodriguez, 2006). In his seminal work Gulati discusses the differentiation

reason between repeated alliances on one-time alliances. The author argues that the reason and the consequence of the repeated alliances between the same companies is relying on the *interfirm trust* established during the time and the repeated alliances, where the author borrows the definition of the term “trust” from Bradach and Eccles (1989) as follows; “*a type of expectation that alleviates the fear that one’s exchange partner will act opportunistically*”(Gulati, 1995, p. 91). The interfirm trust requires reciprocal loyalty, facilitating future alliance realisation between the same companies. The author also continues by studying different types of trust-based contracts such as relational contracting, obligational contracting, value-added partnerships, process-based trust etc and shows that the companies with prior alliance experience, prefer to rely on this experience and continue to work with them, mostly on R&D alliances (Gulati, 1995; Higgins & Rodriguez, 2006; Krishnan et al., 2006). Prior contracts between companies allow both parties to know each other during the research which creates trust and familiarity to rely on for further partnership. (Higgins & Rodriguez, 2006)

The product strategies and the strategy of the firm

The product strategies and strategy are also important factors in Open Innovation adoption. The innovative product range of a company is often a good indicator of understanding the degree of innovativeness of a company. If a product is new to a market, then the perception of it will be more “radical” compared to improved products (Hagedoorn et al., 2018). Hence, the product strategies gain importance while considering the firm’s innovativeness perception. Companies are willing to increase the innovative product range in the eyes of their customers and also in the market. When we think about the importance of product diversification in Open Innovation adoption, we can address it (Lichtenthaler, 2008). In his research, the author addressed more than 150 middle and large firms and questioned the two Open Innovation practices of technology transaction, namely, exploration and exploitation. He found 6 different clusters starting from “close innovation” practitioners to “open innovators”. The author classified the participant middle and large companies into six clusters as follows: 1) Closed innovators have very limited external acquisition and exploitation levels with a high level of internal R&D that those companies can be considered as closed innovators. 2) Closed innovators – type2* (the author also gave the same name to this cluster. We suggest adding -type2* as a diversification between these two clusters); these companies are more or less the same as the first cluster. However, they prefer to acquire a large part of their technology from

external sources. 3) Absorbing innovators have a strong demand for external sources besides do not have the same exploitation level of technology. 4) Desorbing innovators primarily focus on internal technology development and its commercialisation by licensing agreements. 5) Balanced innovators use both licensing and cross-licensing tools to improve their internal knowledge and use this external knowledge in their production. 6) Open innovators have a strong acquisition level of external technology for internal use (production) but do not prefer to apply their knowledge assets for their production process. On the other hand, they have a strong commercialisation of internal knowledge level. Those companies' production processes rely on licensing agreements. The author highlights some of the typologies of those middle and large companies and the importance of product diversification's positive effect on Open Innovation adoption. Companies between the 4th and 6th clusters have a more diversified product range than the average of the participant firms. Product characteristics also positively affect Open Innovation adoption as described previously in the P&G example (Dodgson et al., 2006). Product diversification can be considered a result of technology outsourcing. When a company can increase their R&D level by the intermediary of outsourcing external technology, they can quickly respond to customer needs and wishes. As a result, the company can increase product diversity and enter new markets (Cesaroni, 2004). The product lifecycle is also an important factor for companies who are willing to stay in the game of competition. When the high innovation rate highly influences the product lifecycle in the market, the new product turnover will be high. New and improved products will take the older (compared to the newcomer) products' place. Hence, the sales will decrease. In this case, the producer must continuously innovate to stay in the game. However, the in-house innovation process can be costly in terms of time and R&D investment. External knowledge acquisition can be a shortcut solution to gain time and to adapt itself to the market conditions, and avoiding the “uncertainty” risk of a newly innovated product, by using external knowledge (Chesbrough, 2003a; Chesbrough & Crowther, 2006; Dziurski & Sopińska, 2020; Martinez et al., 2014; Oduro, 2020).

The patent activity and the R&D intensity

The patent activity and the R&D intensity are the two critical factors of our research. R&D activity is generally tracked by R&D expenditure in a company (Chesbrough, 2003a; Dang & Motohashi, 2015; Lichtenthaler, 2009b), and the R&D expenditures are generally used as a proxy for innovation input. The output of the R&D investment, to facilitate the tractability of

this latter, patenting activity (in our case, patent statistics) can measure the output (Dang & Motohashi, 2015; De Noni et al., 2017).

The literature (Lichtenthaler, 2010) emphasized the patent portfolio quality as an important Open Innovation activity decision factor. Those firms are generally willing to acquire or commercialize technological knowledge (Chesbrough, 2003a; Lichtenthaler & Ernst, 2007) and have intense R&D activity. In other words, the corporate patent portfolio constitutes the primary driver of the opening up process of a company's innovation process (Lichtenthaler, 2010). Nonetheless, we cannot presume that all the companies with a high-quality patent portfolio are willing to be present in the technology transaction position. The opening-up decision depends on the firm's choice or, in other words, it depends on its business model, which describes how the company create and captures value (Chesbrough & Rosenbloom, 2002). However, a good quality patent portfolio will facilitate companies' commercializing or acquiring external knowledge. As stated by (Lichtenthaler, 2010) "*opening up (external commercialization or acquisition of technology) will be a requirement rather than an option for companies to keep up with competition*".

When coming to the R&D intensity, we can cite Cohen and Levinthal's calculus for its measurement as "*the ratio of R&D expenditures to total assets (R&D divided by sales (W. Cohen & Levinthal, 1990, p. 138))*" (Kuo et al., 2018). The patent stock is also considered an indicator highly correlated with companies' R&D input (Kuo et al., 2018). The authors tried to find any relationship between the R&D intensity and Open Innovation activities. Laursen et al. tested the complementarity relationship between the R&D intensity and external *breadth and depth* knowledge search where *breadth* means the number of sources used for Open Innovation and *depth* refers to the intensity of collaboration with each source (Laursen & Salter, 2006, p. 145). However, they could not find any evidence which can support this relationship. Instead, they have put in evidence the substitution effect between R&D intensity and external knowledge search.

The nature of the existing technology

The nature of the existing technology is an important factor in adopting Open Innovation by the firms. Important factors are the aggressiveness, complexity, modular nature or the experience or habits, and even the technology level of the company's activity (high-tech or non-high-tech industries) with existing technology. The *aggressiveness of the technology* is

characterized by *higher specialization of the R&D activities and a stronger focus on radical innovations relative to incremental innovations*, and it is defined as *the proactive exploration, retention, and commercialization of radically new technological solutions* (Lichtenthaler & Ernst, 2009). Thus, the firms that solicitate an aggressive technology strategy, owing the superior technology in their portfolio, are essential. Those firms tend to focus on constantly developing in-house new technologies rather than acquiring new knowledge from outside. In order to understand the opening up process (Lichtenthaler & Ernst, 2009), the authors conducted a survey analysis with 155 participant companies. The results show that the companies with a high level of aggressiveness are intended to keep their knowledge inside and are not willing to acquire from external sources. However, those companies' urge to become a market leader is so powerful that they prefer to acquire external knowledge when needed to keep their market position. The authors classify again those companies in 6 clusters, which are similar to the previous analysis of Open Innovation practitioners, namely: 1) Defensive closed innovators, which are not willing to acquire external knowledge but rely on in-house R&D; 2) Defensive technology acquirers; which rely on internal knowledge but in order to gain and sustain competitive advantage, they are open to external knowledge acquirement, 3) Reserved technology acquirers, are open to external knowledge acquirement but not willing to commercialize internal knowledge, 4) reserved technology sellers, which commercialize actively the technology that they develop internally, 5) aggressive proprietary innovators, are not open to external knowledge in principle, and they prefer to use in-house technology for in-house production, finally 6) aggressive open innovators, are the firms with a high knowledge exploration and exploitation level. Those firms rely dramatically on external knowledge acquisition for product development but also commercialize internal knowledge. Therefore, the level of technology aggressiveness deeply affects the decisions in the technology management process, particularly the opening up decision. In the same vein, the two types of companies, open innovators and closed innovators defined by (Lazarotti et al., 2010). The authors put evidence that the open innovator companies chose an aggressive technology and innovation strategy to become the market leader.

On the other hand, there is some evidence that the industry's technological capability is important when adopting Open Innovation. The firm's technological capability or technological level is related to the R&D intensity of its technology. According to the OECD definition and classification, the average R&D intensity is higher in the high-tech industries than in the low-

tech industries (OECD, 2011). According to R&D intensity, the OECD created a classification of four categories, namely high-, medium-high, medium-low and low-technology industries. Again, the OECD classify some main industries under those four categories in the following:

High-technology industries: Aircraft and spacecraft, pharmaceuticals, office- accounting and computing machinery, radio- TV and communications equipment, medical- precision and optical instruments

Medium-high technology industries: Electrical machinery and apparatus, motor vehicles, trailers and semi-trailers, chemicals excluding pharmaceuticals, railroad equipment and transport equipment, machinery and equipment

Medium-low technology industries: Building and repairing of ships and boats, rubber and plastics products, coke- refined petroleum products and nuclear fuel, other non-metallic mineral products, basic metals and fabricated metal products

Low-technology industries: Manufacturing, recycling, wood- pulp- paper- paper products- printing and publishing, food products- beverages and tobacco, textiles- textile products- leather and footwear (OECD, 2011).

In the literature, authors put in evidence in different industries the orientation and adoption of Open Innovation. While some researches put in evidence the Open Innovation adoption difference between high-technology industries (high-tech industries) and the remaining industries which can be called non-high-tech industries (Gassmann & Enkel, 2004, p. 335; Keupp & Gassmann, 2009; Lichtenthaler, 2008, 2008), there are also some researches pointed out different barriers and adoption factors of Open Innovation according to technological intensity in the industry (Bigliardi & Galati, 2016; Dziurski & Sopińska, 2020; Fu et al., 2014; Verbano et al., 2015). More specifically, based on a survey of 157 Italian SMEs, Bigliardi and Galati classified tree clusters according to their R&D intensity. Accordingly, their research shows that the high-technology industry SMEs do not face any Open Innovation barrier related to organizational or financial factors but related knowledge, namely loss of know-how, availability of relevant knowledge and imitation problems. On the other hand, those companies' Open Innovation adoption follows a path with “*customer involvement, external networking, internet exploration, know-how acquisition, knowledge provision, and alliances with complementary companies*”. The second cluster with medium-innovative industries (medium-high technology industries according to OECD classification) adopt mainly “*external*

networking, inward IP licensing, know-how acquisition, outward IP licensing, and knowledge exploitation” and face generally financial and strategic barriers while adopting Open Innovation, namely economic and financial problems, granting other’s technology without enough knowledge (or absorptive) capacity, and the high actual technology transfer costs than planned costs. The third cluster is composed of less innovative industries (low-technology industries according to OECD classification) that adopt mainly “*customer involvement, external networking, and internet exploration*” and encounter collaboration and organizational barriers, respectively, difficulties in finding the right partners, opportunistic behaviour, cultural differences, and lack of managerial competencies, managerial complexities, cultural internal barriers inside the firm, administrative and legal burdens (Bigliardi & Galati, 2016, pp. 876–878).

According to the company’s technological orientation, which we are taking into account, the company’s product or process orientation determines the company’s inbound or outbound choice. In the literature, authors put in evidence that the product innovation orientation is strongly associated with internal R&D activities as a long term oriented purpose. Process-oriented activities, however, are based mainly on the learning-by-doing process, which is much more short-term oriented and less costly for the company (Hervas-Oliver et al., 2021). In a research conducted in Spain with 3867 SMEs, the authors showed that non-high-tech SMEs with a process-innovation orientation generally have very small internal innovation capabilities. They also show that those companies have limited use of external sources and prefer embodied technology transfer, like machinery or new equipment. Inversely, product-oriented SMEs show a development of internal capabilities through R&D and customers as information sources.(Hervas-Oliver et al., 2021, p. 6).

The complexity of the product

The complexity of the product or the process creates a natural protection against imitation threats in the manufacturing sector. It also creates a natural barrier for the new firms willing to enter the market by imitating other companies’ products. In other words, if a new company wants to be a player in the same market as those who are using complexity as a protection tool, they have to increase the “*true innovations*”, the innovations that *generate new products, new production methods, or new markets* (Sengupta & Sengupta, 2014, p. 86). Industries with complex products and technologies generally require many components, such as the computer, software, semiconductor, telecommunication, and automotive industries. We have stated that

the complexity of the product creates a natural barrier of imitation earlier. (This statement is generally valid for tacit knowledge. The tacit knowledge and the secrecy are used as an informal protection tool for the knowledge.) Previous research emphasized that firms acting as radical innovators, with a dramatic, innovative distance from other firms in their market, prefer to use formal appropriation mechanisms that require disclosure. In other words, these “radical innovator” companies prefer to use more informal appropriation mechanisms such as lead-time advantage, secrecy, and product complexity to avoid publicly revealing their radical innovations’ fundamentals (Zobel et al., 2017). When the tacit knowledge level is high and the product complexity is high, the Open Innovation approach will increase the company’s innovativeness (Gassmann & Enkel, 2004; Zobel et al., 2017)). Paradoxically, because of the modular nature of the components in those industries, the protection is also provided by protected IP, most generally by patents or licenses. Hence in these industries, the products and the IP related to the product are relatively indivisible (Henkel et al., 2013).

The product modularity

Modularity is a hierarchical system comprising small sub-systems that can be designed independently and function as a holistic system. The product structure, or architecture, is an important part of a product change. Ulrich shows that for modular products, any change can be made by only changing the functional part of the product, whereas, for integral products, it requires changes in every component. (Ulrich, 1995, p. 426).

Different studies show different aspects of product modularity in the literature. Generally, studies suggest that product modularity has a facilitator aspect in product innovation directly. For example, Vos et al. (2018) advocate that modularity increases product innovation, specifically customization. Modularity offers customers more flexible configurations and customizations, particularly for IT firms. (Vos et al., 2018).

Kamrad et al. (2013) argue differently and advocate that product modularity can reduce the innovation rate in component technologies. The authors put in evidence that, in a market with insufficient technology knowledge consumers, a modular upgrade of a product can lower the absorption of innovation by customers, but instead, a software update for the operating system, would be much more affordable and easy for the users to adopt and use the innovation. as an example, the authors take the iPad which gave the possibility to change the software by updates or applications, but cannot be replaced by any hardware device (Kamrad et al., 2013)

Wang et al. (2020) address collaborative innovation and product modularity relationships. In their work, they show that modularity has a positive effect on: 1) labour division in the collaborative innovation network by balancing interests with their partners' expectations, and creating a new relationship by working "side by side" with the partner company, 2) increase the firm's product innovation capacity by the configuration of modules according to customer needs, 3) *reduce asymmetric information flow between the participants, by creating a standardized interface of modules, 4) flexibility coordinating firm and external partners, by giving an independency of working partners because of the modularity and independency of products; in other words, modular products can be designed and produced independently, which reduce the close relationships between the partners for working on a single product, 5)generating business ecosystem effects in a network, by creating a working area where all partners can work cooperatively (H. Wang & Shu, 2020).

Nevertheless, *product modularity* is also a facilitator of Open Innovation adoption. A high product modularity is a characteristic to exploit the advantages of the Open Innovation paradigm. Companies which have more modularised types of manufacturing industries, such as IT systems where the interfaces or components can be separately adjustable (Gassmann & Enkel, 2004; Greul et al., 2018), can adopt easily opening up the process compared to companies with low modularity(Gassmann & Enkel, 2004).

4.1.2. External factors

The Open Innovation adoption decision is generally made by the top management, firm's executive board (Lichtenthaler, 2008; Marcolin et al., 2017) or by the Open Innovation pioneers (champions) of the company who lead the transition from closed to Open Innovation process (Chesbrough & Crowther, 2006; Marcolin et al., 2017). However, not only internal determinants are influencing this adoption decision. There are some external factors which may influence this decision (market or technology environment) (Schroll & Mild, 2012).

The environmental factors and ICT

The environmental factors, including the technological opportunities, the degree of market (or environment) turbulence and the search activities of other firms in the same industry have an influence on the firms knowledge exploration decision (W. Cohen & Levinthal, 1990). In other words, the external environment is shaping the searching behaviour (Laursen & Salter, 2006). Generally speaking, in the Open Innovation literature, the "environment" itself, is considered

first “the companies inside environment” and secondly, the “outside” of the companies environment. We believe that above, we’ve already given some components of the inside environment of the company. In this part of our research, as an exogenous factor, we are willing to discuss the companies’ external environment.

The first and the most studied factor of the companies’ external environment includes; the market, the industry dynamics namely, technology intensity, technology fusion, new business models (Huizingh, 2011; Schroll & Mild, 2012), technological turbulence(Lichtenthaler, 2009b), industrial characteristics, competitive intensity, globalization and patent protection (Gianiodis et al., 2010; Verbano et al., 2015), also business ties, government ties, and universities (Zhu et al., 2017).

Market turbulence

The previous literature shows that environmental factors such as dynamism or turbulence positively affect Open Innovation practices. Especially in outbound Open Innovation practice, environmental dynamism significantly affects SMEs (Popa et al., 2017, p. 7). Duysters et al. (2003) define turbulent business environments as follows “when several market components (turbulent environment) are having rapid, frequent or unpredictable change”(Duysters & De Man, 2003, p. 50)

Companies prefer rapidly adopting external technology in a dynamic environment since their technology will become rapidly obsolete (Popa et al., 2017; Teece, 2007). Similarly, Shahin et al. studied six indicators for Open Innovation adoption, including absorption capacity, dimension of innovation, material, organizational, environmental, and individual factors. Their study aimed to identify the indicators of Open Innovation adoption and to prioritize the indicators of Open Innovation adoption based on NPD factors. The authors find that environmental factors are important in the first rank of all other factors (Mahdian & Shahin, 2020, pp. 418–419). Greco et al. (2017) also find the importance of environment in the Open Innovation adoption process.

New information technologies (ICT)

The diffusion of new information technologies is also an important factor of Open Innovation adoption. Basically, it is the spread of a new idea from a source of invention to the final user (Chakrabarti, 1973). The diffusion by definition is the “*process by which an (1)innovation is (2)communicated through certain channels over(3) time, among (4)members of a social*

system, it is a special type of communication in that the messages are concerned with new ideas”(Rogers & Everett, 1983, p. 5). It is a four step concept which concern those four elements; innovation, communication channels, time and the social system. Innovation is here referred as a new idea, an object or a process which is new to the people or the group of people from a unit of adoption. The communication channels is the information exchange of an innovation between the individuals or units. It can be interpersonal such as face to face communication or mass-media channels such as internet, TV and so on. The time factor is involved in different phases of the innovation diffusion equation; (1) First, it is involved in the innovation decision step where the transition from knowledge to innovation time is decided by the decision-making unit.(2) Then during the innovation adoption process become, the *innovativeness*, which describe the degree to which, individuals or units adopt earlier time the new ideas rather than others(Rogers & Everett, 1983, p. 23).(3) Finally, the *innovation adoption rate* is also include the time effect. It define as the relative speed with which the members of a social system adopt an innovation. *The members of a social system* constitute the forth step of the diffusion (-of innovation) concept. It is a set of interrelated units which are join to find a solution of a problem or accomplish a mutual objective. The *social system* create boundaries within the innovation can be diffused (Rogers & Everett, 1983). The diffusion (-of innovation) hence, is not a simple process but a combination of different concepts. The diffusion (-of innovation) is “achieved” when the users increase (Guellec, 2017b).

As regards to the diffusion of new information technologies, we are referring the information and communication technologies (ICT). In the literature, the ICT is the key factor which enable a rapid interaction and knowledge exchange within and outside of the organization (Dodgson et al., 2006). Chesbrough (2003) state three important erosion factors which undermine the closed innovation logic such as; the increased mobility of workers, increased number of universities which are more capable on R&D activities and increase the highly educated people number, declining US hegemony in the international market and increased venture capital opportunities which enables the start-up creations in the market. The additional erosion factor of closed innovation that (Chesbrough & Bogers, 2014, p. 16) add in the literature which allows the knowledge spread and increase the knowledge sharing capabilities of the firms, namely the ICT which increase firstly firm specific internal ICT networks, than the internet the World Wide Web.

The digitalization provides novel conditions for generating, sharing, retrieving and storing data or knowledge that could affect the boundary management of organizations (Bogers et al., 2016). The internet technologies or more generally the ICT have an undeniable impact both on customer / consumer side and producer/ service provider side of the economic system. One side, it creates alliances like triple helix or quadruple helix models (Savitskaya et al., 2014) and ecosystems², on the other side it creates organizational changes and generate new business models which enables Open Innovation practice. The ICT tools involve the user in the innovation process as the most valuable external knowledge source (Brunswick & Chesbrough, 2018; von Hippel, 1986, 2006), and supporting the R&D for the new product

² The ecosystem concept has different significance different field of research. (Tsujiimoto et al., 2018) studied this concept and find approximately four different significance of ecosystem concept in the management literature used since 1995, namely ; 1) industrial ecosystem, 2) business ecosystem, 3) platform management ecosystem and 4) multi-actor network ecosystem. The authors define these ecosystems as follows: 1) Industrial ecosystem, is the first use of ecology concept as an analogy to understand the industrial transformation of a raw material to an end-product by creating not only the product but the waste. The industrial ecosystem researchers contributes the literature by introducing a sustainable industry perspective, which is related to the ecology and ecological affairs. It emphasized the optimization of the use of natural resources such as energy and production materials with an appropriate management network. 2) business ecosystem: The business ecosystem focus on the business model(Chesbrough & Rosenbloom, 2002) concept (value capture and value creation) as central variables. Tsujiimoto (2018) analysed five different types of business ecosystems respectively: (1) digital ecosystems, (2) complementary (sub-industry) ecosystems, (3) supplier ecosystems, (4) business group (M&A) ecosystems. 3) platform management ecosystem research is concentrated on the relationship between the platform and other factors where the platform defined by Gawer (2014) as: “*we define internal (company or product) platforms as a set of assets organized in a common structure from which a company can efficiently develop and produce a stream of derivative products. We define external (industry) platforms as products, services, or technologies that act as a foundation upon which external innovators, organized as an innovative business ecosystem, can develop their own complementary products, technologies, or services*”(Gawer & Cusumano, 2014, p. 417) , and 4) multi actor ecosystem which include entrepreneurs and investors, external innovators, users or user communities, government or government agencies etc. Soon after Tsujiimoto (2018), (Bogers et al., 2019) propose a broad definition of ecosystem as “*an interdependent network of self-interested actors jointly creating value*”.

development (Dodgson et al., 2006), or crowdsourcing³ to create and gather new ideas (Ahn et al., 2019) which is also considered as an inbound knowledge flow from outside the firm boundaries. In other words, companies can benefit from IT strategies to implement a successful Open Innovation. Empirical studies show that when IT strategies align with Open Innovation strategies, the companies can benefit from Open Innovation. based from a survey of 225 companies, (Cui et al., 2015) put in evidence that IT strategies enables the Open Innovation. In this research, the IT alignment is considered as the harmony between the IT (information technology use) and business strategy. The authors approach to the IT strategies from two angle; IT flexibility and IT integration. When there is a IT flexibility, the company can easily adapt new IT applications to the existing IT base and can manage the knowledge sharing with internal (inside the company, e.g. P&G example) and external sources (suppliers, customers etc). IT integration refers to the ability to integrate data, communication technologies, and collaboration application in order to exchange knowledge with external sources. The result of their research shows that the IT strategies enhances Open Innovation performance.

More specifically, recent studies provides empirical evidence of ICT tools enhancing outbound Open Innovation by providing information. Aloini et al. (2019) emphasize the ICT tools as follows : 1) Collaborative tools, that involve participants to collaborate for finding new ideas or solutions for existing products or services, 2) Content management tools, for specific organizational needs which put together different parties of management team, 3) Business intelligence (BI) or Business Analytics (BA), which allow the researchers to find trends in the business and market data and to facilitate decision-making (Aloini et al., 2019, p. 31).

The technological turbulence

The term "technological turbulence" refers to the speed at which technology changes in a particular setting, while "market turbulence" describes the level of uncertainty and instability within a company's market ((Lichtenthaler, 2009a). *The impact of technological turbulence* is not only on the product life cycle but also on the negative direction of R&D costs. It has a tendency to shorten the product life cycle and compel companies to seek new products for

³ Crowdsourcing is a different way of external knowledge access (inbound Open Innovation) in digital platforms (Bogers et al., 2017). The concept is defined as an "act of outsourcing a task to a 'crowd' rather than an agent in the form of an open call" (Afuah & Tucci, 2012).

market launch, essentially leading to an increase in R&D expenditure (Gassmann & Enkel, 2004). The company's decision makers are under pressure due to the unpredictability of the market and economic conditions, which necessitates quick and responsive decision-making. This leads organizations to seek trustworthy external information (Krishnan et al., 2006; Laursen & Salter, 2006). Hence, when technology undergoes rapid changes, it leads to an upsurge in Research and Development (R&D) expenditures within the product and service market. In simpler terms, a company's ability to extract value from its technology becomes constrained as a result of technological turbulence (Lichtenthaler, 2009b) but external information search will be high in these conditions. The adoption of Open Innovation provides companies with the chance to leverage their technology by offering it for use by other companies (outbound Open Innovation activities), as long as this technology is considered state-of-the-art compared to existing technologies in the market (Lichtenthaler, 2008) Alternatively, companies can acquire external technology (inbound Open Innovation activities) when they are unable to develop all the necessary technologies within a short timeframe (Lichtenthaler, 2009b). According to Lichtenthaler (2009b), fast technological advancements in the market create an opportunity for companies to capitalize on their technology by making it available to other firms. In essence, turbulent technological conditions play a facilitating role in the decision-making process of adopting Open Innovation strategies.

The competitive intensity

The competitive intensity can be considered a related factor of environmental turbulence. (Lichtenthaler, 2009b) explains in his work the relation between Open Innovation adoption and the competitive intensity of the technology market as follows; The intellectual property protection by patents limits the technology substitution in a way, however, in the technology market, technology transfers (by patent or licensing agreements) may be high and doesn't necessarily involve a competitive intensity for a firm's specific technology. The competitive intensity increase the managerial challenges in order to keep the market position in the eye of the customer and to stay in the game. When the priorities change (to keep the technological resources in hand and strengthen the market position of the company), outbound Open Innovation activities may be limited for some companies. However, the same competitive intensity on company can create a pull effect for inbound Open Innovation activities. Companies which are trying to keep steady their market position, paradoxically will be solicited ready to use technology in the market by inbound Open Innovation activities. Hence, both

turbulent technology and market conditions and competitive intensity has a positive effect on Open Innovation activities.

In the same vein, Fosfuri (2006) shown the likelihood of rising effect of competition on the technology market (Fosfuri, 2006).

The industry speed

Previous research in the literature needs to show evidence of Open Innovation adoption success or failure in a particular industry (Chesbrough & Crowther, 2006; Lichtenthaler & Ernst, 2009). However, same research put evidence that even the industry characteristics don't bring a significant difference in Open Innovation adoption decisions; the technology intensity of the industry in question is much more important for this decision.

The industry difference has already been subject to different research such as, the importance of scientific knowledge in the biotechnology and pharmaceutical industries, as well as other R&D intensive industries such as computer, semiconductor or aircraft where the patents are the source of profit and a motivation source for the R&D activities (Mazzoleni & Nelson, 1998).

The industry speed is an important characteristic for the Open Innovation adoption rate between industries. The industry speed can be observed in the length of product life cycles, the frequency of changes in industry structure, and the developments of new markets (Gianiodis et al., 2010). Chesbrough (2003) stated the “*time to market*” effect as one of three erosion factors of the closed innovation. For many products, by the increase of innovation and use of new technologies, the time from production to the market time became shorter. For many other particular products, the shelf life of the particular technology became shorter (Chesbrough, 2003a, p. xxiii). In industries with a high speed (a change speed that we are mentioning), such as network technologies and services, Open Innovation can provide an advantage by integrating external knowledge either by outsourcing through licensing agreements or joint R&D agreements, etc (in other words, by inbound Open Innovation activities). In the same vein, pharmaceutical companies started to involve external innovators in 1990. Those companies increased their concentration on core advantages instead of on relatively less-critical activities. Hence, those companies prefer to outsource those activities for a lower cost and faster from external providers, in-licence patents when the technology development is in

the later stages and out-licence their patents when they are in the early stages of the technology development (Gassmann et al., 2018, p. 79).

Companies with a relatively low industrial change speed (such as building material manufacturer YTONG) will have a low rate and must adapt to the new technology (Gassmann & Enkel, 2004). We can also approach the industrial differences by the concentration of R&D. The R&D intensity of the industry is also an important factor for Open Innovation activities. In their research investigating the relationships among the knowledge stock, technology strategy and knowledge searching, and the innovation output quality, in other words, the Open Innovation impact on the patented inventions, Cammarano et al. (2017) put in evidence that the industry that pharmaceutical industry companies characterized more open behaviour. In contrast, hardware and equipment companies hold more knowledge and create inside the company. (Cammarano, Michelino, et al., 2017, p. 212).

Government, political factors

The government aims to establish a conducive scientific atmosphere fostering openness and collaboration. By creating an environment that values and encourages the exchange of ideas and knowledge, the government aims to facilitate the growth and development of scientific research. Universities are seen as potential research centres, generally financed by the government for companies. Big companies like ABB, Siemens, Daimler and GE reduce their in-house R&D activities and increase their partnership with universities for R&D (Gassmann et al., 2010). Chesbrough et al. (2018) put evidence that large companies prefer to collaborate with universities for more than half the projects for problem definition and problem solving stages of R&D (Brunswick & Chesbrough, 2018).

Governmental factors are also important, including environmental factors. According to Naqshibandi et al. 2014, governmental bodies facilitate the inbound Open Innovation process. Close ties with government officials improve the information flow and interpretation of regulations, settling negotiations, and breaking barriers mostly in a transition economy. The authors researched Malaysian companies in high-tech industries. They find that the managerial relationships between the company and other R&D structures, such as universities and governmental officials, have positively affect inbound Open Innovation (Muzamil Naqshbandi & Kaur, 2014). The government, both in local, regional, and national dimensions, has an important role in industrial policy decisions. Therefore, companies' relationship with

government authorities plays an enabler role in adjusting the conditions for the company's favour (Galvao et al., 2019, p. 813).

Besides this facilitator role, the public research centres are also related to a government institution. The universities, the government ties, and public research institutes are generally considered complementary to a companies external research channels (Galvao et al., 2019; Greco et al., 2016, 2017)

The guidelines presented here serve as appealing incentives for the companies being surveyed. Based on their responses, it is evident that educational incentives do not hold the same level of attraction as other promotional activities. However, it is worth noting that 65% of these companies responded positively to government-sponsored educational initiatives. Therefore, we can conclude that the government plays a significant role in motivating Open Innovation and patenting endeavours through its incentivizing efforts (Fu, 2015; Savitskaya et al., 2010; Y. Wang, Zhou, et al., 2012)

The globalization

The globalization have different meanings in different contexts. In our research, we are referring globalization from economical perspective. (Steger, 2009, p. 38) define globalization as “ *the intensification and stretching economic interrelations across globe*” Economic globalization which started by the international trade in the era of ancient Greeks, Roman and Egyptian Empires, gain a higher speed since 1950(Akram et al., 2011). After the World War II, during the economic forum of Bretton Woods on July 1944, USA and England playing the leading role, the major economic player countries reached towards a consensus on increasing the world international trade and agreed to establish new rules of international trade activities (Mir et al., 2014). The participant countries agreed also to create a more stable money exchange system where the currency of countries was pegged to affixed gold value of US dollar(Steger, 2009). This conference laid foundation of International Bank for Reconstruction and Development (IBRD) which will became later a part of International Monetary Fund (IMF) and World Bank. The World Bank’s mission was to provide loans for Eirope’s post-war reconstruction process but during 1950’s they’ve started to finance different industrial projects in developing economies around the world. The first agreement for the regularisation of multilateral trade between countries has established on 1947, the General Agreement on Tariffs and Trade (GATT). Later in 1995, during the Uruguay Round negotiations of GATT, the World

Trade Organization (WTO) established as a replacement body of GATT. However, by the early 1970 the global economy which was controlled by the nations come to its end; the wages increased and pushed the demand to an increasing trend. In 1971, the president Nixon decided to abandon the fixed gold rate system but afterwards the global economy entered in an unstable period which characterized by energy crisis in 1973 (OPEC's oil embargo to US during Arab-Israeli war which extended to other countries such as Netherlands, Portugal and South Africa). By the 1980's, the British prime minister and US president led the neoliberal⁴ revolution against Keynesianism and led the world economy to a more "liberal" way. Finally, the collapse of Soviet Union in 1989-91 increase the legitimacy of neoliberalism and liberal economic order in the world. The result of the economic globalization lead to the internationalization of trade and finance, the rise of transnational (international) companies and finally, increase the importance of international economic organizations (IMF, World Bank, WTO (Steger, 2009)). The international companies with their economic power on national income (by taxes and the source of GDP), controls the technology, world's investment capital and were dominant in the international markets. The globalization effect push those companies abroad where the costs are lower and labour cost is cheap(Steger, 2009). The international trade has also a direct influence on innovation activities by increasing the speed of accumulated knowledge spread of foreign inventors, thus increasing the innovation activities in the host country.

One important factor that influence the globalization effect, is also the mobility of an increased amount of people which obtained a university of or post-university grade (Chesbrough, 2003a, p. xxii). Those highly skilled people when started to work in a company, increased automatically their know-how and accumulate a knowledge, however, when they decide to leave the company, they also bring with them the accumulated tacit knowledge with them.

⁴ Neoliberalism introduced by Adam Smith and David Ricardo in the economical literature which considered that the economical equilibrium is possible if the competition would be done freely and without any constraint. Reversely, any constraint to the free competition would generate a disequilibrium which will lead to a social stagnation, political corruption and unresponsive state bureaucracies (Steger, 2009, p. 41)

This mobility creates two important results; first is that the knowledge accumulation and highly skilled people increase the value of the people in the market. Second, those people create a spill-out effect which creates new start-ups in the market.

From this point of view, globalization is a facilitator factor of knowledge, technologies and new business practices spread by the flows of goods & services, financial tools, capital, and people (OECD, 2016, p. 43). By the beginning of 21st century, companies started and increased their attention and displacement to abroad. Thanks to this displacement, companies started to interact with different customers, competitive and competent suppliers, and the growth of the international trade together with the perfection of world capital markets, the economic globalization has become an irreversible trend (Gao, 2008). Plus the companies go abroad and meet with world's leading research environments, plus they seek new innovative products and new markets to place them. This evolution of the world trade balances, triggered the innovation based competition; in a way, it also influenced the India and China for their rise as major international players (Herstad et al., 2008).

Furthermore, the change in the transport industry and the technological change in ICT (Information and communication technologies) has enabled the acceleration of globalization (OECD, 2016, p. 44) which also increased the trade freedom and interaction between countries. Trade freedom (Popa et al., 2017), collaboration as a subcontractor with a foreign company (Gassmann & Enkel, 2004), and exportation activities are considered as crucial for Open Innovation adoption because it creates a knowledge and new technology flow through the companies.

Patent protection in the country

Patent protection in the country is a facilitator factor of the Open Innovation adoption process. Empirical researches show that a country's patent protection positively affects international business activities including foreign direct investment, exports, licensing, technology transfer and inter-firm alliances (Papageorgiadis et al., 2014). Some research evidence that strong patent protection in the country encourages firms to profit from Open Innovation (most specifically from outbound Open Innovation) by enhancing technology transfer and technology diffusion (Arora et al., 2002; Gambardella et al., 2007; Lichtenthaler, 2009b). Fu (2015) emphasizes that the diffusion of innovation between firms and across countries can be transmitted by different mechanisms such as; licensing, international trade, capital movement

through foreign direct investment, and movement of people through countries for different reasons (migration, education, work etc), international research collaboration, media and internet diffusion, integration into global value chain of foreign technology transferred within the supply chain (Fu, 2015, p. 6).

However, strong patent protection may require detailed paperwork and a long patent application process. This can (and does sometimes) be a disincentive factor for the patent application decision of the company. First, a patent grant requires a long time because of the detailed granting procedure, personnel engagement and money to keep the patent property in hand and oblige to give detailed information of the new invention, which creates a wide diffusion of new invention information. However, it also creates an important entry barrier, especially for emerging economies (Mazzoleni & Nelson, 1998, p. 278). (Arora & Gambardella, 2010, p. 787) advocate that a strong IPR encourages high-technology firms, like semiconductors or biotechnology, to profit from the entry barrier effect and use the entry of design firms seeking to sell their intellectual property. The authors emphasize that the firms where R&D and manufacturing is complementary, the strong IPR does not affect licensing because of the complementary relationship. However, when there is no complementarity like the increased licensing activity of design firms and high-technology firms, the strong IPR has a positive effect. The same relationship exists for small firms, which are more responsive to patent protection

Table 19 Open innovation adoption factors

Internal	
Size	(Guellec, 2017a; Spithoven et al., 2013) (Brunswicker & Chesbrough, 2018; Lazzarotti & Manzini, 2009; Verbano et al., 2015). (Greco et al., 2017)
Age	(Berchicci, 2013; Brunswicker & Vanhaverbeke, 2015; Hsieh et al., 2016; Michelino et al., 2015)
Organisation structure	(Mortara et al., 2010). (Kratzer et al., 2017) (Pertusa-Ortega et al., 2010)
Management involvement	(Lichtenthaler & Ernst, 2006). (Barlatier & Dupouët, 2010)
Knowledge exchange capabilities	(Dodgson et al., 2006)
Core competences	(Prahalad & Hamel, 1990). (Christensen, 2006)
Geographical area	(Guellec, 2017b, p. 51). (Boschma, 2005; Harhoff et al., 2014) (Chesbrough, 2003a) (Mitkova & Wang, 2015) (Balland et al., 2015).
Familiarity with other firm's technology	(Gulati, 1995; Higgins & Rodriguez, 2006)
Product strategies and firm strategy	(Lichtenthaler, 2008) (Hagedoorn et al., 2018).
Patent activity and R&D intensity	(Chesbrough, 2003a; Dang & Motohashi, 2015; Lichtenthaler, 2009b) (W. Cohen & Levinthal, 1990, p. 138; Kuo et al., 2018)
The nature of existing technology	(Gassmann & Enkel, 2004, p. 335; Keupp & Gassmann, 2009; Lichtenthaler, 2008, 2008) (Bigliardi & Galati, 2016; Dziurski & Sopińska, 2020; Fu et al., 2014; Verbano et al., 2015)
The product complexity	(Gassmann & Enkel, 2004; Zobel et al., 2017))
Product modularity	(Ulrich, 1995, p. 426) (Vos et al., 2018) (Kamrad et al., 2013) (H. Wang & Shu, 2020) (Gassmann & Enkel, 2004; Greul et al., 2018)
External factors	
Environmental factors & ICT	(Huizingh, 2011; Schroll & Mild, 2012) (Gianiodis et al., 2010; Verbano et al., 2015),
Market turbulence	(Popa et al., 2017, p. 7) (Duysters & De Man, 2003, p. 50) (Popa et al., 2017; Teece, 2007) (Mahdian & Shahin, 2020, pp. 418–419)
Technological turbulence	(Lichtenthaler, 2009a) (Lichtenthaler, 2008)
Competitive intensity	(Lichtenthaler, 2009b) (Fosfuri, 2006).
Industry speed	(Gianiodis et al., 2010) (Chesbrough, 2003a, p. xxiii). (Gassmann & Enkel, 2004) (Cammarano et al., 2017, p. 212)
Government & political factors	(Muzamil Naqshbandi & Kaur, 2014) (Galvao et al., 2019; Greco et al., 2016, 2017) (Fu, 2015; Savitskaya et al., 2010; Y. Wang, Zhou, et al., 2012)
Globalization	(Steger, 2009, p. 38) (Herstad et al., 2008) (Gassmann & Enkel, 2004) (Popa et al., 2017)
Patent protection in the country	(Papageorgiadis et al., 2014) (Arora et al., 2002; Gambardella et al., 2007; Lichtenthaler, 2009b) Fu (2015)

Source: Typology of OI adoption factors (Gianiodis et al., 2010; Verbano et al., 2015) and improved by author

In this part of our research, we have tried to gather the previous studies on this issue and listed on the Table 19.

4.2. Barriers for Open Innovation implementation

Open Innovation is defined as the purposive inflows and outflows of knowledge. In other words, companies can create and develop processes to explore and transfer external knowledge or to exploit and create channels to move out the unutilized internal knowledge. This knowledge exchange can be manageable in the Open Innovation model (Chesbrough & Bogers, 2014). However, companies need help limiting mostly the large firms (Chesbrough & Brunswicker, 2013) to adopt and use the OI. In the literature, the research addresses the barriers to Open Innovation from different levels of analysis. (Sulaymonov & Du, 2020) categorize the barriers into six segments as follows: (1) managerial and operational: insufficient top management support for Open Innovation activities, (2) legal: IPR, (3) HR barriers, (4) cultural, (5) environment, (6) financial barriers.

(Savitskaya et al., 2010) addressed this issue from three different levels of analysis in a specific country survey data in China: (1) internal firms' environment, (2) institutional factors (innovation system in the country- NIS) and (3) cultural background barrier effect on Open Innovation. They studied a specific region (Yunnan province) in China with mixed participants in terms of size, industry and R&D level. They find that Chinese firms, no matter the R&D intensity of the company, are acquiring the technology when the company R&D level is high and want to keep the technology for itself. Also, small companies, because of the lack of complementary assets to commercialize their knowledge on their own, are willing to sell their surplus technology when their business model is relevant to selling it. However, they have validated the positive effect of public funding on the R&D output.

4.2.1. Inbound Barriers

The main barriers they have found to inbound activities are no adequate technology to offer, inbound activities taking too much time and resources, and NIH the most important barriers. The most important findings for outbound Open Innovation barriers are the weak IP protection and the infringement fear of the companies, the idea of “not sold here” (NSH) related to the cultural aspects of the participants (strong long-term orientation) and the difficulty of finding buyers.

Different authors first investigate the NIH syndrome. It is first studied in the master thesis of Clagett (1967). Based on eight case studies to identify the reasons for the existence of the NIH syndrome. Katz and Allen (1982) studied 50 R&D project groups to identify the curvilinear

relation between tenure employees and the performance of these R&D groups, and they introduced the “NIH syndrome” in the literature. They define this syndrome as “the tendency of a project group of stable composition to believe that it possesses a monopoly of knowledge in its field, which leads it to reject new ideas from outsiders to the detriment of its performance”. De Pay (1989) realized both empirical and theoretical analysis to explain different innovation periods in the firm. Boyens (1998) contributes to the NIH research by identifying simulations of attractive knowledge commercialization. A particular contribution of this research is also the perception of other syndromes. As a complementary response, an over-enthusiastic approach to the knowledge commercialization “Buy-In” (BI) syndrome and a negative attitude through external knowledge commercialization “only used here” (OUH), which is complementary to the “sell-out” (SO) syndrome describing again, an over-enthusiastic approach to external exploitation of knowledge. Finally, Merhwald (1999) studied NIH syndrome among 51 R&D managers and 89 scientists in 53 large German companies. The results show that the NIH syndrome cannot be observed directly because of its multidimensional construct (including different parties in the organization). According to this survey, the author regroups some participants’ possibly negative attitudes through knowledge exploration (Lichtenthaler & Ernst, 2006). Accordingly, some preliminary reasons which prepare a negative attitude like NIH can be listed as; (1) cultural aspects that come from prior negative experiences, (2) lack of incentive system to promote innovation and difficulties in communication between different parts of the organization, (3) status issues of the management and (4) a general attitude of resistance or a feeling of insecurity (Katz and Allen 1982).

Lichtenthaler et al. (2006) recontextualize this syndrome and extend with some over-enthusiastic responds of participants (employees or other Open Innovation implementation actors) towards external knowledge.

In their research among large firms, Chesbrough et al. (2013) find that the main barrier for large companies is managing the OI adoption journey from closed to Open Innovation (Chesbrough & Brunswicker, 2013). In terms of management, the external relationship management with innovation, protecting internal critical know-how (NSH), and identifying new innovation sources are important for the companies. However, the effectiveness of IPR and avoidance of external or already existing knowledge (NIH) has the least importance for large companies (Chesbrough & Brunswicker, 2013).

The literature has also discussed the industrial barriers (Dziurski & Sopińska, 2020). Chesbrough et al. (2006) put evidence that non-high-tech companies' innovations are similar to high-tech industry companies. Both seek to increase revenue and the number of products (Chesbrough & Crowther, 2006). Naturally, high-tech industries attract more attention in the literature for barriers to research because of their high dependency on technology. Accordingly, high-tech firms always seek new inventions outside their borders and are more open to the adoption of Open Innovation (Bogers et al., 2017; Chesbrough & Crowther, 2006; Laursen & Salter, 2006). However, Open Innovation adoption is not reserved only high-tech companies but also non-high-tech companies as well (Chesbrough, 2003a; Flor et al., 2021; Kirner et al., 2009; Laursen & Salter, 2006; Martinez et al., 2014; Van De Vrande, de Jong, et al., 2009)

When we look closely at the barriers, we can differentiate them as inbound and outbound, according to their influence on the company's Open Innovation adoption behaviour. Inbound barriers affect companies outside-in patenting or licensing decisions. More specifically, the workers or organization's extra protective behaviour namely not invented here syndrome (NIH), a negative previous outside-in patenting or licensing experience, a lack of financial promotion from government, long negotiation process with the potential inbound partner, the level of the proposed technology which is not suitable with the buyer companies technology level (no adequate technology or complex technologies) , or the high transaction cost of the proposed technology may create barriers for inbound Open Innovation adoption. Lichtenthaler et al. (2006) studied this behaviour from two angles, created a frame of it (table xx), and identified three extensive behaviours concerning knowledge acquisition, accumulation, and exploitation. The authors considered those attitudes as the extensions of the NIH. In order to simplify our research, we are going to consider all those components as NIH syndrome. Respectively, the authors named all-stored-here (ASH) for knowledge accumulation, and only-used-here (OUH) for knowledge exploitation.

ASH is defined as the attitude of external knowledge accumulation in a negative way within the company. The authors advocate that previous negative experiences or a lack of trust in the partner may cause this negative attitude (Lichtenthaler & Ernst, 2006). Accordingly, the Company will tend to keep all the knowledge inside the company and decrease the opening-up process speed.

The OUH is the fear of strengthening the competitor. It is also related to a need for more experience and other organisational and legal difficulties hindering the Open Innovation (Boyens, K. (1998)).

Table 20 The major attitudes to externally carrying out knowledge management

	Knowledge acquisition	Knowledge accumulation	Knowledge exploitation
Internal	NIH	ASH	OUH
External	BI	RO	SO

Source: (Lichtenthaler & Ernst, 2006)

NIH - general explanation

The lack of internal commitment is defined as “not invented here” syndrome (Chesbrough & Crowther, 2006). It means that since the invention is not from our company, it does not belong to us, our company/ our culture. So it cannot be ours. This approach was first identified by Katz Allen (1982) and then entered in the literature by other authors (Lichtenthaler & Ernst, 2006). Van de Vrande et al. (2009), in their survey of 2230 SMEs, put in evidence that shows that lack of employee commitment or resistance to change is the most important internal factor which hinders Open Innovation (Van De Vrande, de Jong, et al., 2009) It is also associated with only used here (OUH) syndrome by Lichtenthaler & Ernst (2006) (Lichtenthaler & Ernst, 2006) .

NIH- Rival involvement in our business and Oversea competitor may buy from our licensor

External knowledge loss or involuntary knowledge sharing can occur during partnerships. Both in inbound and outbound Open Innovation, in our case, technology transfer, companies have to open up their knowledge and their specialities to secondary parties. Normally, companies are looking to work with skilled and experienced external partners. However, geographical distances may create a disadvantage and to lose control iover the transferred technology. Also, the risk of being unable to enforce the contract in emerging and transitional economies is an important factor hindering outbound Open Innovation (Johnson & Mottner, 2000, p. 181). From this point, companies may need to be more open to sharing their technology for inbound or outbound activities (Coras & Tantau, 2014; Oumlil & Juiz, 2016; Sulaymonov & Du, 2020). We consider those two barriers included in NIH syndrome (Lichtenthaler & Ernst, 2006)

NIH- May reduce our innovation capacity

As previous reasons, external knowledge acquisition can be considered as a factor which can reduce internal R&D activities. Sometimes, internal incentive systems of a company can create this attitude; since the new technology will not be created internally but acquired from external sources, it will not be considered a “real innovation”. (Lichtenthaler & Ernst, 2006, p. 376)

NIH- Lack of trust to external knowledge and don't feel secure

In their research on Slovenian companies, Krapez et al. (2012) put evidence that the most important barrier which hinders Open Innovation is the NIH syndrome effects, more specifically, misunderstanding and distrust between partners and theft of know-how and ideas (Krapež et al., 2012)

In the same vein, mostly in emerging markets or transitional economies, there could be infrastructure issues, or even legal infrastructures can be new and not very well established for contract enforcement etc (Johnson & Mottner, 2000, p. 181). This can easily create trust problems between partners (Krapež et al., 2012). Oduro (2020) point out this barrier as a collaboration barrier under the topic of misunderstanding and lack of trust between innovation partners (Oduro, 2020).

Negative previous experience

The distance between partners, mostly in terms of uncertainty, is an important factor for companies' decision-making for cooperation. Previous cooperation with a company may be a facilitator factor to reduce uncertainty and work with a secure bounding. It can also reduce information asymmetry (Van De Vrande, Vanhaverbeke, et al., 2009). However, a negative previous experience can also hinder Open Innovation possibilities. In their study, Dubouloz et al. (2021) put evidence that “*the nature of barriers does not vary across OI modes, but their intensity does*” (Dubouloz et al., 2021, p. 113). In their research, the authors show that the previous collaboration experience in SMEs positively influences SMEs to create bounds and habits in workers' minds. However, a negative experience can create a barrier also (Dziurski & Sopińska, 2020, p. 318).

Lack of government incentive

Government incentives or public subsidies impact innovation and economic growth, which is considered very important according to OECD (Open Innovation in Global Networks 2008).

Greco et al. (2017) studied 43230 companies from 14 European countries participating in the Community Innovation Survey (CIS). The authors clustered their results according to public subsidy, size and region. The results show that local public subsidies have a positive impact on Open Innovation efficiency in small companies, national public subsidies have a larger positive impact, which includes not only small but medium companies also, and finally, Western European countries receive more public subsidies, which enable those companies in this part of Europe to have more efficient Open Innovation activities (Greco et al., 2017). According to a study conducted in Canadian SMEs, authors put in evidence that the government incentives for R&D are important for innovation rate. Specifically, in their sample from Quebec, the authors find that the R&D and innovation intensity fail because of the lack of government incentives, compared to Ontario and British Columbia (L. A. Hall & Bagchi-Sen, 2002).

Long negotiations

The IP-related negotiations are detailed and sometimes complicated. However, it is also necessary to clear all the vague or contradictory points for both sides of the contract. However, this negotiation process can be long and time-consuming for both parties (Barchi & Greco, 2018, p. 354). Because of its exhausting nature, the long negotiations can create a hindering captor for the Open Innovation process. However, its time-consuming nature and its bargaining character of negotiations can create a barrier to Open Innovation. Prud'homme (2019) discussed the nature of the contracts and pointed out that negotiations “*lead up with bargain*”. The author defines the transaction cost of a technology transfer as a sum of different costs, namely, searching and screening cost, information cost, bargaining (or negotiation) cost, decision-making cost (making the contract), and monitoring the enforcement costs (Prud'homme, 2019, p. 3). Accordingly, we presume that the long negotiations increase the transaction cost also and create a barrier to Open Innovation practices.

No adequate tech for us in the market, they are too complex

In their study, Lichtenthaler et al. (2006) put evidence that the NIH attitude (or syndrome) has different consequences such as not using properly the external technology because of insecurity through external knowledge, failures of implementation and delays in the innovation process, generalisation of different external technologies which in result, decrease the profitability and the potential use of external knowledge, and finally, *inappropriate evaluations of external*

knowledge which in consequence, create a barrier for the company to consider other technologies “not suitable for them” (Lichtenthaler & Ernst, 2006, p. 380).

Other company’s technology complexity may be challenging for the companies. It can create a natural barrier to licensing activities (Flor et al., 2021). However, the granted technology may also be too complex, and the company’s workers need a comprehensive understanding of its potential (Bigliardi & Galati, 2016; Van De Vrande, de Jong et al., 2009). Oduro put in evidence the same barrier in SMEs in Ghana. The author put evidence that the lack of internal knowledge creates a barrier to understanding the partner’s technology and hinders inbound Open Innovation activities (Oduro, 2020).

High transaction cost

The transaction cost of the innovation may be higher than the company's financial power. Companies cannot go further in the Open Innovation process (Dziurski & Sopińska, 2020; Galia & Legros, 2004). The previous research showed that the transaction cost is an important factor that creates a barrier to the inbound Open Innovation process. The cost of inbound licensing may be higher than the planned cost at the beginning of the process. In the cluster analysis among SMEs in Italy, Verbano et al. (2015) put evidence that the open upstream cluster companies consider the high cost of inbound licensing as a barrier to Open Innovation process (Verbano et al., 2015).

4.2.2. Outbound barriers

IPR complexity

Previous studies show that the protection of IPR is a very important factor for the concession of IP. The strength of patent protection in the country may positively affect licensing decisions by creating a reliable environment for companies to share their knowledge (Chesbrough et al., 2006; Zuniga & Guellec, 2009). Again, Gambardella et al. (2007) show that when IPR is reliable, the licensing level of the companies increases (Gambardella et al., 2007).

On the other hand, IPR complexity also increases the fear of potential violations when the appropriation regime is weak. Savitskaya (2010) has highlighted that IPR complexity can hinder innovation processes for Chinese companies. (Savitskaya et al., 2010).

NSH

Giving up a temporary monopoly position may create a loss of control over the market because of the “unintended knowledge spillover” effect. Therefore, companies may be reluctant to share their patent portfolios (Bianchi et al., 2014). The companies may stay away from selling their technology for fear of losing their “*corporate crown jewels*” (Rivette & Kline, 2000), and this creates a barrier for those companies for outbound Open Innovation adoption (Lichtenthaler, 2009b).

Contract complexity

Besides a lack of financial resources, IP transfer contracts may be complicated to build for the counterparties. Hoffmann et al. (2001) show that the critical success factor of an alliance relies on contributing individual strengths and looking for complementary resources, the precise definition of rights and duties of both parties and deriving mutual objectives for business strategy (Hoffmann & Schlosser, 2001).

Not our strategy

The external technology exploitation negatively correlates with the not sold here syndrome, limiting the company’s licensing strategies.

Previously studied by Lichtenthaler et al., the not-sold-here (NSH) attitude reveals in different forms which, in principle, hinder the exploitation activity (Lichtenthaler et al., 2010). The authors put in evidence different behaviours and related antecedents of this negative attitude. The reluctant company strategy for outbound Open Innovation can be related for numerous reasons; however, in his study, the author put evidence of the following reasons and antecedents: (1) lack of previous experience with positive effect on NSH, (2) product diversification has negative effect on NSH (in two ways: can hinder Open Innovation because the company is willing to keep the innovation for its own NPD process; Licensing can also increase the market competition so the managers prefer to limit the licensing in order to limit the competition increase in the market. Alternatively, the licensing activity can increase the NSH), (3) transaction frequency: the low transaction frequency can be related to the high transaction cost or the managerial difficulties that the workers have to deal with if there is a new technology transfer in the company, however, if the technology transfer frequency is high, then the experience level will increase, and it will reduce also NIH syndrome also decrease managerial difficulties.(4) competitive activity: The competitive activity in the technology

market has a negative effect on NSH's attitude. First, because of the high market competition, promote the competitors' licensing activity. Accordingly, the licensing activity "*signals*" the exploitation potential as an opportunity instead of a thread. Second, the competitor's licensing activity proves it can overcome managerial difficulties with time and practice. Third, the competition may positively affect demand and reduce the NIH effect, reciprocally NSH effect (Lichtenthaler et al., 2010).

The negative attitude of the NSH can also be expressed as neglecting the outbound activity as part of the company strategy. The closed innovation model advocates the need for sharing the company assets by external parties. As an extension of this view, companies can reject the idea of exploitation, which also reflects that the knowledge should not be shared if it is not used internally (Amann et al., 2022; Burcharth et al., 2014).

Not sufficiently developed technology

Peeters et al. (2006) studied the importance of *perceived barriers* in a company. In their research, the authors put evidence that the perceived barriers may negatively affect a firm's patenting behaviour. This perception can hinder innovation by creating organizational rigidities like employee resistance to change or lack of leadership, by creating cost-related barriers such as high cost and risk association to a potential innovation project, and finally customer, related barriers such as customers' "late reaction" to the product etc. (Peeters & van Pottelsberghe de la Potterie, 2006). The authors spotlight the importance of perception as an important factor that can create real barriers for a firm.

Similarly, Amann et al. (2022) studied the barriers. They named a barrier such as "*depreciation of knowledge*", which implies the anxiety of "*not being attractive*" by the partner (Amann et al., 2022). Our research considers "*not being attractive by the partner*" related to this perception. Their technology cannot be shared because it is not developed enough to be shared.

Difficulty to find buyer

Numerous researchers cite the difficulty in finding a buyer as a barrier to Open Innovation. Enkel et al. (2009) find that companies consider the difficulty of finding the right partner an important problem (Enkel et al., 2009). Van de Vrande et al. (2009) found the same barrier in their research conducted on SMEs. The authors show that the SME's difficulty is not the innovation volume but finding The buyer for the invention (Van De Vrande, de Jong, et al., 2009). While Savitskaya (2010) put in evidence the barriers in Chinese companies, besides

cultural and financial barriers, the existence of the difficulty to find a buyer for their technology is an important factor which hinders outbound Open Innovation in Chinese companies (Savitskaya et al., 2010)

Lack of previous experience or bad previous experience

The previous technology transfer experience is an important starting point for better outward technology exploitation. Lichtenthaler et al. (2010) state, by referring to the dynamic capabilities theory, that a firm's prior technology exploitation experience increases the company's learning and experiences about outbound Open Innovation practices. As a reminder, dynamic capabilities are *“the capacity of an organization to (1) sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets”* (Teece, 2007). In other words, if a company does not have the necessary experience for technology exploitation, this can easily create a protective attitude which can hinder the exploitation process. This negative (or protective attitude) is transitive with other attitudes such as *“losing control of our patents (e.g. corporate crown jewels (D. Kline, 2003))”*. Meanwhile, previous exploitation experience may increase the knowledge and experience of the management and progressively, it will decrease the negative attitudes towards technology exploitation (Lichtenthaler et al., 2010).

Table 21 Barriers of Open Innovation

Barriers - Inbound	
NIH Rival involvement	(Lichtenthaler & Ernst, 2006)
NIH Reduce innovation capacity	(Lichtenthaler & Ernst, 2006, p. 376)
NIH Lack of trust	(Krapež et al., 2012)
Negative previous experience	(Dziurski & Sopińska, 2020, p. 318)
Lack of gov incentives	(Greco et al., 2017; L. A. Hall & Bagchi-Sen, 2002)
Long negotiations	(Barchi & Greco, 2018, p. 354; Prud'homme, 2019)
No adequate techa	(Bigliardi & Galati, 2016; Lichtenthaler & Ernst, 2006; Oduro, 2020; Van De Vrande, de Jong, et al., 2009)
High transaction cost	(Dziurski & Sopińska, 2020; Galia & Legros, 2004).
Barriers - Outbound	
IPR complexity	(Chesbrough et al., 2006; Savitskaya et al., 2010; Zuniga & Guellec, 2009)
NSH	(Bianchi et al., 2014; Lichtenthaler, 2009b; Rivette & Kline, 2000)
Contract complexity	(Hoffmann & Schlosser, 2001)
Not our trategy	(Lichtenthaler et al., 2010)
Not sufficienty developed yet	(Amann et al., 2022; Peeters & van Pottelsberghe de la Potterie, 2006)
Difficulty to find buyer	(Enkel et al., 2009; Savitskaya et al., 2010)
Lack of previous experience	(Lichtenthaler et al., 2010)

Source: Typology of OI barriers (Bigliardi & Galati, 2016; Dziurski & Sopińska, 2020) and improved by author

In this part of our research, we have tried to gather the previous studies on this issue listed in Table 21.

Conclusion of Chapter 4

In this chapter, we delved into the factors contributing to adopting open innovation and the barriers that can hinder its implementation. The adoption factors encompass both internal and external aspects. When it comes to internal factors, previous research has highlighted various elements such as company size (Brunswicker & Chesbrough, 2018; Lazzarotti & Manzini, 2009; Verbano et al., 2015), age (Berchicci, 2013; Brunswicker & Vanhaverbeke, 2015; Hsieh et al., 2016; Michelino et al., 2015), organizational structure (Kratzer et al., 2017; Mortara et al., 2010; Pertusa-Ortega et al., 2010), corporate culture and management involvement (Barlatier & Dupouët, 2010; Lichtenthaler & Ernst, 2006), knowledge exchange capabilities (Dodgson et al., 2006), core competences (Christensen, 2006; Prahalad & Hamel, 1990), geographical location (Balland et al., 2015; Guellec, 2017b, p. 51; Harhoff et al., 2014; Mitkova & Wang, 2015), familiarity with other firms' technology (Gulati, 1995; Higgins & Rodriguez, 2006), product strategies and business strategy of the firm (Hagedoorn et al., 2018; Lichtenthaler, 2008a). Additionally, other influential factors include patent activity and R&D intensity within the organization (Chesbrough, 2003a; W. Cohen & Levinthal, 1990; Dang & Motohashi, 2015; Kuo et al., 2018; Lichtenthaler, 2009b) as well as the nature of existing technology employed by the company (Bigliardi & Galati, 2016; Dziurski & Sopińska, 2020; Fu et al., 2014; Verbano et al., 2015). Another important consideration is product complexity (Gassmann & Enkel, 2004; Zobel et al., 2017) and product modularity (Gassmann & Enkel, 2004; Greul et al., 2018).

The external aspects of open innovation adoption are several. These include the relationship between environmental factors and information and communication technology (ICT) (Gianiodis et al., 2010; Verbano et al., 2015), market and technological volatility (Mahdian & Shahin, 2020; Popa et al., 2017; D. J. Teece, 2007), competition levels within the market (Fosfuri, 2006; Lichtenthaler, 2009b), the speed at which industries operate (Chesbrough, 2003a; Gianiodis et al., 2010), government policies and political factors (Muzamil Naqshbandi & Kaur, 2014) (Galvao et al., 2019; Greco et al., 2016, 2017) (Fu, 2015; Galvao et al., 2019; Greco et al., 2016, 2017; Muzamil Naqshbandi & Kaur, 2014; Savitskaya et al., 2010; Y. Wang, Zhou, et al., 2012), globalization and freedom of trade (Gassmann & Enkel, 2004; Herstad et al., 2008; Popa et al., 2017; Steger, 2009, p. 38), as well as the level of patent protection in the market (Arora et al., 2002; Fu, 2015; Gambardella et al., 2007; Lichtenthaler, 2009b; Papageorgiadis et al., 2014).

Next, we studied the hindering factors that harm both inbound and outbound open innovation processes. Regarding inbound open innovation hindering factors include the NIH syndrome (lack of trust, involvement of rivals in business activities leading to reduced innovation capacity) (Krapež et al., 2012; Lichtenthaler & Ernst, 2006), negative past experiences (Dziurski & Sopińska, 2020, p. 318), lack of government incentives (Greco et al., 2017; Hall & Bagchi-Sen, 2002), lengthy negotiation terms (Barchi & Greco, 2018, p. 354; Prud'homme, 2019), inability to find suitable technology offers for inbound licensing or encountering excessively complex technologies (Bigliardi & Galati, 2016; Lichtenthaler & Ernst, 2006; Oduro, 2020; Van De Vrande et al., 2009) high transaction costs (Dziurski & Sopińska, 2020; Galia & Legros, 2004).

The impediments to outbound open innovation include NSH syndrome (Bianchi et al., 2014; Lichtenthaler, 2009; Rivette & Kline, 2000), the complexity of intellectual property rights (IPR) (Chesbrough et al., 2006; Savitskaya et al., 2010; Zuniga & Guellec, 2009) and contracts (Hoffmann & Schlosser, 2001), a lack of an outbound open innovation strategy (Lichtenthaler et al., 2010), the perception that existing technology is not developed enough for trade (Amann et al., 2022; Peeters & van Pottelsberghe de la Potterie, 2006), difficulty in finding buyers (Enkel et al., 2009; Savitskaya et al., 2010), and a lack of experience or negative experiences in outbound activities (Lichtenthaler et al., 2010).

Our focus on patents and patenting strategies in open innovation processes is driven by recognising their significance in fostering technological advancements. Patents protect intellectual property (IP), enabling inventors to secure exclusive rights to their creations. We aim to shed light on organizations' different approaches to leveraging patents for competitive advantage by studying the existing literature on patent strategies and exploitation in open innovation processes, particularly inbound and outbound processes. These strategies include licensing or selling patents to other companies, cross-licensing agreements, or using patents as a defensive measure against potential litigation. Additionally, our review explores the hindering factors organizations may encounter when exploiting patents within open innovation processes. The subsequent chapter will delve into our research question and methodology, outlining the framework we have chosen for our empirical study. Following this, we will present our findings from the data analysis phase, which will further contribute to our understanding of patent strategies and exploitation in open innovation processes in the next chapter.

Chapter 5 Methodology

According to Gombault (2005), no single epistemological approach is better than others in the literature. However, it all depends on the research question, the state of the art of the existing knowledge, and the accessibility of the data. In this study, we try to respond 3 research questions that we find important to respond to:

“What patenting strategies do Chinese companies employ in the Open Innovation process?”

“What forms of patent valorisation exploitation do Chinese companies use in this process, and what factors affect this process?”

“What type of companies incorporate the Open Innovation model and patent exploitation? Does it have any specificities concerning the exploitation choice of the companies?”

By using existing literature and proven and existing criteria, we wanted to see the specificities in Chinese companies’ open innovation adoption and their open innovation practices. We are adopting a post-positivist approach because of its flexibility, and by deduction of existing criteria in a different field of research, we are adopting quantitative research even if we are seeking possible specificities in our research field.

To explain in detail our epistemological positioning and methodological choice, we divided into 3 sub-chapters, the present chapter. In the first sub-chapter (sub-chapter 5.1), we explain our research context: China. The second sub-chapter (sub-chapter 5.2) explains our epistemological positioning post-positivist approach and our methodological choice quantitative study. In the last part of this chapter (sub-chapter 5.3), we explained our research design in detail.

5.1. Context of empirical research study

Our problematic concerns the exploitation of protected invention in the framework of the Open Innovation. From our point of view, an emerging and newly opened economy with a high rate of R&D investment and patent application would fit to our problematic’s field research. This need bring us to the field of China.

5.1.1. Innovation context in China

The invention of gunpowder around 1000 AD in China has dramatically changed the world. First, Arabic countries used it in the 12th century, and Europe in the 14th century during the wars. It was used first to fear the enemy, but over time, it contributed to the invention of cannon balls and, finally, the weapons as the term that we are using today. Together with the usage of the compass (100 AD), these two Chinese inventions contributed to the changes of borders and allowed the countries to explore new lands like America in 1492. However, even though these two inventions originated in China, the usage and improvement of these two technologies have been made in the rest of the world (particularly in Europe)(Rosenberg, 1983).

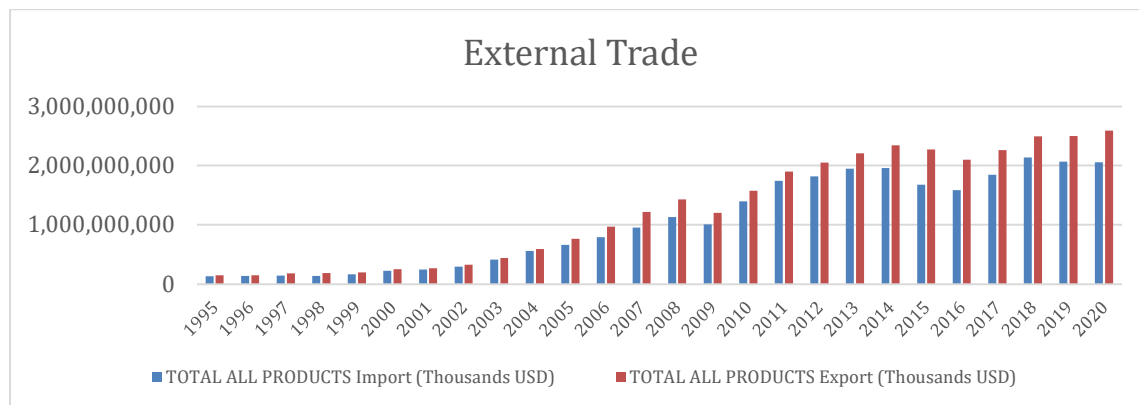
The emerging economies' technological capacity transition may follow different paths. Some firms may invest in internal R&D to increase in-house technology development. However, most firms needing more in-house R&D capacity choose to imitate and adapt existing production processes and technology (Fatima, 2017). Even if it is not considered a noble way to imitate and participate in the market, it is the easiest way to learn and increase a company's innovation capacity (Schewe, 1996). Both ways allow the companies to close the gap and align the companies' innovation capacity to the leading technology (Fatima, 2017). However, ethically, the imitation option is not acceptable. Therefore, the technology transfer for increasing the learning capacity of a company is the standard and promising way to increase innovation capacity. As a high workforce and production capacity and emerging economy example, the Chinese government promoted the technology transfer from foreign countries to increase Chinese companies' innovation capacity.

The international technology transfer channels may include (1) interaction with foreign customers and suppliers, (2) foreign direct investment (FDI), and (3) technology transfer through licensing or patent (Fatima, 2017) and also reverse forward engineering (Zhang & Zhou, 2016), migration or movement of people, integration into global value chains through foreign technology transfer (Fu, 2015, p. 258).

In the Chinese innovation context, the economic change from a closed to an open economy significantly influences this shift. After declaring the new Chinese People's Republic in 1949, China adopted communism and a planned economy. The latter lasted until 1978, when, under the influence of Deng Xiaoping, China switched to a market-oriented economy. This transition is most visible after 1989, with a speed of increase of GNP from 5.4% to 12% (Lin & No,

2004). Its economic growth has transformed the country from an agriculture-driven economy, mainly closed to the world, to an open economy (Shiraishi & Sonobe, 2019, p. 120). The three main changes in Chinese economic history, namely, adopting a planned economy, market orientation, and opening up the process of economic activities, increase the speed of China's innovation capacity (Worldbank, 2021). China increased its high-tech production volume by combining low-cost labour with foreign manufacturing know-how, either from imported products or foreign direct investment and technology transfers via licensing (Ning et al., 2017).

Figure 13 China's external trade figures



Source: (UNCTAD, 2021)

The statistics shows that the combination of exported products is dominated by manufactured goods.

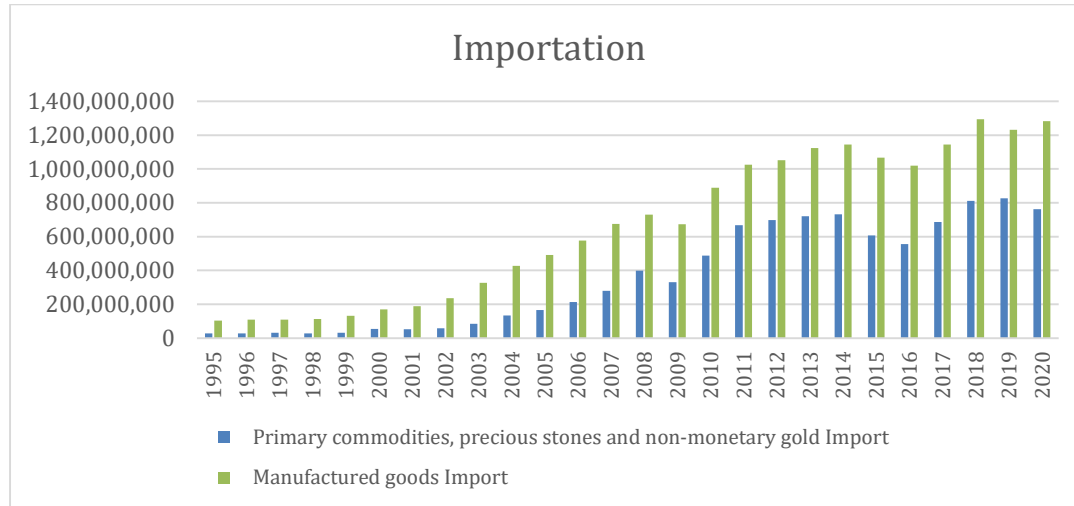
Figure 14 China's exportation figures



Source: (UNCTAD, 2021)

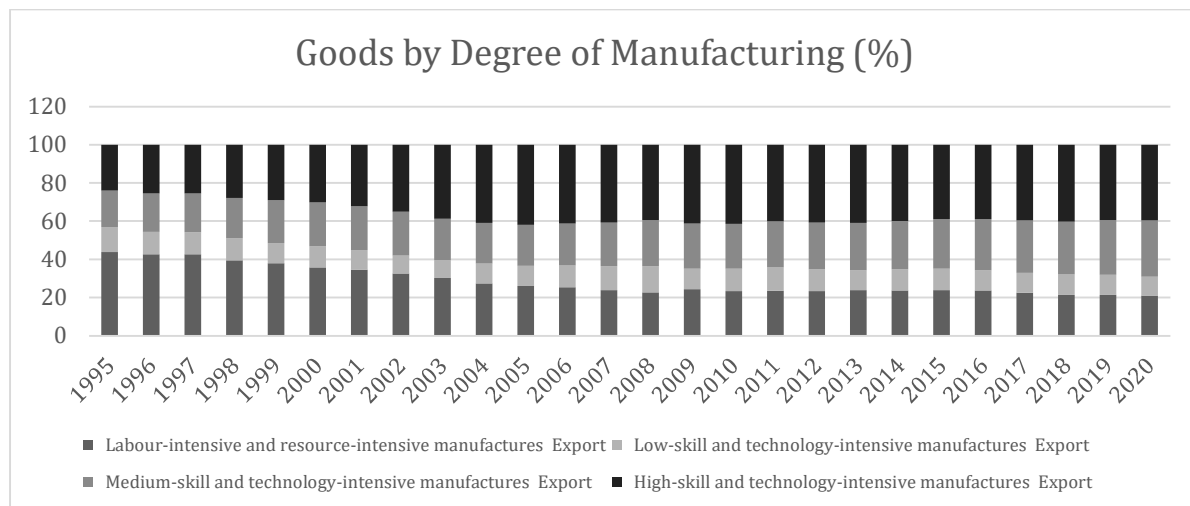
On the other hand, the manufactured product importation as well as all the importation volume increase follow the same trend

Figure 15 China's importation figures



When we go further to analyse the product combination breakdown, the domination of high-skills and technology intensive product share in the exportation volume became evident, mostly after 2001.

Figure 16 China's manufacturing goods by degree of technological intensity



Source: (UNCTAD, 2021)

In the literature, different authors also study the government's role in promoting and framing innovation in the country. Fu et al. (2015), referring to Faber et al. (2008), explain the three roles of the government as *a broker*, *increase demand articulation*, and *stimulate innovation*. More specifically, the government plays a role as a *broker* by bringing together different actors

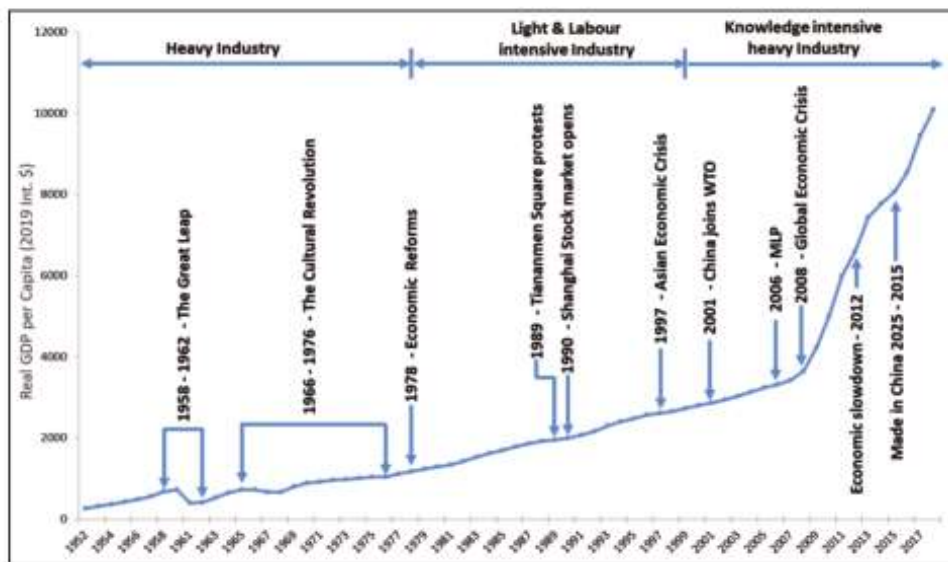
in the innovation system and trying to create a synergy of innovation. For example, putting in action a strong IPR policy for building an efficient and reliable transaction market can be considered a broker role of the government. *Increasing demand articulation* is also related to the Open Innovation policy of the government. The demand articulation is associated with the standard set in the market. Fu et al. (2015) explain the standard setting in the market from the market entry regulations point of view. The idea is that the government's influence on market protection positively increases the competitive advantage. Fu et al. (2015) developed this approach by adding regulations for competition policy towards Open Innovation, specifically in the markets where high competition levels also increase innovation capabilities, such as the electronics and telecommunication market. Similarly, establishing technology development zones (e.g., the Torch plan) is considered a demand articulation mode for the government. Finally, the *stimulation of innovation* is embodied in different policies. Fu et al. 1 (2015) materialize the government effect mainly on fiscal policies, as well as science and technology plans (Fu, 2015, pp. 146–148).

Therefore, it will only be complete to consider the technology transfer path with government effect in China. Since the foundation of the “*People’s Republic of China*,” the Chinese economy has been a planned economy where the government controls all fields. Since 1980, the government has started changing the country’s economic structure from an agricultural economy to a planned socialist economy (Shiraishi & Sonobe, 2019, p. 119).

In a bibliometric analysis of Chinese science and technology program development, Huang et al. 2015 show this trend using the Tsinghua University public policy database. Their bibliometric citation analysis results show that the government policy is primarily focused on applied sciences; despite increasing governmental S&T agencies, the companies’ collaboration with those institutions is decreasing, and the administrative influences in the related policies are significant. The research also put in evidence the evolution of the S&T policy. Accordingly, every science and technology plan is shaped according to the needs of related administrative government branches. More specifically, when for the plan 1978-1984, the important topics were *the import of technology and equipment, rewards for S&T excellence, oceanographic instrumentation and new products, and uniform scientific measurement standards*; the 1985-1994 program focused on *high-tech R&D, human resources in S&T, and rewards in S&T* (C. Huang et al., 2015). As a reminder, in 1982, China launched the Key Technologies R&D plan to promote technical upgrading; in 1986 High-tech R&D plan -or Spark Plan- to develop

innovation capacity in innovative industries; in 1988, the Torch plan to establish high-tech development zones, and focused on innovation after 1990 (Fu, 2015, p. 15; L. Li et al., 2019). The adhesion to WTO in 2001 also influenced the evolution of the S&T programs. We can observe this reflection in the 1995-2005 plan as follows: *institutional reform, international cooperation and industrialization program, and rewards for S&T*. China has become the largest economy in terms of trade and marks a significant increase in high-tech product manufacturing and exportation. The composition of products dramatically shifted from labour-intensive to technology-intensive composition after 2001. The influence of China's adhesion in WTO in 2001 increased China's total imports and exports from 24 billion \$ in 1980 (Worldbank, 2021) to 2,809 billion \$ in 1995 and 4,646 billion \$ in 2020, resulting in a production and industrial development growth (UNCTAD, 2021).

Figure 17 The evolution of Chinese manufacturing



Source: (Agarwala & Chaudhary, 2021)

After 2005, the S&T program shows a dramatic difference with new topics such as *indigenous innovation and energy saving engineering, industrialization program, HR in S&T, and development plans* (C. Huang et al., 2015). 2006, the National Medium- and Long-Term S&T Technology Development Plan 2006-2020 was launched. The program targets a shift from a low-cost manufacturing growth model to a high-tech and knowledge-based sustainable model and targets to make China a world leader in S&T by 2050 (Agarwala & Chaudhary, 2019). The required financial support for sustainable R&D growth comes from government funding mostly (Fu, 2015, pp. 15–19). Accordingly, the five-year plan launched in 2016 and targeted

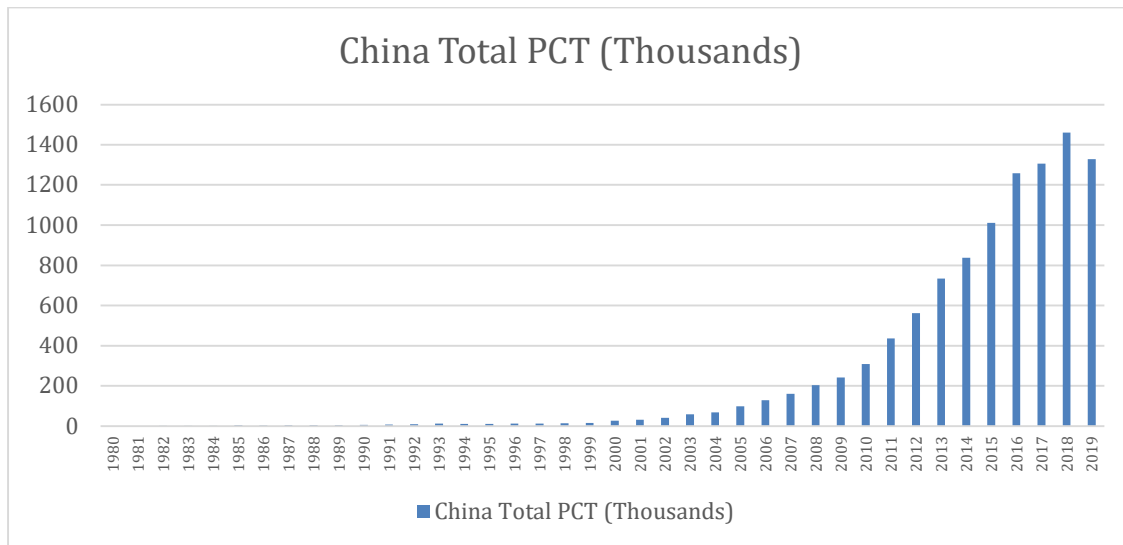
technological growth, and the program Made in China 2025, launched in 2015, targeted the self-reliance and growth of China (Agarwala & Chaudhary, 2021).

5.1.2. IP Policy

The IPR evolution in China dates just after the establishment of the People's Republic of China in 1949. The first Provisional Regulation of the Protection of Invention rights was established in 1950 by the Chinese government, but the Restoration of the IPR system began in the 1970s. The modern IPR law was promulgated around 1980-1990 to attract FDI, fulfil bilateral agreements with foreign countries, and establish the State Intellectual Property Office (SIPO) in 1980. Since then, the Patent law, established in 1985, has significantly changed in 1993, 2001, 2009, and 2021. Respectively, the change in 1993 was made to enter GATT and sign the "Memorandum of the Chinese and U.S. Governments on Protecting Intellectual Property." The difference in 2001 was made during the adhesion process in WTO. The third change occurred in facilitating the technology transfer conditions and licensing procedures for domestic and foreign countries in China in 2009. Finally, in 2021, same as in 2009, to improve and strengthen the licensing conditions, the IPR underwent changes.

The adhesion in WTO also positively affected to Chinese IPR system and helped China for joining in different international IP conventions, namely the Paris Convention for the Industrial Property Rights in 1985, the Madrid Agreement for Registration of Marks in 1989, the Berne Convention for Literary and Artistic Work protection in 1992, Convention for the Protection of Procedures and Phonograms against Unauthorized Duplication of Phonograms in 1992, PCT (Patent Cooperation Treaty) in 1994, and WIPO Copyright Treaty in 2007 (besides its adhesion in WIPO in 1980) (Fu et al., 2021, pp. 371–372).

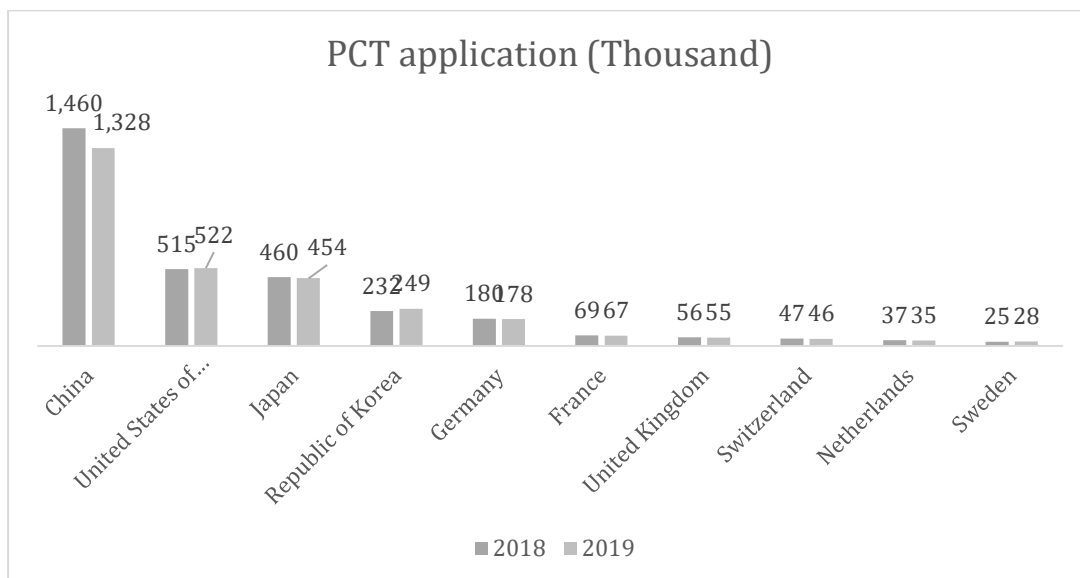
Figure 18 China’s PCT grant



Source:(WIPO, 2021b)

The patent surge in China became more visible after 2001. The same surge is visible In China’s overseas patent application in PCT statistics. As a reminder, the PCT application is one of the oversea patent applications besides the Paris Convention (Fu et al., 2021, pp. 371–372).

Figure 19 China’s PCT application



Source:(WIPO, 2021b)

The authors relate the increase in patent applications for different reasons. Patent protection is extended to cover additional years, and patent coverage is broadened. In 1993, the invention patent protection increased from 15 years to 20 years. Individuals are granted the right to have

their invention patent, which they have invented during working hours. In 2001, the private and publicly owned companies patent applications started to be treated equally (Fu et al., 2021, pp. 371–372; Prud’homme & Zhang, 2019). The strong FDI flows encouraged the patenting and in-house R&D capabilities (A. G. Hu & Jefferson, 2009), and government incentives helped the companies reduce the R&D expenditures but increasing R&D investment and taxes (Prud’homme & Zhang, 2019). The privatization of state-owned companies also has a positive effect on patenting. Also, the government patent subsidy program increased patent applications at the regional and provincial levels. However, because of the critics, such as the subsidy program decreased the patent quality, the Chinese government decided to curb and progressively finish the subsidy program by the end of 2025 (Fu et al., 2021, pp. 371–372).

Figure 20 China’s patent application and patent grant evolution

Year	Application			Grant		
	Invention Patents	Utility model	Design Patent	Invention Patents	Utility model	Design Patent
2021	30%	54%	15%	15%	68%	17%
2020	29%	56%	15%	15%	65%	20%
2019	32%	52%	16%	17%	61%	21%
2018	36%	48%	16%	18%	60%	22%
2017	37%	46%	17%	23%	53%	24%
2016	39%	43%	19%	23%	52%	25%
2015	39%	40%	20%	21%	51%	28%
2014	39%	37%	24%	18%	54%	28%
2013	35%	38%	28%	16%	53%	31%
2012	32%	36%	32%	17%	46%	37%
2011	32%	36%	32%	18%	42%	40%
2010	32%	34%	34%	17%	42%	41%
2005	36%	29%	34%	25%	37%	38%
2000	30%	40%	29%	12%	52%	36%
1995	26%	53%	21%	8%	68%	25%
1990	24%	67%	9%	17%	75%	8%

Source : (*China Statistical Yearbook 2022, 2022*) data for prior years are not available are not available

The patent application increase is also a subject of criticism about the patent quality. The literature increases the critics about the diminishing trend of the patent quality of Chinese patents. In their study on IP regimes in China, Prud’homme et al. (2019) discuss that patent quality does not follow the same increasing path despite the increasing number of patent applications. The authors associate this trend with two reasons. First, the *state-supported patent applications*’ quality is poor, and second, the increasing utility model application pulls down

the patent stock quality of the countries' overall patent stock (Prud'homme & Zhang, 2019, p. 225; Zhao, 2020). The utility models provide a type of protection, easier to obtain, cheaper and faster than invention patents. The literature shows that this type of protection is generally used in latecomer countries such as East-Asian countries (Y. K. Kim et al., 2012; Prud'homme, 2017; Prud'homme & Zhang, 2019; Torres-Barreto et al., 2016). The statistics also show that utility model applications and grants are always higher than invention patent applications.

5.1.3. Open Innovation Policy

At the beginning of the 2000s, IP literature authors were reluctant to integrate China's IP (S. Li, 2004; Liang & Xue, 2010; Xue, 1997; Zimmerman, 2013). The question was simple: how can a country which "banned the property" by default during the communist economy be able to protect the IPR properly (S. Li, 2004), and how will the transformation begin? The scholar's approach to Chinese IPR discussion was quite similar. Peng et al. (2017) say that it is related to "culture and politics", while Li (2004) approach from institutional change theory's formal and informal constraints. According to the institutional theory approach, institutions are "humanly devised constraints that shape human interactions" (S. Li, 2004). Formal constraints are the formal institutions and legal obligations such as constitutions, civil and commercial codes, contracts, etc. Formal constraints cover the society's social and economic order, in other words, the legal side of the society. The informal constraints come from the human side of the society, which includes norms, values and conventions and are a "part of a heritage" called culture, or in the Chinese context called "guanxi". Hence, Li argues that informal constraints can help formal constraints succeed, and reciprocally, formal constraints can also influence and reinforce informal constraints. However, informal constraints change slowly compared to formal constraints (S. Li, 2004, p. 105).

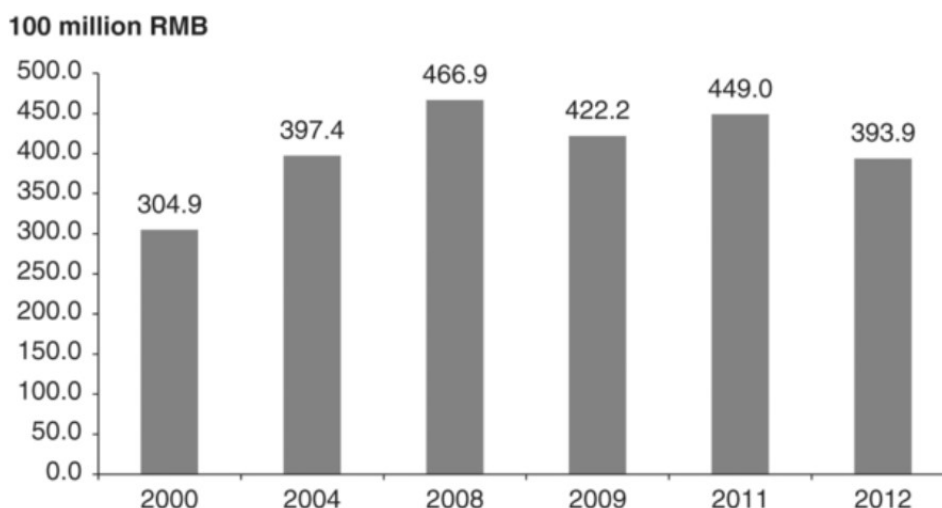
The literature explains that the transformation required knowledge accumulation and increasing the absorptive capacity of the companies (Dosi & Yu, 2021; Lichtenthaler & Lichtenthaler, 2010). With this transition and the accession of the WTO in 2001, China began to increase the speed of its production growth and industrial development. The government's pressure during this transition period focused on increasing Chinese enterprises' absorption capacity through foreign technology transfer (Naughton & Segal, 2002). As discussed earlier, the Chinese government promotes Chinese companies' innovation capabilities through different policies. Fu et al. (2015), in their analysis of Open Innovation and government influence in the Chinese innovation system, discuss that the most important strategy of the

Chinese government is to promote indigenous innovation in Chinese companies. The Chinese government uses programs such as S&T programs (2006-2020) and MIC25 (Agarwala & Chaudhary, 2021; Fu et al., 2021). Fu et al. (2015) consider all those efforts and regulations as Open Innovation policies to encourage indigenous innovation in China.

In the early 1980s, the government aimed to improve foreign investment in China, but it was still limited. Firstly, foreign companies were worried about entering the country, and at the same time, they feared that their export rate would decrease. Secondly, the selection process of the Chinese government requires criteria and a selection process to select the candidate who can be the primary technology partner (Naughton & Segal, 2002). However, with the tax incentives, foreign investment policies and regulatory programs the Chinese government implemented, they showed a willingness to use Open Innovation modalities to improve indigenous innovation capacities.

Accordingly, besides in-house R&D activities, Chinese companies also have external technologies. Foreign countries' technologies with endogenous innovation efforts created the dynamic of the Chinese innovation shift. We can see the results of those policies from technology licensing statistics. The Chinese companies used foreign technology licensing and patent purchasing as the main inbound activities during the transition process. The foreign technology acquisition statistics in 2000-2012 show this trend (Fu, 2015, p. 25).

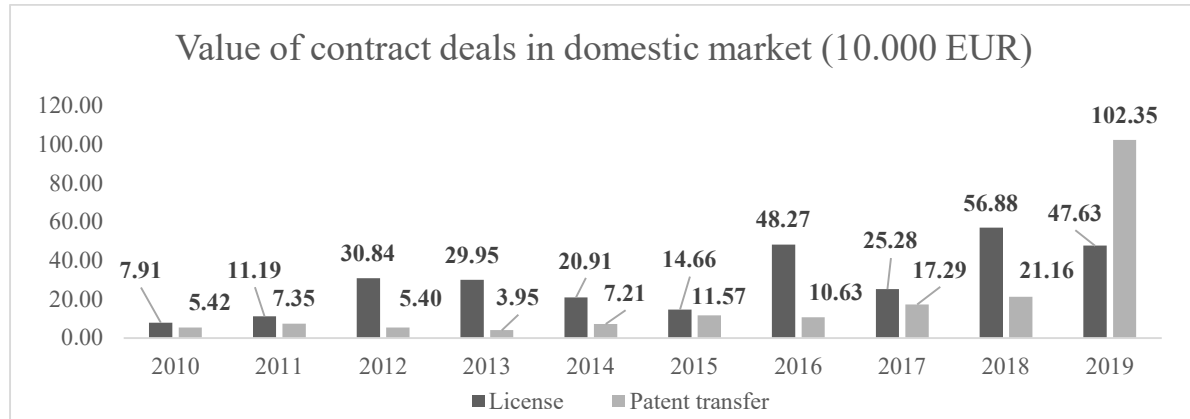
Figure 21 Foreign technology acquisition of Chinese companies



Source: (Fu, 2015, p. 25) (however the information about foreign technology acquisition is not available for 2010 and after 2012- author's note)

The domestic licensing and patent purchasing activities also show an increasing trend after 2010.

Figure 22 Technology transfer contracts evolution



Source: China Statistical Yearbook 2020 (stats.gov.cn)

The government's effort to promote Open Innovation is undeniable. However, in this field, we are looking to answer three research questions;

“What forms of patent exploitation do Chinese companies use during the open innovation process, and how do different factors influence the open innovation process?”

“What types of Chinese companies adopt the open innovation model and engage in patent exploitation?”

“What drivers influence patenting and patent exploitation strategies in open innovation processes in China? Are there specific features that influence Chinese patent exploitation strategy in China?”

5.2. Epistemological positioning

Epistemology is the study of the construction of valid knowledge. It is concerned with those questions: What is knowledge? How is it elaborated? What is its value? (Piaget, 1967)(Piaget, 1967, p.6). These questions concern the nature of the knowledge (epistemological assumptions), the way of the knowledge is construction (methodological assumptions), and how the validity of the knowledge is justified (Gavard-Perret et al., 2018). The researcher should and must find a suitable way to use during its research while searching for responses to

its research question. And the researcher has to respond to two essential questions beforehand: the first one is the research strategy. The second one is to justify its epistemological choice (Wacheux, 1996). The types of approaches lead the researcher to embrace qualitative, quantitative or mixed research methodologies (Creswell, 2013). In management sciences we distinguish three epistemological paradigms: positivism, constructivism, and interpretivism (Thietart, 2014).

Positivism considers reality and the law of nature universal laws where the knowledge considered as absolute truth and related to natural als (Evrard et al. 2000). the role of the researcher remains external and tries to find a universal reality through causal relations. Therefore, the researcher ranges the elements of research from easy to complicated order. The system the researcher builds is a hypothetical-deductive beforehand (Wacheux, 1996, p.39).

On the other hand, constructivism proposes to see reality as a construction where reality depends on human actions. In other words, the researcher knows beforehand the reality from their own experiences and plays the role of constructor intentionally (Le Moigne, 1995). Accordingly, knowledge is a construction of the interaction between the subject and the researcher.

Interpretivism stays between positivism and constructivism, according to Gavard-Peret (2018). Positivism seeks to explain reality, while interpretive tries to understand what sense is given by the actors. The authors explain the interpretative as a considerable lived experience, and a constructed knowledge (Gavard-Perret et al., 2018). The knowledge related to this process aims to comprehend the meaning of the reality through interpretation of the actors decisions (Allard-Poesi et Maréchal, 2007).

Between those main paradims, we find also **post-positivism** as an approach more adoptable in different situations, more flexible than the positivism. Especially Popper and Kuhn criticise the positivist approach and argue that “*the theories cannot be validated for sure, but can be refute*”. In other words, if a theory can be refute, it can be considered scientific (Gavard-Perret et al., 2018). Therefore, the post-positivism challenges the absolute truth of knowledge by recognizing that “*it is not possible to remain positivist when studying the human behaviour or actions*” (Creswell, 2013) and gave the flexibility to the researcher by assuming the difficulty of adaptation of positivist approach to social phenomenon. While the post-positivist methodology try to identify some regularities (patterns) by induction, it formulates some

conjunctures or mechanisms which can explain regularities also differences, and finally investigate empirically (Gavard-Perret et al., 2018 p: 26). The table below resume the existing epistemological paradigms and their positions.

Table 22 Comparative synthesis of five main epistemological paradigms

	Positivism (Scientific realism)	Post-positivism	Pragmatic constructivism	Interpretivism	Constructivism (in the sens of Guba & Lincoln)
Ontological hypothesis	There is a real in itself (THE real) independent of what is being perceived and of the representations that one may have of it	There is a real in itself independent of, and prior to, the attention that can be paid to it by a human who observes it. The real is organised into three stratified domains: the deep real, the actualised real and the empirical real	There are human experience flows	There is structured human activity. The significance consensually attributed by subjects to a situation in which they participate is considered the "objective reality" of that situation	The real is relative: there are multiple socially constructed realities, which are not governed by natural, causal or other kinds of laws.
Epistemological hypothesis	The real (in itself) is not necessarily knowable (possible fallibility of measuring tools)	The innermost reality is not observable. The scientific explanation consists in imagining the functioning of the generating mechanisms (GM) which are at the origin of the perceived events	The real is knowable through active human experience. In the process of knowledge, there is interdependence between the knowing subject and what he studies, which can nevertheless exist independently of the researcher. The intention to know influences the experience of what is being studied.	The real is knowable through experience. In the process of knowledge, there is interdependence between the knowing subject and what he studies. The intention of the knowing subject influences the lived experience of what he studies.	In the process of knowledge, there is an interdependence between the knowing subject and what he studies
Purpose of the knowledge	To know and explain observable phenomena (possibly via non-observable concepts)	Uncovering the generating mechanisms and their activation modes in context	Building intelligibility in the flow of experience for the purpose of intentional action	Understand the process of interpretations, sense-making, communication, and engagement in situations	Understand the constructs of the meanings involved in the phenomenon studied
Knowledge status	Knowledge corresponds exactly to reality. Statements in refutable form	Knowledge of the generating mechanisms tends to correspond exactly to them	A plausible interpretation that suits active human experience and is viable for action	A plausible interpretation that fits the lived experience	A plausible subjective interpretation
Specific methods of justification	Neutrality. Objectivity. Justification of external and internal validity	Explanatory power of the identified GPs. Justification of the validity of the GMs through successive tests in quantitative or qualitative research	Functional adaptation and viability of knowledge to intentional action. Justification of the validity of generic knowledge through testing in action (qualitative research)	Hermeneutic and ethnographic methods. Justification of the communicational, pragmatic and transgressive validities.	Hermeneutic methods mobilized in a dialectical manner. Trustworthiness and authenticity. It cannot be generalized

Source: (Gavard-Perret et al., 2018, pp. 18–19)

Considering the construction of our research question, we are adopting the post-positivist approach (Gavard-Perret et al., 2018), and we are seeking to explore the specificities of Open Innovation processes in Chinese companies. This question led us to an exploratory study using the variables that proved their existence in previous research conducted in occidental countries.

In other words, we are mostly in a deductive approach to see the specificities of the Chinese companies. Our research studies the same variables in a different context and looks for any differences or specificities. Nevertheless, the particularity of the context leads us to solicit a quantitative survey for 1) collecting a high number of data in a short time and 2) the specificity of the context, which does not allow another type of research besides quantitative data survey (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Mbengue & Vandangeon-Derumez, 1999; Yin, 2003, 2014, 2018).

Methodology choice

The researcher has to choose how to construct the knowledge. Either the researcher has to build the knowledge by exploring or testing the knowledge already existing in the theory (Charreire-Petit & Durieux, 2014). More specifically, the test is used to prove what is real. It aims to confirm and verify the real knowledge, and the researcher is conscious of what can be found from this research. On the other hand, the construction of knowledge is related to the exploration of what exists. The researcher aims to bring some new evidence of knowledge by construction. The researcher must know what will be found at the end (Kirk et Miller, 1986).

Nevertheless, neither test nor exploration is related to a specific paradigm epistemological. The researcher can “*claim to belong to paradigms as different as positivism, constructivism, pragmatism or interpretativism*” (Charreire-Petit & Durieux, 2014). Therefore, the researcher can mobilize either “*different forms of observations, interviews, surveys, simulations or quasi-experimentations*” to explore and develop new theoretical projects rather than to test them (Charreire-Petit & Durieux, 2014).

While the positivist approach tries to bring an explication to the relations such as “*whenever A occurs, then B tends to occur*”, the post-positivist approach tries to explain the relationship more intelligible such as “*whenever A occurs, then B tends to occur*” in this or that context (Gavard-Perret et al 2019). The methodological flow of identification of different stages of this relationship is made through three different modes of thinking: induction, abduction, and deduction (Bhaskar 1998b), which are not iterative but useful.

Induction is a scientific mode of thinking which takes into evidence the observation of the reality from a singular case study and generalizes the results as universal statements (these souffiane, Gaavard-Perret 2019 p: 26).

Charreire et Durieux. (2007, p. 60) state that *“there is only induction if, by verifying a relationship (without proving anything), on a number of concrete examples, the researcher assumes that the relationship is true for all future observations”*.

The deduction is a scientific mode of inference that finds the reality in the field by using the existing theoretical knowledge. It assumes that knowledge already exists, and the theory follows the experience (Mbengue et Vandangeon-Derumez, 1999). In other words, as a consequence of a rationalist approach, *“if we consider that all companies have a board of management, then by deduction, it is possible to conclude that, for a particle case of organization example, that since this is a company also, therefore necessarily this organization has a board of management”* (Gavard-Perret 2019, p: 8).

Abduction is again a scientific mode of inference consisting of making conjectures about the possible reasons for a phenomenon using field observation and theoretical elements. Gavard-Perret (2019) remind us that abduction is *“a matter of making conjectures about the possible causes of a certain observed phenomenon (Locke, 2010). The conjectures thus established will then have to be examined through rigorous theoretical criticism and empirical testing (Bhaskar, 1998)”*. The authors also remind us that abduction, different from induction, is not seeking to establish rules such as *“whenever A occurs, then B”*, but instead, to identify plausible causes of the phenomenon, by using existing information (Gavard-Perret et al., 2018, pp. 27–28). In our research, we have chosen abduction because of the nature of our research question.

The testing or exploration is more likely to be done in the post-positivist approach, either using one or both of these tools as methodological decisions. However, this choice depends on what the researcher wants to put in evidence in its research and is open to the researcher's epistemological positioning. Gavard-Perret et al. (2018) precise that the researcher must not maintain the epistemological positioning to methodological considerations. The authors remind us that the researchers generally consider quantitative research tools positivist tools, whereas qualitative research tools are associated with interpretivist or constructivist approaches. Also, the authors remind us that both quantitative and qualitative tools can be used (Gavard-Perret et al., 2018, p: 39). In the same vein, Yin (2014) precise that *“(and yes) the case study research can include, and even be limited to quantitative evidence. Any contrast between quantitative and qualitative evidence does not set apart the various research methods”* (Yin, 2014, p. 55). In other words, for explorative analysis, it is not an obligation to use a qualitative

approach, and it is always possible to use quantitative research tools if necessary (Yin, 2014, p. 55).

In their research, Mbengue et al. (1999) shed light on clarifying the epistemological positioning and objectivity of both qualitative and quantitative research methods. They highlighted how quantitative methods are employed in non-positivist epistemological frameworks, while qualitative approaches can also be utilized within positivist paradigms. The initial phase of the study involves offering guidance through a four-step framework for epistemological positioning. These steps include 1) The specific research question and the overall research context heavily influence the practical decisions made during a research study. It is crucial to determine what type of data can realistically be collected within this particular context; 2) The method utilized for data collection should view the questionnaire as an objective tool for gathering a substantial amount of information within a restricted timeframe; 3) The relationship between theory and empirical observation should consider both qualitative and quantitative research methods as neutral, adaptable, and applicable in various contexts. For instance, an abductive approach may involve utilizing a quantitative research tool to develop a model or facilitate analytical generalization processes. Consequently, the literature highlights that categorizing data using quantitative tools such as correspondence analysis or factorial analysis aids researchers in elaborating on and simplifying complex datasets (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 2014); lastly, 4) The scientific validity of the study is typically contingent upon its specific context, thereby limiting the generalizability of its findings, even if they are valid (Mbengue & Vandangeon-Derumez, 1999). Regarding the impartiality of data collection methods, the authors contend that employing both quantitative and qualitative approaches is beneficial and mutually enriching for most epistemological perspectives.

Yin (2014) also stressed the methodological choice in his seminal study “Case Study Research”. First published in 1984, Yin explains the roadmap of a case study research by providing a systematic and rigorous blueprint of this research. This tentative of Yin also provides a roadmap for qualitative research in general and makes the qualitative research approach more systematic (Piekkari & Welch, 2018). In his study which evaluated and became more comprehensive during the years, Yin argues that the qualitative (case) study can sometimes be limited to quantitative data only, Besides using both data as in mixed methods, a case study can be *limited* with a quantitative analysis (Yin, 2014, p. 55, 2018, p. 44).

Considering the construction of our research question, we are adopting the post-positivist approach (Gavard-Perret et al., 2018), and we are seeking to explore the specificities of Open Innovation processes in Chinese companies. This question led us to an exploratory study using the variables that proved their existence in previous research conducted in occidental countries. In other words, we are mostly in a deductive approach to see the specificities of the Chinese companies. Our research studies the same variables in a different context and looks for any differences or specificities. Nevertheless, the particularity of the context leads us to solicit a quantitative survey for 1) collecting a high number of data in a short time and 2) the specificity of the context, which does not allow another type of research besides quantitative data survey (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Mbengue & Vandangeon-Derumez, 1999; Yin, 2003, 2014, 2018).

This inquiry has prompted us to conduct an exploratory study employing variables that have been previously identified in research conducted in Western nations. In essence, we predominantly utilise a deductive approach to examine the distinct aspects of Chinese companies. Our investigation delves into these variables within a different context, searching for any disparities or specific attributes.

Ideally, the research methodology is adapted to the research object, and, for example, the decision to use qualitative or quantitative methods is made by the researcher when developing the research question (Thietart, 2014). In reality, the selected method

depends on the access to the field. In management science, researchers use quantitative methods to test existing theories, most often statistical studies based on surveys or interrogation of existing databases. Qualitative analyses, however, are particularly useful for building, enriching or developing theories: in most cases, face-to-face or telephone interviews. This is not quite what we find when we look at the methods deployed in research on Chinese companies.

Table 23 The methodological choice of Chinese field in management sciences

Auteur	Topic	Methodology	Methods used to meet the field
Savitskaya, Salmi, & Torkkeli, 2010, 2014	Open Innovation barriers	Quantitative : Survey in Yunnan province - 501 companies	Survey conducted by an international organization
Ma, Lee, & Chen, 2009	Invention activités analysis in China	Quantitative : Database analysis	USPTO and CNIPA database
Wang, Roijakkers, & Chen, 2012, Wang, Roijakkers, & Vanhaverbeke, 2013	How small business improve their innovation capacity	Quantitative : Documentary and database analysis	Database, internet, company websites, phone interviews
Perks, Kahn, & Zhang, 2010	R&D and marketing integration in Chinese companies	Quantitative : 200 survey responses from 6 large companies	E-mail, internet, public reports
Hu & Jefferson, 2009	Research and modelling on patent growth in China	Quantitative : Database analysis	Report carried by Chinese National Statistics Office
Mitkova et al 2015	Open Innovation strategies of Chinese companies	Qualitative	Phone interview
Prange, 2012	Internationalization strategies of Chinese companies	Case study	Literature and documentary review
Xue, 1997	Système d'innovation en Chine	Case study	Literature and documentary review
Li, 2004	Faiblesse de la protection de la Propriété Intellectuelle en Chine	Case study	Literature and documentary review
Haakonson & Slepnow 2018	Danish FDI effect on Chinese companies	Case study	Literature and documentary review
Soon et al 2016	Evolution of patent application trend	Case study	Literature and documentary review

As illustrated in Table 20, research on innovation in China can be grouped according to their methodologies into several groups: quantitative studies using patent and licensing databases (e.g. (Ma et al., 2009; Y. Wang, Zhou, et al., 2012; Y. Wang et al., 2013) or based on survey data (e.g. (A. G. Hu & Jefferson, 2009; Perks et al., 2010; Savitskaya et al., 2010, 2014) often conducted in partnership with government institutions; and qualitative studies based on limited interviews arranged through personal and institutional contacts (e.g. (Mitkova & Wang, 2015)) and case studies based on literature review and documentary search (e.g. (Aladagli & Oulion, 2015; Haakonson & Slepniow, 2018; Soon et al., 2016; Xue, 1997)).

Our research question aims to explore the IP exploitation in the framework of Open Innovation in China, lead us to an explorative study. However, the difficulty of the field lead us to conduct a quantitative survey which gave us the possibility to use different methods of analysis.

Company selection

The generation of new technologies and innovation can be measured by patent numbers or R&D spending (Gries et al., 2017). The criteria of our research while searching participants was the patent activity. Hence, we are using patent data as innovation indicator. We wanted to find companies who have an active patent activity both in national and international dimension. Therefore, we used patent data as innovation indicator. Our sample consist of the Chinese companies with intensive patenting activity in order to understand the patent exploitation strategies.

Our sample is chosen in three steps. First, we've started our research from SIPO database (State Intellectual Property Office of China, which is called China National Intellectual Property Administration- CNIPA since August 2018(*EPO - China, 2020*). Our research has started in September 2013 but we've collected the company information in May 2014. Accordingly , we've collected the previous years (2013's) active patenting companies list from CNIPA's internal contact which we've found using Chinese universities relationships. The list was comprising only two information: the name and the total patent of the company in China. The first list comprising 1000⁵ companies supplied by CUFE team from CNIPA's 2013 database. We've also asked for the least patenting companies⁶ from CNIPA's database in order to create a difference between active patenting and non-active patenting behaviour of companies. In total, we had 2000 companies from CNIPA.

⁵ Voir le fichier : 中国专利公开排序_20141128.xls in

C:\Users\gizem\Dropbox\Doctorat_MasterFile\Doctorat\Donnes\3_Analyses du questionnaire\6_Questionnaire and Raw data\Qtionnaire\Longlist\1-NewCompanyList_2015

⁶ Voir le fichier : 有效发明 1 件的企业_20141231_Least1patent.xlsx in

C:\Users\gizem\Dropbox\Doctorat_MasterFile\Doctorat\Donnes\3_Analyses du questionnaire\6_Questionnaire and Raw data\Qtionnaire\Longlist\1-NewCompanyList_2015

Second, we've made the same research in the EPO's (European Patent Office - Austria) database in France by ourselves. This time, we've searched between 2010-2014⁷ in order to expand the data and search if the listed companies in Chinese database grant PCT patents from EPO as well. Our list reached more than 100.000 company. However, we had the same problem as we had in CNIPA's company list: the list couldn't provide us the company details. In order to be able to accelerate our research and gain time, we've decided to move with the CNIPA's database and keep the EPO data for cross-check. The expansion of the data provide us the international patenting activities of the companies.

Finally, we've created a list of patent holder companies which includes only the name and the number of patents of the company. However, in order to expand our research and to be able to find a contact from the company to ensure the safety of our research, we had to continue our study on the internet to be able to collect the contact information and the names associated with the head of the R&D department (if it exists). Nevertheless, we couldn't find specific names assigned to the head of R&D department position by our web research.

In the first search, we've collected the web sites and phone numbers of some of the companies. At first, we tried to find them by phone from France. But given the strong hierarchy and the sensitivity of the subject, we could not reach the name of the head of R&D department. Then, we shared the list of companies among Chinese colleagues for the collection of contact information to find from Chinese web sites and from their networks which helped us to conclude the company information

Industry dispersion (e.g. put some table like this, using STAN-nace codes and industry description)

To differentiate the industries and to understand the industry dispersion of the companies, we've used the OECD's industry definitions (OECD, 2019b).

We've also used the same OECD industry descriptions to identify the high-tech and low tech industries in our sample;

⁷ Voir le fichier : 2010_2014_COMPANY LIST.xlsx in

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WIPO\EPO\EPO_lis.

Table 2
Sectoral classification

Variable	Description
LT Manufacturing [n. 693]	Low-Technology Manufacturing: Wood, pulp, paper, paper products, printing; Food products, beverages and tobacco; Textiles, textile products, leather and footwear; Manufacturing, n.e.c.
MLT Manufacturing [n. 523]	Medium-Low-Technology Manufacturing: Building and repairing of ships and boats; Rubber and plastics products; Coke, refined petroleum products and nuclear fuel; Other non-metallic mineral products; Basic metals and fabricated metal products
MHT Manufacturing [n. 589]	Medium-High-Technology Manufacturing: Electrical machinery and apparatus, n.e.c.; Motor vehicles, trailers and semi-trailers; Chemicals excluding pharmaceuticals; Railroad equipment and transport equipment, n.e.c.; Machinery and equipment, n.e.c.
HT Manufacturing [n. 314]	High Technology Manufacturing: Aircraft and spacecraft; Pharmaceuticals; Office, accounting and computing machinery; Radio, TV and communications equipment; Medical, precision and optical instruments
Technical Services [n. 193]	Technical Services: Research and development enterprises; Architectural and engineering activities and related technical consultancy; Technical analysis and testing.
InfoTech Services [n. 164]	Information Technology Services: Telecommunications, computer services and related activities
Financial Services [n. 309]	Financial Services: Financial intermediation, including insurance and pensions, and activities ancillary to financial intermediation, plus the renting of machinery and equipment (excluding real estate activities).
Professional Services [n. 450]	Professional and Other Business Services: Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holding companies; travel agents and tour operators; real estate activities; publishing
Transport Services [n. 272]	Transport and Storage Services: Land, water and air transport, including pipelines, post and courier services, plus cargo handling and storage, but excluding travel agents and tour operators.
Wholesale Services [n. 489]	Wholesale and commission trade (except motor vehicles and motorcycles)

Source:(Tether & Tajar, 2008)

During our research, we've interviewed the R&D managers or the head of R&D department. Therefore, we frame the wording of “*companies*” and sometimes “*the responded companies*” as the unit of analysis in our study.

In the beginning of our research, we were planned to meet with the company R&D responsible face to face. However, the field conditions doesn't allow us to do it so.

The first challenge was to find the right person from the company. We can explain this situation in the light of *guanxi*, a concept often used to understand the nature of interpersonal relationships in the Chinese context (Davison et al., 2018; Gibb & Li, 2003). The importance given to *guanxi* makes it difficult to enter a field (particularly within companies and the government), and a personal introduction is needed to get an interview. While this is far from impossible, as evidenced by the number of existing studies on China in various fields of the social sciences, it requires time and being on the ground as much as possible, which is not always the case depending on the constraints of the research project, funding constraints, etc.

The difficulty of management science studies is that they are concerned with companies, and in particular, their internal dynamics and strategies. In a Western context (especially in the United States and Western Europe), including in a competitive market, companies tend to be more transparent, and likely to share information than in China. This is partly due to the specificities of the Chinese economy and its institutions. The competition faced by companies - especially private companies - is very strong. This leads companies to be reluctant of outsiders

when it comes to technology and innovation issues, whether Chinese or foreign. This is especially true when we specifically ask questions about their R&D strategies abroad - by definition - sensitive because they are strategic for the companies, which requires additional trust in the researcher and the institution he/she represents.

Secondly, an obvious difficulty is linked to the Chinese language. Although many Chinese senior managers have some knowledge of English, their proficiency of a Western language remains marginal. As a result, research on business in China is carried out either by Chinese researchers, many of whose works are not translated in foreign languages, or by foreign researchers who speak and read Chinese, and who in fact specialise in China, or by researchers from outside China who need translations and interpreters. While the amount of data available in English is steadily increasing, many documents exist only in Chinese. Language thus acts as a 'filter' that is not neutral. However, this difficulty is specific to any research conducted in a foreign country, when the researcher does not know the language of the country he or she is studying.

We've used the CAI-YUANPEI research project for our field research. This project gave us the opportunity to reach the field and conduct the research.

5.3. Research design

In the beginning of our research project, China as a research field was a very far option for us to study as an emergent market. Our aim was to study and search the innovation from the light of Open Innovation theory the Chinese companies. By the help of our network, we've found the CAI YUANPEI program. The CAI YUANPEI program's objective is to create and develop a network between Chinese and French research laboratories in order to develop scientific and technological exchanges. The exchanges concern the researchers and PhD students in all the scientific research fields (CAI YUANPEI, 2014). Being a part of the CAI YUANPEI program gave us a fruitful opportunity to have an access to the field. during our research project, we've collaborated with one of the first economics and management universities of China, The Central University of Finance and Economics in Beijing (hereinafter CUFÉ)⁸.

⁸ [School of Finance , Central University of Finance and Economics \(cufe.edu.cn\)](http://School of Finance , Central University of Finance and Economics (cufe.edu.cn))

The first meeting in CUFE (Beijing) was on 11th of December 2013. Our first meeting was initially to introduce ourselves, to collect the secondary data, understand the possible information that we can collect from the field and to see by ourselves what can and what cannot be done in the field. We've also shared the information about the aim of our survey, general information about the survey questions, our expectations about the surveyors and about the survey results.

We've also discussed how to collect company information from Chinese patent database and from internet. The first visit to Beijing and to CUFE gave us a deep insight about the difficulties and the possibilities of the field. accordingly, we've shaped our research realistically and coherently from the field dynamics and our research question. Hopefully, the CUFE team provide us all the documents which explain the Chinese patent and patenting dynamics, the information about the government control and promotion activities through the national plans as well as the difficulties to reach without an intermediary to any R&D department in a company etc. Hence, our first visit to China gave us a more real image about the field.

More specifically, before coming to the field, we were expecting to conduct face to face interviews and possibly a qualitative research with 10 to 20 companies. Therefore, we've solicit the know-how of the CUFE team which they were doing research very often to the government agencies, particularly to the ministry of economic affairs. We've discussed all the possibilities of field research with the Chinese university team such as, face to face interviews with or without a translator, sending the questionnaire by post, or by email and make some reminders until having a response, or trying to make it by ourselves in their office etc. We've concluded that a qualitative research is difficult even impossible for a foreigner.

First, a face to face interview was not possible because, we could only communicate in English or in French, but Chinese companies workers spoke only in Chinese. We also thought if we can hire a translator who can follow us during the interviews and help us to create connections to conduct the survey. Unfortunately our time and our budget was limited and the necessary connections with the companies couldn't be done in one month in the field. Second, it was not possible to conduct phone interviews either. Companies are not likely to have a free-talk about the company information on the phone to the persons that they didn't meet before or this person is not a person approved beforehand by the top management of the company. We were convinced that it was impossible for a stranger/ foreigner, non-Chinese person to access in a

Chinese company. Even if we could, it wouldn't be possible for our contacts to find more than 1 or 2 companies for an interview which wouldn't be enough for an analysis.

We had to change our approach to the field because of the field conditions and we've then changed our interview approach to a questionnaire with qualitative questions which the CUFU members use for their research.

In that case, we first thought to send the questionnaire by e-mail, or by ordinary mail to the R&D responsibilities of the companies. However, we were told that this method also will fail because of the sensitivity of our research question, the respondents wouldn't take into consideration our request. Finally, we've agreed to create a team, under the supervision of our CAI-YUANPEI program responsible in China and us from France, in order to conduct the survey by phone interviews in China.

Recruitment and survey administration

The first meeting enlighten us a lot, and gave us the insight how to use the field resources effectively; by the light of our introduction meeting, we were convinced that we can only conduct a quantitative research with the sources that we have. Because of the language barrier, we had to make the interviews in Chinese. Accordingly, with the help of our program responsible in China, we could create a team of 2 surveyors in the beginning of our research. One month later this assignment, we've increased the surveyor number to 6 people from master students in order to be able to collect the data in short term and not to push too much our team members.

The students (surveyors) were bilingual (English and Chinese). They were all in the second year of their study, and they were all had a previous knowledge about the patents and IPR. However, their previous survey experience was limited with 2 to 5 interviews. Therefore we had to prepare them for possible difficulties and how to conduct a survey with R&D responsible (what to say, what not to say etc.) and we trained them for any difficulties and how to conduct a questionnaire.

The surveyors reported every week to us and copy to their supervisor in China by mail. We were also in touch with them daily basis using Wechat⁹ communication application. We were

⁹ [WeChat - Free messaging and calling app](#)

giving support for their issues, such as no answer or worse (rude answers etc.). When we've selected the companies from our list, we've send it to the surveyors to complete the missing information such as demographics and contact person details from the R&D department, and we've asked the surveyors their schedule and their calendar in order to organize our daily exchange and the period that they can work for our project.

Nevertheless we've reached a level of answers where no surveyor could proceed more. After 10 attempts of failed contact either because not reaching the company or the peron we want to survey, we declared these companies as not interested in filling out the questionnaire. By the end of March, we had finished only 50 questionnaire.

In this moment, we assigned new and more experienced persons as surveyors in order to stay in the schedule. After this assignment, we've carried 134 questionnaire and we've finished our data collection.

Missing data

Missing Data (abroad questions, questions with low response rate, possible explanations for the missing data)

In the beginning of our research, our company list had 1000 companies, active in patenting. However, we had to exclude governmental research institutes and universities from our list and drop to 658 companies¹⁰. Secondly, we've excluded foreign companies and we created a list of 310 companies.

In order to create a differentiation among the participants, we've also added 50 new companies which have 1 patent application in 2013 as the "least one patented company". However, we couldn't collect any information from those companies. Because of their closeness through third parties they refuses to answer.

At the end of our research process, we've collected 134 survey which 3 of them un-answered. However, during our data process, we've find that 2 questionnaire with full response belongs

¹⁰ NEW company list_ChineseCompaniesOnly_MASTER in
C:\Users\gizem\Dropbox\Doctorat_MasterFile\Doctorat\Donnes\3_Analyses du
questionnaire\6_Questionnaire and Raw data\Qtionnaire\Longlist\1-NewCompanyList_2015

to foreign companies. We had to exclude those from our sample. In total, we had to exclude 5 companies. we've then proceed our research with the remaining 129 questionnaire.

Our survey questions composed of particular attention to patenting concession of companies. Those kind of questions and information may be acceptable for weastern countries. However, in eastern countries, mostly in our field, it is confidential. To surpass this problem, during our research, we've searched for the highest authority in the company to participate our survey. First, because of the confidentiality issue, we couldn't collect all informations asked in our survey. Some companies stay reluctant for some part of questions, mostly for "abroad", "other" and "patent portfolio" questions. Some companies doesn't respond to a whole part of some topics. In order to save the reliability of our survey, we've decided to exclude some question, because of the lack of responses.

Respectively, we've excluded the following questions: 1) all open-end questions asked under form of "other", 2) all "abroad choice" questions such as "abroad patenting" etc, 3) all "portfolio composition" questions which we couldn't collect enough information to include in our analysis.

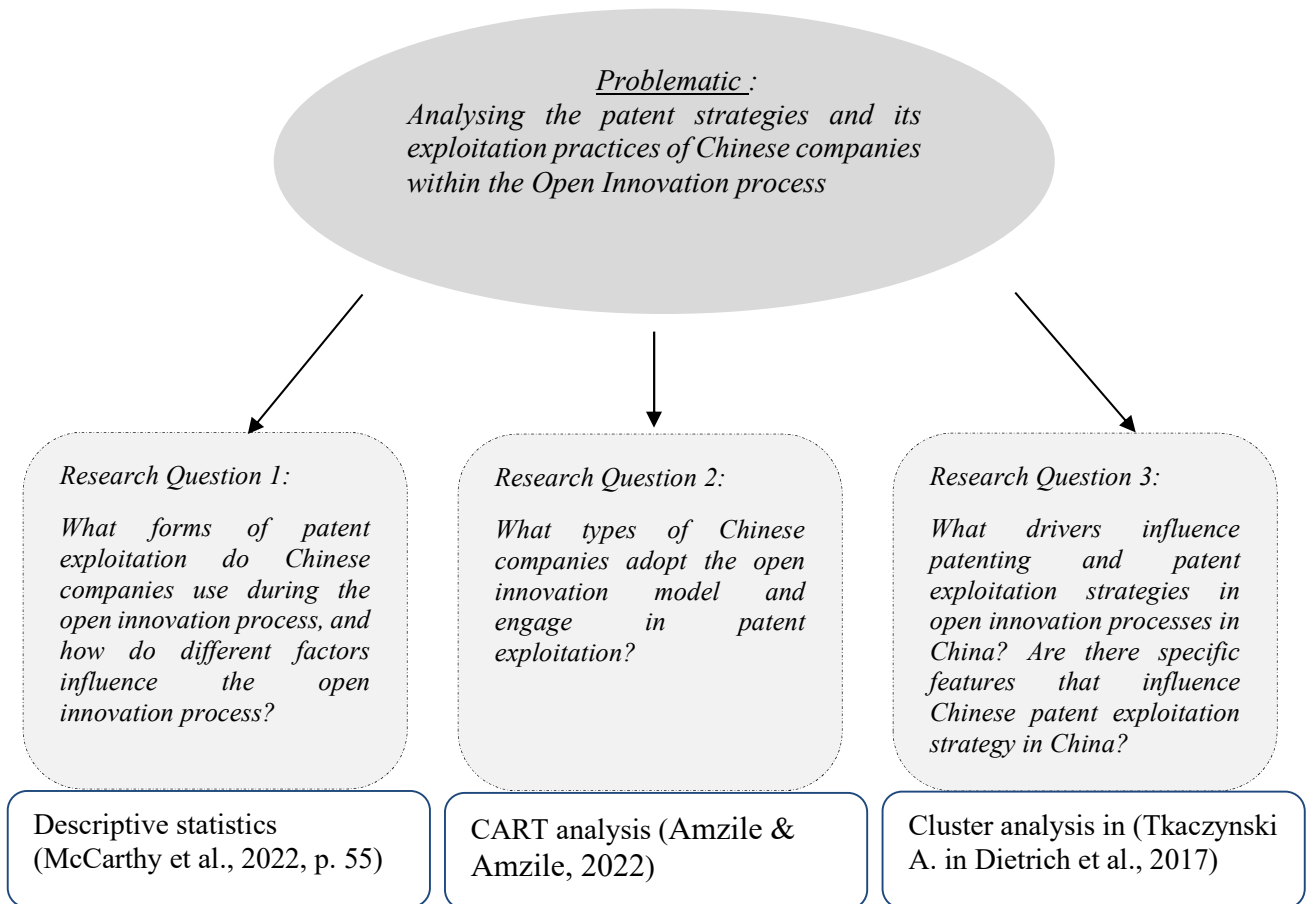
Again, because of the ethical concerns, we are not able to share the real name of the companies and respondents in our research.

Data analysis

We've first, used the data analysis program Sphinx for the first coding of our data on excel. Our purpose is to generate a descriptive analysis first, to prove the existence of Open Innovation modalities in the field. In the second step of our research, we needed to find an analysis which can put in evidence the Open Innovation adoption behaviour of the companies (CART analysis), and to identify the specificities about the exploitation strategies of the companies (Cluster analysis).

To do so, we've started to collaborate with some experienced colleagues in quantitative data analysis from our network . Accordingly, we've solicited Stata first to run descriptive statistics, and to familiarize the data and results about the companies. Therefore, our results from descriptive statistics came from Stata. Then, we've faces some analysis problems in the program and we've solicited SPSS for further analysis that our colleagues can work comfortably. Therefore we've run SPSS for CART and Cluster analysis.

Figure 23 Research designs



In order to respond to our question, we wanted to verify first the existence of Open Innovation pattern in Chinese context (deduction). Therefore, we've first made descriptive statistical analysis to understand the field and to see if there are Open Innovation modalities used by the participant companies. The results prove the existence of Open Innovation modalities in the Chinese context.

Then we've analysed the regularities or differences which can refute some theoretical details. The existing Open Innovation literature already explored different types of Open Innovation modes and strategies in occidental cases. In order to gain a better understanding of the unique aspects of the Chinese context as an emerging Asian economy, we conducted a descriptive analysis using Stata software. This analysis provided us with some notable patterns among Chinese companies (McCarthy et al., 2022, p. 55)

To analyze the data, we utilized the CART Decision Tree analysis technique in SPSS. This decision tree, originally derived from data mining methods, represents a structured framework

of choices. It is visually represented as a tree, with the various possible decisions displayed at the end of the branches (leaves). Those leaves are reached by a model which is constructed through dichotomous tests. The model explain the variables as a binary choice bucket and put the decisions in an iterative method to an order. This allows to show a group of participants in a binary explication of variables. (Amzile & Amzile, 2022). The CART analysis shows us, by using existing variables establish some rules in a binary form. We use decision tree analysis to identify the Open Innovation behaviour of the companies while patenting and while using patents internally and externally. (McCarthy et al., 2022, p. 126)

We use also a cluster analysis to identify different Open Innovation strategies, and to put in evidence possible specificities of Chinese companies Open Innovation strategies. The Cluster analysis used as a tool to identify the exploitation strategies of the companies. our purpose is not to find if there is any defensive or offensive exploitation groups, but rather, to put in evidence specificities of those groups (Tkaczynski A. in Dietrich et al., 2017).

Survey questions

Our survey consist of 7 main parts, 27 topics and total 311 questions mainly consist of 4 Likert scale.

Table 24 Survey questions themes

Themes	Questions
Patenting	1) Market perception, 2)Government incentives, 3) Protection choice, 4) Alternative protection, 5) Patenting reasons (in China and abroad if exist), 6) Exploitation of patents, 7) Abroad country choice, 8) Country choice, 9)Patent concession experience.
Open Innovation	10) Inbound patenting motivation, 11) Outbound patenting motivation, 12) Inbound licensing motivation, 13) Outbound licensing motivation, 14)Inbound licensing - Partner selection 15) Inbound licensing- Partner criteria, 16) Outbound- Partner selection, 17) Outbound- Contacting partner, 18) Initiative to approach the partner.
R&D collaboration	19) R&D collaboration partner choice,
Portfolio	20) Portfolio composition, 21) Portfolio age, 22) Patent & licence portfolio age (inbound & outbound), 23) Own patent & licence portfolio age (inbound & outbound).
Barriers	24) Outbound barriers, 25) Inbound barriers.
Future plans	26) Future plans
Company profile	Industry, government, export rate, worker number, turnover

The 7 main parts distributed as follows: I) Patenting, II) Patent concession, III) R&D Collaboration, IV) Portfolio age & composition, V) Barriers , VI) Future plans, VII) Company profile. The distribution of themes shown in the Table 21.

Conclusion of Chapter 5

In this chapter, we will delve into the background of our study and highlight the significance of China. As the largest country in Asia, China has earned a reputation as a global manufacturing hub. However, since its economic liberalization began in 1989 with Deng Xiaoping at the helm, China has made significant strides in opening up its economy. Three key developments in China's economic history have propelled its innovation capacity: transitioning from a centrally planned economy to one with market orientation and embracing openness in economic activities (Worldbank, 2021). These changes have been complemented by low-cost labour and increased knowledge acquisition through imported products, technology transfer via licensing agreements, and foreign direct investment. Consequently, China's high-tech production capability has witnessed remarkable growth.

The entry of China into the World Trade Organization (WTO) in 2001, combined with an increase in technology transfer, has greatly contributed to the development of technological knowledge within companies. The Chinese government plays a central role in the country's economic growth due to its planned economy. Consequently, its influence throughout this process is undeniable (Fu, 2015; Fu et al., 2021). In order to foster innovation, the government implements Science and Technology (S&T) plans. Additionally, they exert control over markets by implementing protective measures and introducing new regulations that promote competition. This is particularly evident in industries with high levels of competition such as electronics and telecommunications (Fu, 2015). Moreover, the government continues to foster an innovative environment through initiatives like establishing technology development zones through the Torch plan since 1988 and implementing Sparkle plan which aims at developing innovation capacity and industries. They also provide incentives for advancements in S&T. After 2005, there was a shift in Chinese government policy towards indigenous innovation and energy-saving programs from 2006-2020. The introduction of Made in China 2025 program further emphasizes self-reliance by creating an innovative China where products made within the country are recognized as a national brand (Made In China).

In 1980, the State Intellectual Property Office (SIPO) was established in China, which later became the China National Intellectual Property Administration. Over the years, there have been several amendments to the patent law. In 1993, changes were made following China's accession to GATT (General Agreement on Tariffs and Trade). Subsequent modifications took

place in 2001 after joining WTO (World Trade Organization), in 2009 to facilitate foreign technology transfer regulations, and most recently in 2021 to enhance and strengthen licensing conditions. China joined the Patent Cooperation Treaty (PCT) in 1994. This marked a significant turning point as Chinese patent applications started surging after 2001.

The primary focus of the Chinese government is to encourage homegrown innovation. Various science and technology initiatives have enhanced domestic innovation capabilities (Fu et al., 2015). In the early 1980s, the government aimed to attract more foreign direct investment. However, due to uncertainties within the country, foreign companies were hesitant, and their investment decisions were subject to a selection process overseen by the government in collaboration with local partners (Naughton & Segal, 2002). To address these concerns, the government undertook administrative reforms that included changes in foreign investment policies and the implementation of regulatory programs. These measures helped attract foreign investors and facilitated technology transfer from international companies through licensing agreements or purchasing patents. This strategy allowed Chinese companies to acquire valuable technological expertise from their global counterparts.

In this particular context where the government encourages open innovation practices, we are interested in exploring the answers to three research questions:

“What patenting strategies do Chinese companies employ in open innovation processes?”

“Which forms of patent exploitation do Chinese companies use during this process, and how do various factors influence them?”

“What types of companies adopt the open innovation model and engage in patent exploitation? Are there any specificities that influence their choice of patent exploitation methods?”

In the second sub-chapter 5.2, we position ourselves in a post-positivist posture to use the deduction of existing literature and its flexibility as a methodological choice. Our research question explores IP exploitation in the framework of Open Innovation in China. This question leads us to an explorative study. However, because of the language barrier and limited time concerns, we used a Chinese university to reach the field and conduct a quantitative survey, which, in return, gave us the possibility to use different methods of analysis (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Mbengue & Vandangeon-Derumez, 1999; Yin, 2003, 2014, 2018), the descriptive analysis, cluster analysis and CART (decision tree) analysis. The descriptive analysis allowed us to see the Open Innovation context in China and detailed

information about the Chinese companies. The Cluster analysis gave us two groups of clusters which are particularly similar in terms of patenting choice: adopting a defensive patenting strategy, practising inbound open innovation activities in the first place to increase internal innovation capacity, and outbound open innovation activities solely for increasing revenue. The CART analysis gave us some behaviour paths for patenting in open innovation processes.

The last sub-chapter 5.3 allows us to explain in detail our research design, our survey in detail, the missing data because of the non-responded questions and the criteria we chose to select companies.

In the following section, we explain the data analysis in detail.

PART 2

In this second part of our study, we introduce the empirical part and the results of this empirical research.

Chapter 6 is dedicated to the first analysis of our research, which will respond to our first research question: “What patenting strategies do Chinese companies employ in open innovation processes?”. We used the descriptive analysis to respond to this question. In this chapter, we present the results of this analysis and provide a general presentation of the Chinese companies and the use of patents in the open innovation processes.

Chapter 7 presents the study's results, dedicated to responding to our second question: “Which forms of patent exploitation do Chinese companies use during this process, and how do various factors influence them?”. To respond, we used the cluster analysis. This analysis shows two clusters regarding patent exploitation and open innovation adoption level.

Chapter 8 is dedicated to responding to our third question: “What types of companies adopt the open innovation model and engage in patent exploitation? Are there any specificities that influence their choice of patent exploitation methods?” We used CART analysis, which shows the decision relations between the variables.

Chapter 9 is reserved for discussing the data analysis and the study results. The results of the first question analysis show that Chinese companies are using inbound and outbound open innovation processes. They are large companies concentrated on the east coast of China and from different industries. The results of the second question show two groups that are very similar in patent exploitation but slightly different in openness level by showing the willingness to open and adopt more outbound open innovation activities. The results of the third question analysis show that the patent application motivations are highly related to inbound open innovation activities and defensive, and patents are also highly related to inbound activities.

Chapter 10 is dedicated to the conclusion of our study by bringing theoretical and managerial contributions. Our study showed that Chinese companies prefer collaborating with R&D institutes instead of universities. Chinese companies use inbound and outbound open innovation activities but are more likely to use inbound widely for protective reasons. The use of outbound open innovation activities is to increase their revenue. The final question reveals

that open innovation, specifically inbound open innovation adoption, is related to protective and defensive purposes. The main managerial contributions of our study are that due to competitive market conditions, Chinese companies' trust levels are very low against partners, and Chinese companies are seeking to become more open with the help of government policies.

Chapter 6 Description of factors that impact Open Innovation

This chapter is dedicated to presenting the results of the empirical study of our research. First, we will present the survey results out of 129 participant companies. To gain a deep understanding of the field, we first conducted descriptive analysis, then decision tree and cluster analysis to extract the necessary information from our research.

At the beginning of our analysis, we first conducted the descriptive analysis. We aimed better to understand our research field and the company's profile and identify the specificities related to the field. We also wanted to understand the Open Innovation context in China and to see how the Open Innovation adoption factors affect, both internally and externally, the company's Open Innovation practice decisions. Therefore, we used descriptive analysis for this purpose.

More specifically, we present in this part of our research the presentation of the companies, the external market conditions (sub-chapter 6.1), the use of patents in the Open Innovation context (subchapter 6.2), the Open Innovation modalities and the barriers of Open Innovation (sub-chapter 6.3).

6.1. General presentation of the companies

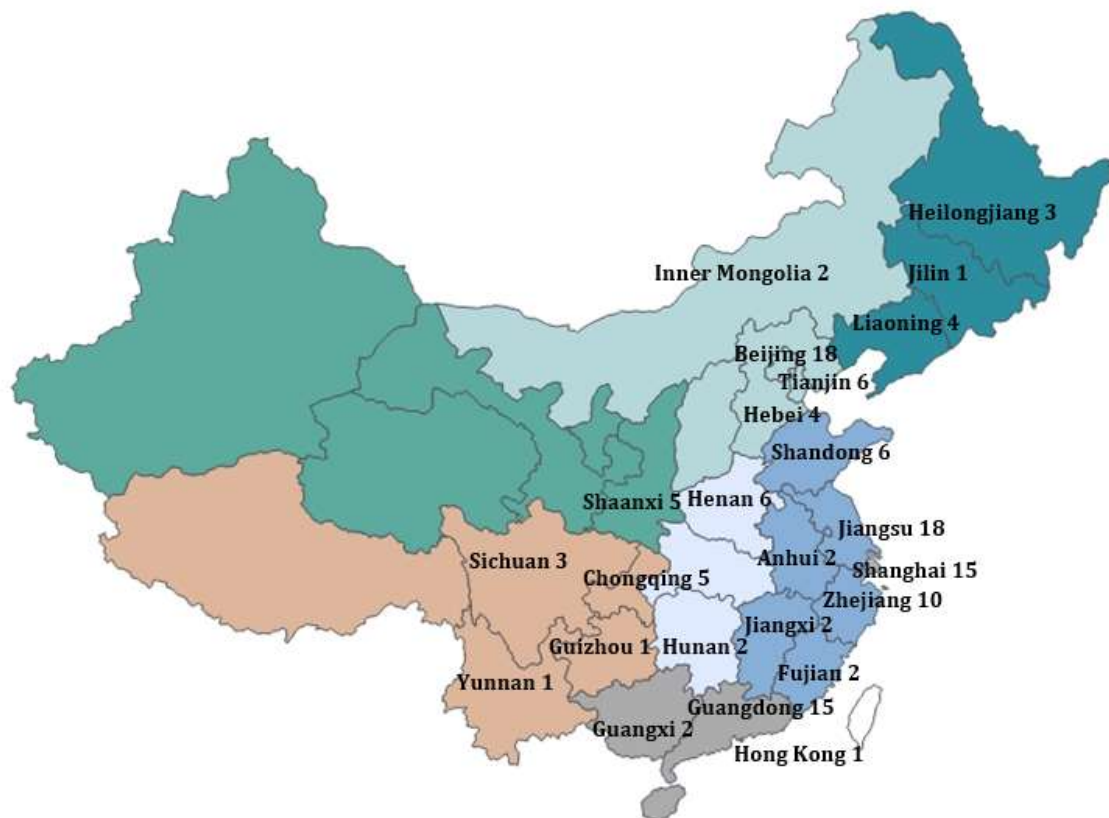
Our sample consists of 129 Chinese companies in different industries and different regions. The age of the companies also varies in a wide range, from 1899 to 2010. More specifically, two companies were established before 1915, 25 companies between 1937 -1960, 67 companies between 1963-2000, and 35 companies in 2001-2010.

Table- 1 Establishment year

	Frequency	%
Establishment year		
Before 1950	6	4.65
1950-1959	20	15.50
1960-1969	8	6.20
1970-1979	9	6.98
1980-1989	16	12.40
1990-1999	31	24.03
2000-2010	39	30.23
Total	129	

It is important to note that 1980 and 2001 hold special significance when considering the establishment dates of companies. Firstly, in 1980, China joined the World Intellectual Property Organization (WIPO), marking the start of China's shift from a closed to an open economy regarding innovation and its protection. Secondly, in 2001, China became a World Trade Organization (WTO) member. The impact of these two affiliations can be seen in the growing number of company establishments post-1980.

Graph- 1 Company locations



Source: [Create Presentations, Infographics, Design & Video | Visme](#)

The company's HQ also vary in different regions. However, we can observe a concentration mostly in Beijing (18), Jiangsu (18), Shanghai (15), Guangdong (15), and Zhejiang (10) regions. More specifically, we can observe a concentration in the coastal regions than the inner regions of China. First, the trade concentration in these regions creates a pushing effect to engage the companies to innovate. Second, related to this concentration, the Foreign Direct Investment (FDI) and the spillover effect positively impact innovation and patenting activity. Besides, patent subsidy programs also increase the patenting and innovation activities in some

regions, specifically Shanghai, Beijing, Tianjin, Jiangsu, and Chongqing. The company's regional concentration is also in line with the result of a recent report that Beijing, Tianjin, and Hebei region innovation activities are centred in Beijing from the north, and the Guangdong-Hong Kong region activities centred in the south..

With a broad classification, 71% of the companies are active in manufacturing industries, 12% are operating in the electricity, gas, and air conditioning industry, 8% are active in information and communication, and the remaining 9% are in different industries.

Table- 2 Industrial distribution of the companies (STAN definition OECD)

	Frequency	%
Stan Industry		
Manufacturing	92	71.32
Electricity, gas, steam and air conditioning	15	11.63
Information and communication	11	8.53
Financial and insurance activities	2	1.55
Accommodation and food service activities	1	0.78
Construction	1	0.78
Mining and quarrying	1	0.78
Professional, scientific and technical activities	4	3.10
Real estate, renting and business activity	1	0.78
Wholesale and retail trade	1	0.78
Total	129	

44% of the companies define themselves as private companies. 40% are public, and remaining 16% is a public/private combination (Howell, 2020).

Table- 3 Company governance

	Frequency	%
Company Governance		
Private	57	44.19
Public	52	40.31
Public/Private share	20	15.50
Total	129	

63% of the companies are Corporate companies. 32% is a subsidiary of Chinese Group companies, and the remaining 5% is a subsidiary of a foreign group (by M&A agreement). The majority of the companies are independent corporate companies .

Table- 4 Company structure

	Frequency	%
Company structure		
Corporate	82	63.57
Subsidiary of a Chinese group	40	31.01
Subsidiary of a foreign group	7	5.43
Total	129	

All the companies are active in export. Only 31% of the companies exportation rate remains less than 10% of their total commerce while 60% have 10 to 50% export activity .

Table- 5 Exportation level (Year/ turnover)

	Frequency	%
Exportation (per year/turnover)		
Less than 10%	39	30.23
10 to 50%	80	63.57
More than 50%	10	7.75
Total	129	

All companies are big companies with more than 300 workers.

Table- 6 Total worker

	Frequency	%
Total worker		
Less than 10	1	0.78
10 to 50	1	0.78
100 to 300	1	0.78
More than 300	126	97.67
Total	129	

All companies have more than 200 million RMB Turnover.

Table- 7 Total turnover (RMB)

	Frequency	%
Company Turnover (RMB)		
20 to 50 million	6	4.65
50 to 200 million	36	27.91
More than 200 million	87	67.44
Total	129	

Nearly all companies have an R&D department, and most have separate patents. 71 companies declare having all the departments related to patent activity.

Table- 8 R&D Management structure

	Frequency	%
R&D Management		
R&D department	25	19.38
Patent department	1	0.78
R&D dep and Patent dep	13	10.08
R&D dep and Patent law dep	2	1.55
R&D dep, Patent dep, and Licence dep	5	3.88
R&D dep, Patent dep, and Patent law dep	4	3.10
Patent dep, Licence dep, and Patent law dep	1	0.78
R&D dep, Patent dep, Licence dep, and Patent law dep	71	55.04
No answer	7	5.43
Total	129	

The companies plan to increase their Open Innovation inbound and outbound activities. Only 37% disagree with outbound patenting and 36% with an outbound license. 56% of those companies are the same, and their establishment year date is before 2000. Besides this, they are active in different domains of the production industry. More specifically, heavy machinery, railway, oil engineering, boiler production, etc.

Patent application strategy

Table- 9 Patent exploitation planning

Future plans	Str. agree	Agree	Disagree	Str. disagree	Total
Outbound Patent	45.5%	7%	37%	11%	100.0%
Outbound Licence	45.2%	15%	36%	3%	100.0%
R&D Collab Foreign comp	58.9%	39%	0%	2%	100.0%
R&D Collab Chinese comp	51.6%	41%	6%	1%	100.0%
R&D Collab Univ	70.2%	29%	1%	0%	100.0%
R&D Investments	33.9%	63%	0%	3%	100.0%

Patents and secrecy are the two methods that all the companies, without exception, use for protection. 26% of the companies are constantly using the patents, while 37% use them often, and the remaining 37% use them sometimes. The companies that stated “often” they are using patents consist of 70% independent corporate Chinese companies and 27% subsidiaries of a Chinese group, with one company that stated that they are a subsidiary of a foreign group. The majority of “often” respondents to this question (66%) are active in export (10- 50 % of their total sales volume), and 15% have more than 50% of their total sales from export.

Besides patents, we also asked the companies which type of protection they prefer to use. We see that the companies highly use secrecy. 39% of the companies claimed they constantly use secrecy, while 33% claimed using this protection “often”. The remaining 28% mentioned that they are sometimes using secrecy.

6.1.1. Protection strategies

Table- 10 Protection strategies

Protection	Constantly	Often	Sometimes	Not systematically	Total
Secrecy	40%	33%	28%	0%	100%
Patents	26%	37%	37%	0%	100%
Utility model	33%	36%	22%	9%	100%
Patenting abroad	1%	26%	48%	26%	100%

The utility model is considered an alternative protection before patenting a new invention by the companies. 32% constantly use utility models to protect inventions before applying for patents. 36% are using it often, while 22% mentioned it sometimes. The remaining 8% need to

be using protection. When we look at these latter respondents, we see that they are active in exportation and they are private companies (55%).

Patenting abroad is not commonly used as a protection. 48% of the companies sometimes patent abroad, while 26% do not solicit this method. Those not using systematic patenting abroad as protection are distributed as 55% private, 21% public and 24% public/private governance. 70% of those companies are independent corporate Chinese companies, while 20% are a part of a Chinese group. However, the exportation rate is also high (60% 10 to 50%, 36% less than 10% of their total sale, and only three companies with more than 50% of total sales). Only 25% mentioned that they are patenting abroad “often,” and only 1 participant said they are constantly patenting abroad. This 1 participant is active in the computer, electronic and optical product industry and has a 10 to 50% exportation volume.

Table- 11 Country choice criteria for patent applications

Country choice	Very important	Important	Somewhat important	No, not important	Total
Market size	40.9%	41%	17%	1%	100%
IPR protection	41.7%	45%	12%	2%	100%
Entry barrier	23.6%	53%	20%	4%	100%
Prev. Experience	37%	46%	15%	2%	100%
Competitors #	11%	43%	46%	1%	100%
Exploring country	15%	65%	17%	3%	100%

We investigated the country choice criteria of the companies who prefer to patent abroad in Table- 11. The market size is an important criteria when choosing the country to patent. In Table- 11, nearly 82% of companies find the market size important, and 17% agree that this criterion is somewhat important. Only one company find it is not essential. When we look at this company, we see that it is a public monopoly company. The two missing companies in this category that consent to respond to this question are active in computer and wholesale retail; one is a public monopoly, and the other is a private semiconductor producer whose exportation volume remains at 10 to 50% of their total sales.

IPR protection is also an important criterion for companies. 87% find that it is important to choose a country with a necessary IPR protection level. It is somewhat important for 12% of companies, while only two companies find it is not. Those two companies are, again, one a public monopoly and the other is an electrical home appliances company, with both less than 10% of exportation volume.

The ease of entering the market is essential for 76% of the companies. However, 20% find it necessary, which is optional for five companies. Three companies of these 5 are private, and two are public. Two companies have a high rate of exportation, and 1 has 10 to 50% of their total sales volume from exportation. The remaining 2 have less than 10% of the exportation volume. Only one participant, a public monopoly company, find that it is unimportant.

Previous experience in the patenting country motivates the companies to patent again in this country. 83% find that their previous experience in this country is an important factor. Most of these respondents (64%) are very active in exportation (10 to 50% of total sale comes from exportation).

15 % find it somewhat important, but two companies do not find it essential, and their export volume remains less than 10% of their total sales.

The number of competitors in the foreign country is highly important for 54 % of the companies. Nearly 70% of those who find important are active in export by a rate of 10% to 50% of their total sale. 68% have a corporate government. Besides 19% (10 respondents) who have public/private governance, the remaining 44 companies are split equally as private and public governance. (22 comp per each). However, 46% find this is somewhat important when choosing the country to patent. When we look in detail at the governance characteristics of those companies who find it somewhat important, besides 14% (8 respondents) who have public/private governance, the remaining 50 companies are split equally as private and public governance. 64% are corporate companies, 31% are subsidiaries of a Chinese group(18 companies), and the remaining 5% (3 companies). The 33% of those companies who find that the number of competitors is “somewhat important” are not very active in export, with less than 10% of their total sales.

59% are active, with 10 to 50% of their total sale. The remaining five companies, which find the competitor numbers somewhat important, are active with more than 50% of their export rate. When we look at those very active five companies, we see that they are all manufacturing companies of automotive parts (3 companies), semiconductors (1 company) and medical devices (1 company).

One participant needs to find the number of competitors important while patenting abroad. When we look at their company structure, we see that it is a public monopolistic company, active in the paper/ printing industry, without a major exportation rate.

80% of the companies find that exploring the country’s market where they are patenting is an important reason for choosing this country. 17% find that exploration is somewhat important, while four companies state that it is not important as a patenting motive. The 2 of those companies who find “not important” are private, while one is public and 1 has public/private governance. 2 companies have a very active exportation rate (more than 50% of their total sales come from export). Two companies are not active at all (less than 10%).

Table- 12 Country choice- Ranking

Range Country	1	2	3	4	5	OTHER
USA	46	21	16	7	15	18
Japan	22	34	25	27	15	0
Germany	14	35	44	12	15	3
South Korea	19	17	14	48	19	6
France	10	11	21	20	46	15
Other	12	5	3	9	13	34
TOTAL	123	123	123	123	123	76

We also investigate the companies, how they would prefer to rank their country choice while patenting among the five first patent applicant countries (USA, France, Germany, Japan, Korea), and if another country exists. Besides ranking each other, the companies put the USA first as the first country to patent abroad (46 companies). The second country is the Germany (35 companies). Japan (25 countries) is the third range most cited country, and in the fourth range most cited country is South Korea (48 countries). Finally, France (46 countries cited most) is in the fifth range.

Finally, we investigated the portfolio of the companies, including age, type and inbound/outbound combination. However, we could not collect significant information. Therefore, we had to exclude these questions from our analysis.

6.1.2. The state of the corporate environment

The literature provides evidence that environmental factors impact the Open Innovation adoption decision. The competitive intensity and industrial characteristics, globalization or trade freedom in the market, patent protection, and technological turbulence impact this decision. In order to understand their market perception, we have investigated the companies about their market conditions in order to understand if this latter has an impact on their Open Innovation activities. We have seen that 85% of the companies find high competition in their

market. Only 15% of the companies do not see the same way the market conditions. More specifically, nine participant companies, of which four are quite monopolistic and active in money printing, mining, aeronautics, and tobacco production industries, need to find their market competitive.

Table- 13 Competition

Competition	Str. agree	Agree	Disagree	Str. disagree	Total
Too many companies in our market	46.5%	39%	8%	7%	100%

Regarding the technological turbulence, we wanted to understand if the other companies in the market have a strong innovation activity. To understand this, we asked if the companies in the market have a strong patenting activity. 86% of the companies find that the companies in their market invest very hard on patenting. The same proportion think that the technological development speed in their market obliges the companies to work on NPD. However, when we investigated if it is difficult to forecast the technological improvement in their market in 3 years, only 21% (6,3% +15%) agree on this question. Most companies find that the technology improvement in 3 years is predictable. Moreover, 35 companies strongly disagree with this question (51%), and only 4 among these are monopolistic public companies. However, the remaining companies are active in semiconductor, IT, and heavy machinery production.

Table- 14 Market turbulence

Market Turbulence	Strongly agree	Agree	Disagree	Strongly disagree	Total
Patent activity	41.1%	45%	9%	5%	100%
NPD	50.4%	36%	12%	2%	100%
Tech. Forecast in 3 years	6.3%	15%	51%	28%	100%

Access to international markets and, reciprocally, access to foreign companies in the market is considered as an adoption factor of Open Innovation. Accordingly, we have asked the companies how to open their market to international players if they have trade freedom in their market. Only 15% of the companies do not feel they have trade freedom.

The majority of the companies, 43%, agree that their market has a high growth potential, whereas 18% disagree and 3% disagree about the growth potential of their market.

Besides, subcontracting activities of foreign companies have a positive effect on Open Innovation activities. Further, we investigate if there is foreign companies collaboration demand in the market for production.

Table- 15 Trade flexibility

Trade freedom	Strongly agree	Agree	Disagree	Strongly disagree	Total
Freedom	64.3%	21%	10%	5%	100%
Growth	35.9%	43%	18%	3%	100%
Subcontract	50.4%	36%	12%	2%	100%
Exportation	6.3%	15%	51%	28%	100%

We investigated the companies if foreign companies are willing to approach for collaboration in production. 60% of the companies agree, and 19% strongly agree that the foreign companies are asking for production collaboration. Only 2% do not have calls from foreigners, and 19% are not concerned frequently.

On the other hand, exportation is highly important according to the companies. 83% strongly agreed or agreed that exportation is important in their market. 13% disagree, and 4% strongly disagree that exportation is important in their market. Those are not all private / or monopolistic companies. Some are computer- IT companies, but there are also monopolistic public companies among them.

6.1.3. Patent application, IPR and governmental policy

When it comes to government incentives, we find that companies generally use government incentives for innovation activities.

Table- 16 Government policy

Gov Policy	Strongly agree	Agree	Disagree	Strongly disagree	Total
Fiscal policy	23.3%	56%	21%	0%	100%
Tax policy	45.7%	48%	6%	0%	100%
Financial policy	30.2%	67%	2%	0%	100%
Guidelines	16.3%	73%	5%	5%	100%
Education	15.5%	50%	33%	2%	100%

79% of the companies agree that the Government fiscal policy is a supportive factor for innovation. However, 21% disagree with this idea.

Government tax policy is an important factor for 93% of companies, while 6% disagree about the positive effect of tax policy on R&D cost reduction.

Government financial policy creates an advantage for 98% of companies. Only 2% remain to disagree with this opinion.

90% of the companies find that the government offers guidelines and support for Science and Technology activities. Only 10% disagree with this opinion. In the same vein,

66% of the companies agree that the government offers education programs for Science and technology activities. However, 33 % disagree, and 2% strongly disagree with this opinion and do not think the government offers education programs in their industry.

Government promotion in R&D collaboration is an important factor for companies. We investigated the companies if the government promote working with different entities such as Universities, consulting companies or other companies. 10% of the companies agree that the government systematically promotes collaboration with universities or R&D institutes. However, 34 % of the companies disagree that there is a governmental promotion for University and industry collaboration. The remaining responses are distributed evenly (27%) between constantly and sometimes.

47% of the companies find that the government mostly promotes collaborating with other companies, whereas 50% “sometimes” to this question. Only 2% of the companies replied not systematically to this question.

For 49% of the companies, the government promotes the companies to collaborate with consulting companies for patent activity. 22% of the companies collaborate “often” with consulting companies. However, 29% of the companies do not agree with this question and find that the government does not promote collaboration with consulting companies for patent activity. Only one company find that the government promote systematically working with consulting companies.

Table- 17 Government promotions

Gov Promotion	Systematically	Most of the times	Sometimes	Not systematically	Total
Universities, R&D institutes	10.9%	28%	27%	34%	100%
Other companies	2.0%	45%	50%	2%	100%
Consulting comp	0.8%	22%	49%	29%	100%

Regarding IPR strength and IPR protection, companies highly agree that the government should strengthen and increase IPR protection in the country. However, at the same time, IPR became more complex according to the majority of the companies (51 % strongly agree and 48% agree).

Table- 18 IPR complexity

	Strongly agree	Agree	Disagree	Strongly disagree	Total
IPR Protection	29.5%	59%	12%	0%	100%
IPR complex	51.2%	48%	1%	0%	100%

6.2. The use of patents in the Open Innovation context

Motivations for patent application in the open innovation processes

We investigated the companies for their patenting reasons both in China and abroad. We received 100% contribution on this question. However, when we investigated their patenting reasons abroad, the contribution dropped to 43%. Hence, we had to exclude the responses for the patenting abroad category from our analysis.

We investigated the companies the degree of participation due to the reasons below while they patent. The primary reasons for patenting their invention are the business's protection and new market access. 59% of the companies "strongly agree" and 32% "agree on this question. 9% "disagree". Blocking competition is also an important reason for patenting. 86% of the companies agreed (12% strongly agree, 74% agree). However, 14% replied that they disagreed with this reason for patenting. Reduce imitation, and the companies highly accept risk. Only 16% "disagree" with this question. Improved image in the market is accepted by 83% of the companies as an important reason for patenting. 17% that they do not share the same opinion (16% disagree, and 2% strongly disagree). Measuring innovation performance is also accepted mostly by the companies (42% "strongly agree" and 41% "agree"). However, 16% disagree, and 2% strongly disagree with this question. Using patents as a motivation for R&D departments and researchers is mostly accepted by all companies (20% strongly agree, 52% agree). However, 27% "disagree" and 1% "strongly disagree" using patents as a motivation factor for their R&D department. Those companies are mostly public companies with a high exportation rate and were mostly established after 1990 (48%).

Using patents as a negotiation tool during cross-licensing agreements is not a very important motivation factor for companies. Only 59% are “agree”, and the remaining companies replied “disagree” with this question. Most of these latter respondents were established between 2000-2010 (40%) in the Eastern region, mostly active in the computer industry and public companies. “Strong portfolio” is accepted by most companies (20% strongly agree, 66% agree). 14% “disagree” on this question. Standard setting is also important for the companies. However, 38% disagreed with this question. Gov incentives are an important motivation for companies. 96% agreed with this question. Only 4% replied disagree, which could be more active in export. However, only 3 of those five are public.

Table- 19 Motivations for patent applications

Patenting motivations	Strongly agree	Agree	Disagree	Strongly disagree	Total
New market access	58.9%	32%	9%	0%	100%
Protection	58.9%	32%	9%	0%	100%
Block competition	12.4%	74%	5%	9%	100%
Reduce imitation	29.5%	55%	16%	0%	100%
Improve image	41.7%	41%	16%	2%	100%
Measuring performance	12.4%	71%	16%	1%	100%
Motivate	20.2%	52%	27%	1%	100%
Cross-licensing	25.6%	33%	40%	1%	100%
Strong portfolio	19.8%	66%	13%	1%	100%
Standard setting	14.7%	47%	38%	0%	100%
Gov. Incentive	41.1%	55%	4%	0%	100%

We investigated the companies how they would prefer to use their patents.

Stocking for strategic use is one of the companies’ most critical reasons for patenting. Our data shows that 2% of the companies replied, “use intensively,” and 65% replied, “use very often,” this motive while holding a patent. However, 32% responded, “Do not use”.

NPD is the highest positive response we received from this category. According to the companies, 48% “use intensively” and 28% “use very often” patents for new product development, and 24% “use often”.

Patenting for using R&D contracts is a principal reason for the companies. 16% replied “use intensively,” and 31% responded “use very often” for this question. However, 47% answered “use often,” and 9% “do not use” patents for R&D contracts.

Patenting for use in a patent pool (4) is acceptable for nearly 57% of the companies; 18% stated “use intensively,” and 39% said “use very often” their patents for entering a patent pool.

The remaining 43% replied, “use often,” and 1% “do not use” their patents in a patent pool.

Using patents in a joint venture or M&A is also essential for the companies. Only 6% replied, “use intensively,” and 25% “use very often.” The Remaining 36% “use often,” and 32% “do not use” their patents for a joint venture or M&A contract as leverage.

Using patents for creating a long-term alliance with a foreign company is also a commonly accepted motive for patenting; for the companies, 6% replied, “use intensively,” and 24% “use very often” patents for creating long-term alliances for foreign companies. Nevertheless, 61% stated “use often” and 8% “do not use” for long-term alliances with foreign companies.

Table- 20 Patent exploitation

Patent exploitation	Use intensively	Use very often	Use often	Don't use	Total
Stocking for strategic use	2.4%	65%	32%	1%	100%
For NPD	48.4%	28%	24%	0%	100%
R&D contracts	15.7%	32%	45%	7%	100%
Patent pool	18.1%	39%	43%	1%	100%
Joint venture /M&A	6.3%	25%	36%	32%	100%
LT alliance with foreign comp	6.3%	24%	61%	8%	100%
Licencing	11.8%	26%	55%	7%	100%

Using patents for licensing is a fundamental reason; while using patents, 12% of the companies “use intensively,” and 26% “use very often” patents for licensing. Also, 55% “use often,” and only 7% “do not use” patents for licensing purposes.

6.3. Open Innovation processes

We investigated the companies if they already have previous experience of any inbound or outbound Open Innovation in China and abroad. We could collect responses for China. However, the companies consented to respond to abroad questions (not more than 77 companies responded). Therefore, we have excluded abroad questions for this section.

All the companies have previous inbound experience, both patent and licence acquirement in China. Only one response is negative, which is a monopolistic company specialising in money printing, and 8 companies consent to this question, which is in Computer (3), Electricity,

gas(1), Manufacture of irradiation (1), Mining and quarrying (1), Rubber & plastic (1), and Wholesale & retail trade (1) industry.

Table- 21 Open Innovation processes

Previous experience	Yes	No	Total
Inbound	91.0%	9%	100%
Outbound	90.0%	10%	100%
R&D Collaboration	93.5%	7%	100%

We also asked about the previous R&D collaboration activity of the companies. We received 123 responses for R&D collaboration in China. 6 companies consent to respond to R&D collaboration in China from Computer & Electronic and Optical Products (2), Electricity & Gas Steam (1), Manufacture of Irradiation (1), Wholesale and Retail (1), and Electrical Equipment (1) industries. On the other hand, 44 companies preferred not to answer this question when we investigated if they had previous experience in R&D collaboration abroad..

6.3.1. Inbound Open Innovation

We investigated the companies about the inbound patenting reasons in China and abroad. Unfortunately, companies consent to respond to reasons for inbound patenting abroad.

Companies answering the Chinese part of this question strongly agree or agree that they buy patents to access a new invention (98%). Only 2 companies “disagree” with this question. One is active in the computer and optical products industry with a more than 50% export rate of total sales, and the other one is active in the household equipment industry with a very low exportation rate. Both are located in the Shandong region and were established at the beginning of 2000.

We saw the same approach from the companies to the reason for blocking rivals as the inbound patenting reason. Most companies either agree or strongly agree that blocking rivals is a reason for patent acquisitions (92%). 9 companies state that they disagree about this reason. All 9 respondents are manufacturing companies in different industries (spacecraft, electronics, electricity and gas, machinery, and motor vehicles). However, 5 of them are public companies, which can explain their monopolistic position without an important export volume. 4 remaining companies are active in exportation and private companies.

When we investigated if their patent buying reason was to reach the complementary technology, most respondents replied positively to this question (87%). 13% of the companies state that they disagree with it by buying patents to reach the complementary technology. Those companies' governance is split predominantly public, and they have a very low exportation rate (less than 10% of their total sale).

Table- 22 Motivation for patent buying within inbound process

Why buying patents	Strongly agree	Agree	Disagree	Strongly disagree	Total
Access new invention	47.1%	51%	2%	0%	100%
Blocking rivals	33.3%	59%	8%	0%	100%
Complementary technology	16.7%	70%	13%	0%	100%

Licensing-in motivations

We investigated the companies why they are buying licences. Unfortunately, 10 companies consent to respond to the questions of this category. The remaining responses are given below.

All respondents to this question are buying licences to enrich their patent portfolio (36% strongly agree, and 64% agree)

Access to complementary technology is also an important driver for the respondents. 32% strongly agree, and 60% agree they are buying a licence to access complementary technology. Nevertheless, 1 company replied, “disagree to this question, which is a public motor vehicle producer with a very low exportation rate (less than 10%). 9 companies replied that their licensing-in activity is not for accessing a complementary technology (“never”).

Cross-licensing, gaining access to a new technology, entering easily in a foreign market, and buying a licence to become a subcontractor of another company are the important drivers for the companies. Respondents replied “strongly agree” and “agree” mostly on those questions with 70-80% participation.

Companies who replied “disagree” on cross-licensing are mostly in computer and optical products, 50% private and 50% public companies.

Gaining access to new technology is not an important reason for 3 companies, which are public companies with a very low exportation rate.

Entering easily in a foreign market is not important for only one respondent, a monopolistic public company active in the aircraft industry with a very low exportation rate.

Subcontracting is not interested in 10 companies, mainly public companies, active in motor vehicles, computer, and electronic optical products industry.

Reducing R&D expenses is also important for more than 60% of respondents. However, 17% disagreed, and 13% strongly disagreed with this question about reducing the R&D expenses.

The use of proven technology is important for the majority of companies. However, 17% disagreed with this question, and 7% strongly disagreed. Those who replied “disagree” about providing proven technology are both from public and private companies. They all have an important exportation rate (10 to 50%).

Table- 23 Motivation for licensing-in

Motivation for licensing-in	Strongly agree	Agree	Disagree	Strongly disagree	Total
Big portfolio	36.1%	64%	0%	0%	100%
Acces complementary tech	31.9%	60%	1%	8%	100%
Cross-licensing	46.2%	49%	5%	0%	100%
Reduce R&D expense	36.1%	34%	17%	13%	100%
Gain access new tech	53.8%	44%	3%	0%	100%
Use proved tech	21.0%	55%	17%	7%	100%
Enter in a foreign market	42.9%	56%	1%	0%	100%
Subcontract licensor	13.4%	78%	8%	0%	100%

Licensing-in typology of partner

We investigated the companies from which institution or type of company they are buying licences. Unfortunately, 10 companies consent to respond to the questions of this category. The remaining responses are given below.

32% of the companies often use patent pool companies' portfolios to buy a licence. The remaining 68% are rarely using patent pool companies.

34% of the companies often use universities to acquire their licences. 19% rarely use this resource, and 23% never use universities to buy licences (9 private, 9 public, 5 public/private).

43% of the companies often use R&D institutes to buy licences. 34% are using this resource rarely, but 23% are never using R&D institutes for licence acquirement (14 Private, 11 public, 2 public/private).

46% of the companies are often using independent companies for buying licences. 48% are using rarely independent companies for licence acquirement. 5% are never using independent companies for licence acquirement

26% often use consulting companies for licence acquirement, whereas 29% are rarely using this source. Remaining 45% never use consulting companies for licence acquirement (22 private, 24 public, 7 public/private).

Table- 24 Typology of partners in Inbound Open Innovation process

Typology of partners	Always	Often	Rarely	Never	Total
Patent pool comp	0.0%	32%	68%	0%	100%
Universities	0.0%	34%	19%	47%	100%
R&D institutes	0.0%	43%	34%	23%	100%
Independent Comp	0.0%	46%	48%	6%	100%
Consulting Comp	0.0%	26%	29%	45%	100%

We investigated the companies if they also entered into an R&D collaboration with one of those entities. 7 companies consent to reply to this question. Nevertheless, the remaining companies' responses are given below.

Our data shows that the company's R&D collaboration preferences show a variable trend.

University collaboration is acceptable by around 41% of the companies. However, 59% prefer to avoid collaborating with universities for R&D projects.

R&D institutions are much more preferred by the companies, with around 64% of companies choosing. However, in total, 36% of the companies "rarely" (34%) or "never" (2%) collaborate with an R&D institute.

Regional technology transfer offices are preferred by 52% of the companies. Nevertheless, 48% rarely prefer this collaboration tool.

We investigated the companies for a possible R&D collaboration and would prefer to enter into direct contact with a company for a partnership. This time, 48% agree (5% "always" and 43% "often"). The remaining 48% "rarely", and 7% "never" prefer to collaborate for R&D.

Our data shows that the companies very little solicit consulting companies. 36% said they rarely enter a relationship while seeking R&D collaboration. 41% "never" collaborate with a

consulting company. Only 23% “often” collaborate with a consulting company for R&D projects.

Nevertheless, 52% of the companies “often” prefer to partner with the companies in the technology development zone for an R&D collaboration. 48% “rarely” prefer collaborating with companies in a technology development zone.

Table- 25 R&D collaboration partner typology

R&D Collaboration	Always	Often	Rarely	Never	Total
Universities	14.2%	27%	42%	18%	100%
R&D institutions	17.2%	47%	34%	2%	100%
Regional Tech Tr Office	0.8%	51%	48%	0%	100%
Direct contact	4.9%	43%	46%	7%	100%
Consulting comp	0.0%	23%	36%	41%	100%
Tech Dev Zone comp	0.0%	52%	48%	0%	100%

Licensing-in – partner selection criteria

Before a licence acquirement, we investigated the companies which criteria they were looking for from the licensor company.

23% of the companies replied that they always pay attention to whether the company is a spin-off company or not. 50% often pay attention to companies’ spin-off structure. 24% “rarely” and 3% “never” pay attention to whether the partner company is a spin-off.

37% of the companies “always” pay attention to the relevance of the license seller companies’ technology, while 49% state “often” to this question. Only 14% of the companies state “rarely” about the licence seller technology relevance with their technology.

Companies give the same responses for the importance of the firm’s technology level. 42% “always” and 47% are “often” paying attention to the technology level of the seller company. 11% of the companies state “rarely” to this category. We see that those respondents who state “rarely” are more or less the same in this category, mostly public companies with high exportation rates (10 to 50%)

Licence seller companies reputation is an important criteria for the companies. 47% of the companies replied “always” and 40% “often” to this question. 13% state they “rarely” take into consideration the reputation of the licensed seller company in the market.

The potential R&D collaboration option is also an important driver for the companies when choosing the licence seller company. 5% of the companies “always” consider this option while buying a licence, and 64% “often”. However, 31% of companies replied “rarely” to the same question. 54% of these latter respondents are public companies; however, 78% have an important exportation activity (10 to 50%).

The price is the most important factor above all other criteria. 61% of the companies “always” consider the price, and 27% “often”. Nevertheless, for 13% the price is “rarely” a criterion when buying a licence. Those companies are mostly private, with an exportation rate of around 10 to 50% of their total sale.

Finally, the patent citation is “always” important for 37% of the companies and “often” for 29%. Those companies who find that it is always important are mostly active in exportation (70% of 44 companies have 10 to 50% of export share from total sales). However, 50% of those respondents are public companies. 29% of the companies find “rarely” important the patent citation and 6% “never” while buying a licence. The companies who “never” pay attention to the patent citation while buying a licence are mostly private companies with a high exportation rate (10 to 50%), and the remaining companies are private monopolistic companies.

Table- 26 Partner selection criteria for licensing-in (inbound) process

Critere for licensing-in	Always	Often	Rarely	Never	Total
Spinnoff	22.7%	50%	24%	3%	100%
Relevant technology	37.0%	49%	14%	0%	100%
Tech level of the firm	42.0%	47%	11%	0%	100%
Reputation of the comp	47.1%	40%	13%	0%	100%
Potential R&D collab	5.0%	64%	31%	0%	100%
Price	60.5%	27%	13%	0%	100%
Patent citation	37.0%	29%	29%	6%	100%

We investigated the companies if they approached the licence seller company directly to buy their licences. Responses show that most companies (70%) rarely take the initiative to approach the licence seller company. Nevertheless, 30% “often” take initiative to approach the license seller company when they want to buy a licence. Those who do not hesitate to approach other companies for buying their licences are mostly private companies, active in the computer and optical product industry and have an important export rate (72% of those have an export rate of 10 to 50% of their total sales).

Table- 27 Direct contact for collaboration

Direct contact to the partner - inbound	Always	Often	Rarely	Never	Total
Licence seller comp		30%	70%		100%

6.3.2. Outbound Open Innovation

We investigated if the companies have a previous outbound Open Innovation experience. 9 companies out of 129 consent to this question, which are respectively in Computer, electronic (3), Electrical equipment (1), Electricity, gas & steam (1), Irradiation manufacturing (1), Mining & quarrying (1), Rubber & plastic (1), and Wholesale & retail industry. 99% of the remaining 120 companies stated “yes” to a previous patent and licence outbound activity in China. 21 companies state no to this question, both patent and licence outbound activity in China. Nevertheless, 20% (4 companies, of which 3 belong to the Computer & electronic and optic product industry and 1 Advertising) of these 21 companies sell licences in China.

Patent selling motivations

We investigated the companies why they prefer to sell their patents. For all questions in this category, 25 companies consent to respond.

Approximately 62% of the companies (24% Strongly agree and 37% agree) agree that they are selling the patents of an activity they have already finished. However, 24% of the companies “disagree”, and 14% “strongly disagree” about they are selling patents of an activity that they are no longer practising. We investigated if they are selling non-core technology patents. 58% of the companies (2% Strongly agree and 56% agree) either agree or strongly agree that they sell non-core technology. However, 24% of the companies “disagree” and 18% “strongly disagree” to sell the non-core technology.

Finally, we questioned if patent selling is a part of their business strategy. Again, 53% of the companies agree that it belongs to their business strategy (3% strongly agree and 50% agree). 38% of the companies “disagree” on this question, while 9% of the total companies “strongly disagree” that patent selling is a part of their business strategy. We see that those companies are more or less the same companies that responded the same way to the previous question.

Table- 28 Motivation for patent selling within outbound Open Innovation process

Motivation for patent selling	Strongly agree	Agree	Disagree	Strongly disagree	Total
Stop related activity	24.0%	38%	24%	14%	100%
Sell not core tech patent	1.9%	56%	24%	18%	100%
Business strategy	2.9%	50%	38%	9%	100%

Licensing-out motivations

We investigated why the companies chose to sell licences. The same consenting companies (25 companies) from the previous question also consented to this category.

The first reason that we asked is to make money by selling licences. Except for 3 private companies active in computer optical products, electricity, gas, and motor vehicle production, all companies agree (70%) or strongly agree (27%) that they are licensed to make money from their patents.

Increasing the reputation is also an important reason for the respondents to license their patents. 33% of the companies strongly agree, and 57% agree about the increasing reputation effect of the licensing, which is why they prefer licensing their patents. Only 11 companies disagree that increasing reputation is not a reason for their licensing activity. 6 are public companies, and the remaining 5 are private. They are from various industries and different regions.

Cross-licensing is an important reason for most companies (10% strongly agree and 80% agree). However, 11 companies disagree that they are licensing for cross-licensing agreements. 9 of these companies are active in export and private companies. The only common point may be their establishment year.

Creating alliances remains an important reason for most companies (2% strongly agree and 54% agree). However, 44 % of the companies do not share the same opinion (38% disagree and 7% strongly disagree).

Standard setting is also considered an important reason for selling a licence. 80% of the companies agree, and 6% strongly agree about this reason for selling licences. Both respondent groups have an important rate of export.

(83% of respondents who are “strongly agree” and 65% of respondents who are “agree” to this question, their export rate constitutes 10 to 50% of their total sales). Only 15 companies

disagreed. These companies are active in motor vehicles and trailers (5 companies), computer and optical products (3 companies), and electricity and air conditioning industries (3 companies). The remaining 4 companies belong to aircraft, non-ferrous metal and machinery equipment industries and all public companies.

Subcontracting with other companies is also important as a licensing reason. For this question, 2% of the companies strongly agree, and 70% agree that their licensing out decision is related to subcontracting production to other companies. However, 28% of companies disagree.

Preventing the competition in the market is not a very common acceptable reason for the companies. While 32% agree on this, most companies disagree (45%) or strongly disagree (22%).

Access in a foreign market is a reason where 61% of the companies state they agree and 28% state they strongly agree. Only 11 companies, mainly public (6 public and 2 public/private), disagree with this question.

Finally, all companies in this question either agree (71%) or strongly agree (29%) that selling licences is a part of their company strategy.

Table- 29 Motivation for licensing-out in outbound Open Innovation process

Motivation for Licensing-out	Strongly agree	Agree	Disagree	Strongly disagree	Total
Make money	26.9%	70%	3%	0%	100%
Increase reputation	32.7%	57%	11%	0%	100%
Cross-licensing	9.6%	80%	11%	0%	100%
Create alliances	1.9%	54%	38%	7%	100%
Standard setting	5.8%	80%	14%	0%	100%
Subcontract	1.9%	70%	28%	0%	100%
Stop competition	2.9%	30%	45%	22%	100%
Access foreign market	27.9%	62%	11%	0%	100%
Comp strategy	28.8%	71%	0%	0%	100%

Licensing-out partner selection criteria

We investigated the companies' criteria when they were finding a licence-selling partner. As in the previous category above, 10 participants consented to respond to the questions. The remaining responses are given below.

Company affiliation appears as important criteria, with a contribution of 23% “always” and 44% “often”. Only for 34% of companies, affiliation is rarely important when selling licences. The latter companies are mostly active in the computer and optical products, Iron and steel, and the electricity and steam industries. They are mostly public (19 companies) with an export rate of 10 to 50% of their total sale (83%).

The market size of the buyer company is very important for 11% and 83%. For 6% of companies, the response is “rarely”, and they consider the buyer company’s market size.

The technology level of the buyer company is also very important for the majority of the companies. For 55%, the technology level is “always” and 38% “often” important. For 7%, it is not important (rarely).

The company’s reputation in the market is very important for 46%, important for 51% and 3% “Rarely”. Those companies are the big private companies.

R&D collaboration potential is also a very important criteria with a contribution of 12% “always” and 72% “often” for this question. For 15% rarely, mostly public companies (55%), and 1% never important a R&D collaboration (a monopolistic company specialized in the heavy machinery and equipment industry.)

Table- 30 Partner selection criteria for outbound Open Innovation process

Criteria licensing-out partners	Always	Often	Rarely	Never	Total
Comp affiliation	22.7%	44%	34%	0%	100%
Market size	10.9%	83%	6%	0%	100%
Tech level	55.5%	38%	7%	0%	100%
Reputation	46.2%	51%	3%	0%	100%
R&D collab	11.8%	72%	15%	1%	100%

Licensing-out – Contacting partner

We investigated the companies the criteria when they are finding a licence selling partner . As in the previous category above same 10 companies consent to respond to the questions. Remaining responses are given below.

The companies are rarely (61%) use the product commercials while attracting the potential customers for licensing. 6% of the companies “never” use the commercials for attracting the potential customers. Only 33% are often use the commercials for attracting potential customers.

Seminars are not also very much used by the companies. 46% rarely use the seminars for communication/ marketing of their licence and 13% “never” use it. 40% often use seminars for the marketing purposes.

New R&D staff is the most used method among all other methods. 5% always use this method and 66% “often”. 29% rarely use new R&D staff for marketing purposes.

Direct contact with the companies is only used by 29% of companies (3% always, and 26% often). 45% of the companies rarely enter in direct contact with the companies and 25 never enter in direct contact with companies for marketing purposes.

The least used method is to use intermediates or agencies for marketing purposes. Only 26% of the companies often use this method while 55% use intermediates or agents for marketing purposes and 19% never use this method.

Table- 31 Licensing-out contacting partner

Partner's contact	Always	Often	Rarely	Never	Total
Commercials	0.0%	33%	61%	6%	100%
Seminars	0.0%	40%	46%	13%	100%
New R&D staff	5.0%	66%	29%	0%	100%
Direct contact	3.4%	26%	45%	25%	100%
Intermediate/ Agent	0.0%	26%	55%	19%	100%

We investigated the companies if they would approach the licensee company directly to sell their licenses. Responses show that most companies (77%) rarely take the initiative to approach the licensee company, whereas 7% “never”. Those companies are mostly private companies with a high exportation rate. On the other hand, 28% “often” take the initiative to approach the licensee company, and 1 company stated that they “always” take the initiative to approach the potential licensee company when they want to sell a licence. The latter company is one of the biggest public motor vehicle manufacturers, with an export rate of less than 10%.

Table- 32 Licensing-out direct contact

Direct contact to the partner - outbound	Always	Often	Rarely	Never	Total
Licensee comp	0.8%	28%	65%	7%	100%

6.3.3. Barriers of Open Innovation Adoption

We investigated the potential barriers that could prevent the Open Innovation process. 21 companies consented to reply to this questionnaire. Nevertheless, the remaining companies' responses are given below.

Inbound Open Innovation Adoption Barriers

The first question we asked the companies was why they are not selling or licensing their patents.

Licensor involvement in the R&D process of the company is one of the worrying issues for 56% of the respondents. The remaining 31% “disagree,” and 14% strongly disagree about the possibility of involvement in their R&D process from the licensor side.

The companies are mostly concerned about the possibility of the licensor double selling a license to an overseas competitor. 58% of the companies “strongly agree”, and 22% “agree” that there is a risk that the licensor may license to overseas competitors. However, 29% “disagree”, and 1% “strongly disagree” with this question.

44% of the companies “strongly agree” and 22% “agree” when we asked if their drawback might be the lack of trust in other companies’ technological competence. However, 34% “disagree” with this question.

18% of the companies “strongly agree,” and 15% “agree” that they do not feel secure using external knowledge. Nevertheless, 55% of the companies “disagree,” and 13% “strongly disagree” with this question.

A bad previous licensing experience is not an important barrier for the companies. 17% “strongly agree,” and 25% “agree” with this question. However, 51% of the companies “disagree”, and 7% “strongly disagree” with this question. We presume that the companies who disagree about this question are the ones who do not have any discouraging experience while acquiring licenses.

Government incentives are an important cost-cutting and encouraging factor while investing in a license. In this sense, only 4% of companies “strongly agree”, and again, 4% of companies “agree” with this question. The remaining 48% “disagree, and 44% “strongly disagree” that

when the government does not give incentives for technology acquisition, they will not stop licensing activities.

Long negotiation process create a barrier to licensing for about 72% of the companies (68% strongly agree, and 4% agree). However, it does not create an issue for 28% of the remaining companies, which are operating in different industries and have equally distributed in public (9 companies) and private governance (9 companies), mostly corporate (individual) companies (72%), however very active in export (64% of the respondents).

Finding good technology can be a barrier to licensing-in process. Therefore, we asked the companies if finding adequate technology is an obstacle for them while licensing. 13% of the companies “strongly agree” and 34% “agree”. The majority of the respondents “disagree” (37%) or “strongly disagree” (16%) with this question.

We investigated the companies if they were concerned that the external technology transfer, either by license or patent acquirement, would reduce their innovation capability. Responses show that the companies disagree that external technology acquisition may negatively affect their innovation capacity. However, 12% “strongly agree”, and 31% “agree” on that question. The remaining 37% “disagree”, and 19% “strongly disagree” on this question.

External technology may be very complex to adapt and use in the host company. We investigated the companies to see if the complexity of other companies’ technology may be an issue for them, which can create a barrier during the licensing process. Our data shows that most companies agree that the complexity of the new technology can be a barrier to licensing-in process. 44% “strongly agree”, and 17% stated “agree” with this question. 40% “disagree” on this question. The latter respondents are predominantly public companies operating in different industries and active in export.

Transaction cost is an important barrier while licensing. 50% of the companies “strongly agree” and 15% “agree” on this question. 35% of respondents find that transaction cost is not an important barrier for licensing-in process.

Table- 33 Inbound barriers

Barriers- inbound	Strongly agree	Agree	Disagree	Strongly disagree	Total
Licensor involvement	36.1%	19%	31%	14%	100%
Licensor license overseas	48.1%	22%	29%	1%	100%
Don't trust	43.5%	22%	34%	0%	100%
Don't feel secure	17.6%	15%	55%	13%	100%
Bad prev exp	16.7%	25%	51%	7%	100%
No promotion	3.7%	4%	48%	44%	100%
Too long negotiation	68.2%	4%	23%	5%	100%
No good tech for us	13.0%	34%	37%	16%	100%
Reduce internal R&D	12.0%	31%	37%	19%	100%
Other's tech is complicated	43.5%	17%	40%	0%	100%
Transaction cost	50.0%	15%	35%	0%	100%

Outbound Open Innovation Adoption Barriers

We investigated the companies about the potential barriers that could prevent the Open Innovation process. 25 companies consented to reply to this question. Nevertheless, the remaining companies' responses are given below.

IPR Complexity and licencing contract complexity are important barriers for the companies. 7% “strongly agree,” and 63% “agree” that IPR complexity is a barrier to outbound licencing. Nevertheless, 20% of the companies “disagree” and 10% “strongly disagree with this question.

Contract complexity is also important. 12% of the companies “strongly agree” and 58% “agree” that licencing contracts are very complex to fulfil and finalize. However, 30% of the companies “disagree”, and 1 “strongly disagree”.

The majority of companies who “agree” that their patent portfolio is not open for sharing or are concerned about losing control. 68% “agree” that it is not for share, and 17% replied they “strongly agree” that their patent portfolio is not for share.

Losing control is an issue for 72% of the companies who “strongly agree”, and 25% stated “agree” on this question. Only 3 companies stated “disagree” with this question. Those companies are private companies but operate in different industries.

We investigated if licencing out is outside their company strategy. 35% replied “strongly agree”, and 28% stated “agree”. Nevertheless, 38% “disagree” with this question.

We investigated if their not selling choice is because of their technology level which has yet to reach a satisfying level to be shared with other companies. 55% of the companies “agree”, while 19% replied “strongly agree” with this question. However, 23% replied “disagree” and 3% “strongly disagree”.

Our data shows that the difficulty of finding a buyer is the least important issue for the companies. 3% stated “strongly agree,” and 36% stated “agree”; however, 43% replied “disagree,” and 18% replied “strongly disagree” for having difficulty finding a buyer.

Table- 34 Barriers for adoption of outbound open innovation

Barriers- Outbound	Strongly agree	Agree	Disagree	Strongly disagree	Total
IPR Complexity	6.7%	63%	20%	10%	100%
Contract complexity	11.5%	58%	30%	1%	100%
Not for share	17.3%	68%	13%	2%	100%
Losing control	72.1%	25%	2%	1%	100%
Against comp strategy	34.6%	28%	38%	0%	100%
Tech not yet developed	19.2%	55%	23%	3%	100%
Difficult to find buyer	2.9%	36%	43%	18%	100%
Lack of prev experience	24.0%	41%	33%	2%	100%

Lack of previous experience is important for the companies. 24% “strongly agree,” and 41% “agree” about the importance of lack of previous experience. Nevertheless, 33% “disagree” and 2% “strongly disagree” with this question.

Conclusion of Chapter 6

This chapter reveals the descriptive analysis of our research and responds to our first research question, “What forms of patent exploitation do Chinese companies use during the open innovation process, and how do different factors influence the open innovation process?”. The chapter is divided into 3 sub-chapters, which represent the general outlook of the companies (sub-chapter 6.1), the use of patents in the open innovation processes (sub-chapter 6.2), and the open innovation modalities (sub-chapter 6.3).

The first sub-chapter 6.1 provides evidence that the companies are large Chinese companies, concentrated in coastal regions of China, mostly in the manufacturing industry and have at least 1 R&D department. Almost half of these companies were established prior to 1980, a crucial period for Chinese economic advancement due to WIPO's involvement during that year. In terms of company governance, our study reveals an approximately equal split between private and public ownership structures. Additionally, all surveyed companies engage in exporting activities, with only 30% having export rates below 10%

The descriptive data analysis revealed that these companies tend to rely on patents and trade secrets as complementary methods for protecting their intellectual property rights due to intense competition within the market. Furthermore, government incentives play a crucial role in fostering partnerships with other businesses.

The findings of the second sub-chapter 6.2 reveal that patent applications are primarily made for defensive purposes within the context of open innovation. These purposes include blocking competition, protecting against imitation, and building a strong portfolio for cross-licensing. Similarly, patents are predominantly used internally in open innovation processes, such as stocking for future use and supporting product development. The selling of licenses is not a common practice among these companies; however, it is important to mention that only a small percentage of companies use their patents externally to establish joint venture agreements, engage in mergers and acquisitions (M&A), or form long-term alliances.

The third sub-chapter 6.3 demonstrates that all companies engage in both inbound and outbound open innovation practices. However, the literature evidence regarding partner selection differs slightly from the actual choices made by these companies. Contrary to expectations, collaborating with universities is not their primary preference, as Verbano et al. (2015) observed (Verbano et al., 2015). The Chinese companies choose R&D institutes and

independent companies in the first place, patent pool companies in the second place, and consulting companies and universities in the third place.

The partner selection criteria indicate companies searching for a possible R&D collaboration partner when selecting an inbound partner. The price of patents and the number of citations are significant factors in inbound licensing decisions.

The descriptive findings reveal that negative past experiences rarely impede open innovation activities as an inbound barrier. The lengthy negotiation process is the primary barrier to companies adopting open innovation practices.

Chinese companies still need help with intellectual property rights (IPR), although the extent is less significant than previous studies have indicated in the outbound open innovation process. Contract complexity remains a barrier despite companies having dedicated research and development departments. The main barrier to outbound open innovation is the fear of losing control over patents, which results in companies being unwilling to share their portfolio. This fear stems from a lack of prior experience and is further compounded by the company's culture.

Chapter 7 Open Innovation strategies

In this chapter, we are trying to respond to our second research question, “What forms of patent exploitation do Chinese companies use in this process, and what factors affect this process?”. We used the cluster analysis.

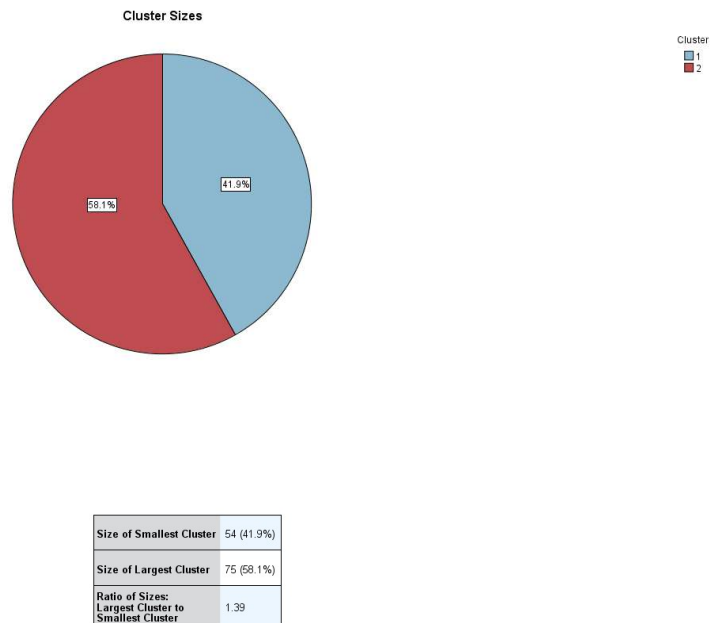
The cluster analysis gave us two main groups of companies regarding the Open Innovation strategies, specifically, the inbound and outbound Open Innovation practices. The two groups of companies are identified by using different variables, especially :

- The patenting strategy (the internal use of the patents, the external use of the patents-outbound licensing or outbound patenting),
- The patenting motivations (offensive or defensive),
- The open innovation practices (inbound and outbound),
- The typology of the partner, and
- Open Innovation adoption barriers.

We also introduced external variables such as market conditions, government incentives, and demographics (turnover, etc.).

We identified and analysed two groups of clusters according to those variables. The details below, show the distribution of the companies in the pie chart.

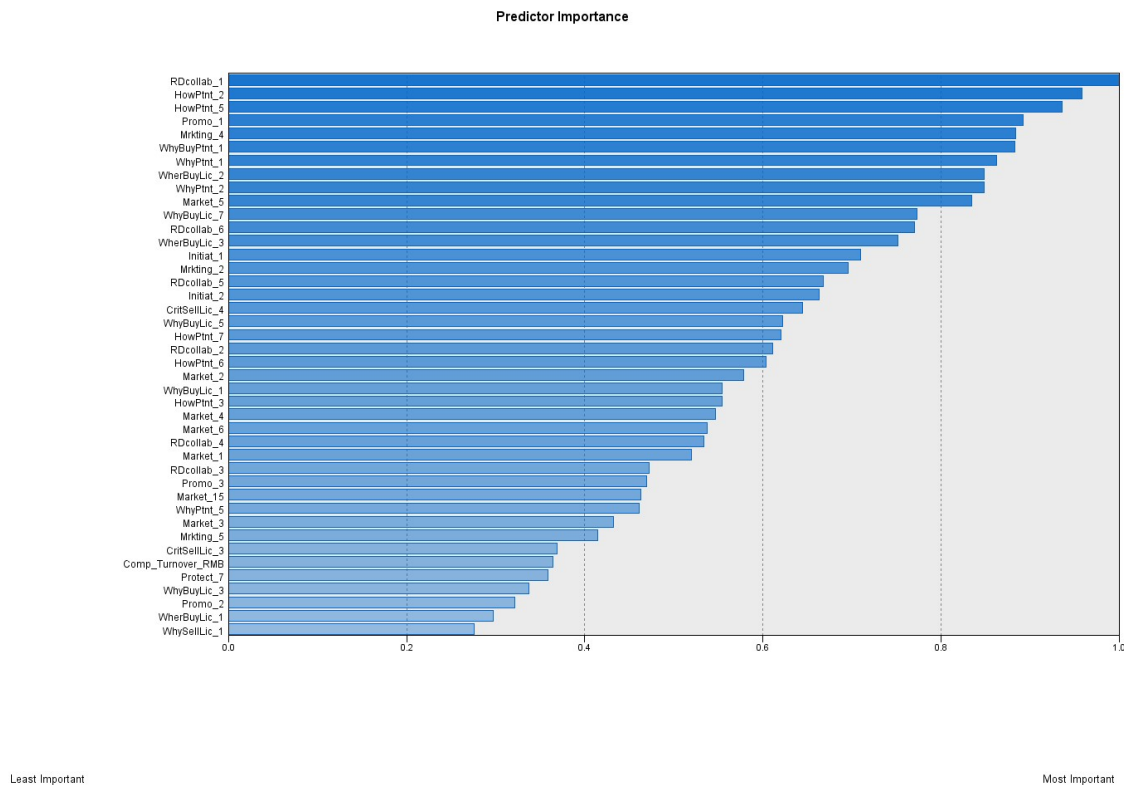
Graph- 2 Cluster distribution



When we study the pie chart, we see that the first cluster is composed by 41,9% (54 observations) and cluster 2 composed by 58,1% (75 observations).

In the graphic below, the level of importance of the variables can be seen for the two-step cluster analysis. The graphics shows that in our cluster analysis, while the most important variable is RDcollab_1 (Univ), the least important variable is WhySellLic_1 (make additional revenue).

Graph- 3 Two-step cluster analysis predictor importance levels



The table given displays the average and standard deviation figures for every cluster. Our survey consisted of questions using a 4-level Likert scale, where the average value ranges from 0 to 4. To simplify understanding, we defined an average level of 2 and identified variables that closely approached a value of 4 as being highly significant.

Answering our research question about the IP exploitation choice, we came to identify two clusters from our analysis. Considering the mean values of the internal and external exploitation motivations, we see that the first cluster is more likely to use external exploitation, and the second cluster is more likely to use internal exploitation motivations.

The cluster analysis gave us a typology of the companies in each cluster. We see that cluster 1 companies are primarily private high-tech companies, established mostly after 1980 and active mainly in Eastern China. Those companies have more than one R&D-related department. They are active in export with a range of 18,52% “more than 50%”, 27,78% “10-50%”, and 7,41% “less than 10%” of total turnover.

Table- 35 Mean and standard deviation values of the variables in clusters

Criteria	Motivation	Variable	Clusters			
			1 Ext Val		2 Int Val	
			Mean	St Dev	Mean	St Dev
Patenting	Protection	Access new markets	2.667	0.549	3.693	0.464
	Protection	Protection	2.944	0.627	3.893	0.311
	Improve image	Improve image	2.741	0.650	3.600	0.637
Int Val	Protection	Product development	2.556	0.691	3.773	0.421
Ext Val	Bargaining	R&D contracts	3.148	0.763	2.133	0.600
	Bargaining	M&A use	2.833	0.694	1.493	0.554
	Bargaining	Alliances foreign comp	2.796	0.711	1.920	0.395
	Bargaining	Using for licence	3.000	0.752	2.000	0.493
Inb Crit	Protection	Access_new inv	2.981	0.237	3.747	0.438
	Protection	Time saving	3.148	0.492	3.840	0.369
	Protection	Entr in a for.markt	2.981	0.136	3.680	0.470
	Pat Pool	Patent pool	2.537	0.503	2.120	0.327
	Univ	Univ	2.537	0.794	1.267	0.475
	R&D inst	R&D institutes	2.889	0.317	1.813	0.711
	Bargaining	Big licence portfolio	3.000	0.000	3.573	0.498
	Bargaining	Cross lic	3.056	0.302	3.613	0.613
Inb Crit	Seller	Approach to the seller	2.630	0.487	2.027	0.162
Out Crit	Bargaining	Make money	2.963	0.272	3.360	0.483
	Tech level	Tech level of the comp	3.167	0.423	3.787	0.599
	Reputation	Reputation	3.000	0.194	3.693	0.519
	Seminars	Seminars	2.759	0.432	1.880	0.544
	Direct cont	Direct contact	2.722	0.596	1.600	0.493
	Agent	Agent	2.463	0.636	1.773	0.481
Out Crit	Buyer	Approach to buyer	2.630	0.525	1.907	0.336
R&D Collab	Univ	Univ	3.148	0.684	1.773	0.535
	R&D inst	RD institutions	3.333	0.583	2.427	0.550
	Tech Tr Off	Reg transfer office	2.889	0.372	2.307	0.464
	Direct cont	Direct contact	2.907	0.559	2.093	0.550
	Agent	Consulting comp	2.370	0.734	1.347	0.479
	Tech devp zone	Tech dev zone	2.944	0.231	2.253	0.438
The Market	High comp	#of companies	2.648	0.935	3.680	0.498
	High comp	NPD	2.870	0.825	3.693	0.464
	Tech turb	Strong patent activity	2.630	0.831	3.640	0.483
	Tech turb	Difficult forecast	2.574	0.838	1.587	0.496
	Tech turb	Market growth	2.556	0.793	3.520	0.529
	Globalization	Trade freedom	2.741	0.894	3.960	0.257
	IPR	IPR Complexity	3.167	0.423	3.747	0.438
Gov	Gov	Univ, R&D inst	3.019	0.812	1.533	0.622
	Gov	Other companies	2.796	0.626	2.240	0.430
	Gov	Consulting comp	2.426	0.690	1.600	0.545
IP protect	IP OI	Patenting abroad	2.444	0.793	1.707	0.514
Turnover	Turnover	Comp_Turnover_RMB	2.963	0.272	2.387	0.613

On the other hand, public high-tech companies in cluster 1, also established after 1980, are active in northern and eastern China in the motor vehicles industry. They are less active in export than private high-tech companies.

We also see that mostly cluster 2 are public, high-tech companies, established mostly before 1980, active in approximately every region, and specifically concentrated in northern China's machinery and equipment industry. Those companies also have more than 1 R&D-related department. However, they are less active in export compared to cluster 1 public companies (as well as private companies).

The private high-tech companies in cluster 2 are also mainly established after 1980, active specifically in Eastern China and computer, electronic, and optical products, machinery, and motor vehicles industries. Those private high-tech companies are active equally in the 10-50% export range (26,67%); however, they are more active than the rest of the public companies in the "less than 10% export" range. They are also less active than cluster 1 private companies in export.

In this study, two groups are identified :

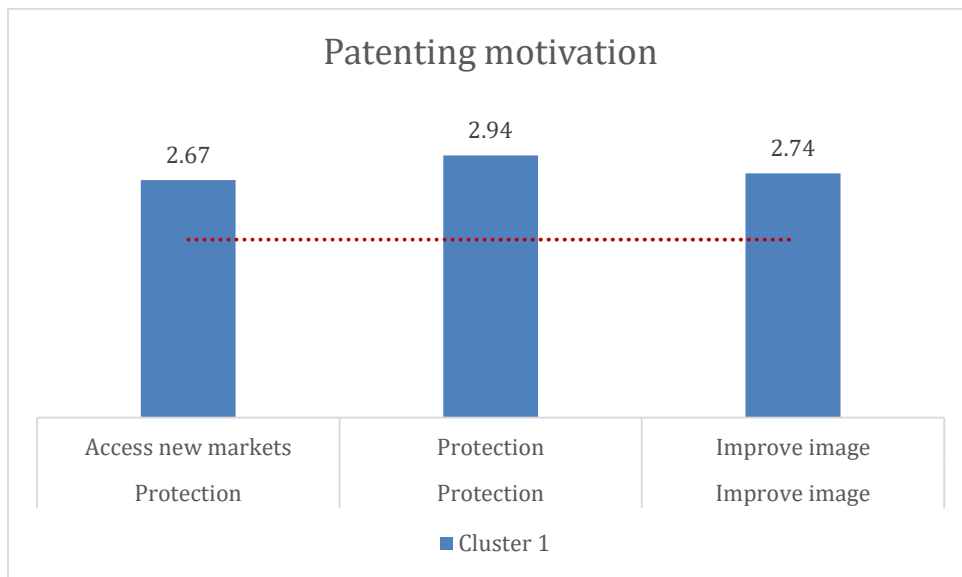
- First cluster: External oriented patent exploitation and active open process
- Second cluster: Internal patent exploitation and low level of open process
- We are going to delve into the details of two clusters in the following subsection.

7.1. External oriented patent exploitation and active open process companies

This analysis consists of identifying groups of strategic behaviours regarding OI implementation. Our analysis shows that cluster 1 is composed of a total of 54 companies, which are 29 private (53,7%), 16 public (29,6%), and nine public/private (16,7%) companies. The building of these groups is based on several independent variables ~~between~~ : governance, technology level (high-tech or low-tech), R&D-related organizations, establishment year of the company, exportation rate, region, and industry activity. Currently, we will analyse the cluster group values about the Open Innovation adoption degrees, patenting reasons, and exploitation strategies.

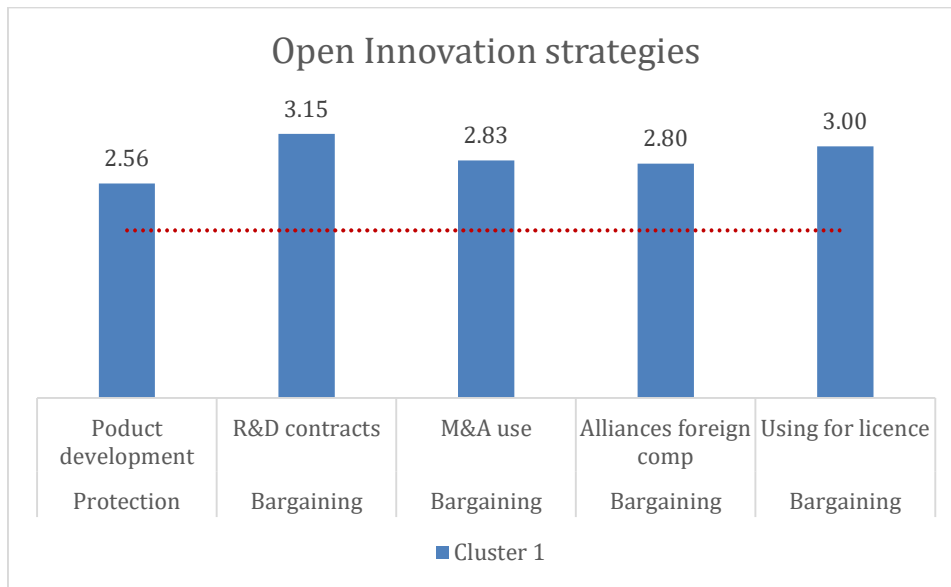
As seen above, the Cluster 1 companies regroup 41,9% of the companies, which are mainly private high-tech companies, established after 1980, and active in Eastern China. The public companies in this cluster also established mainly after 1980, active in northern and eastern China. However, they are less active in exportation, compared to the private companies in this cluster.

Graph- 4 Patenting motivation of cluster 1



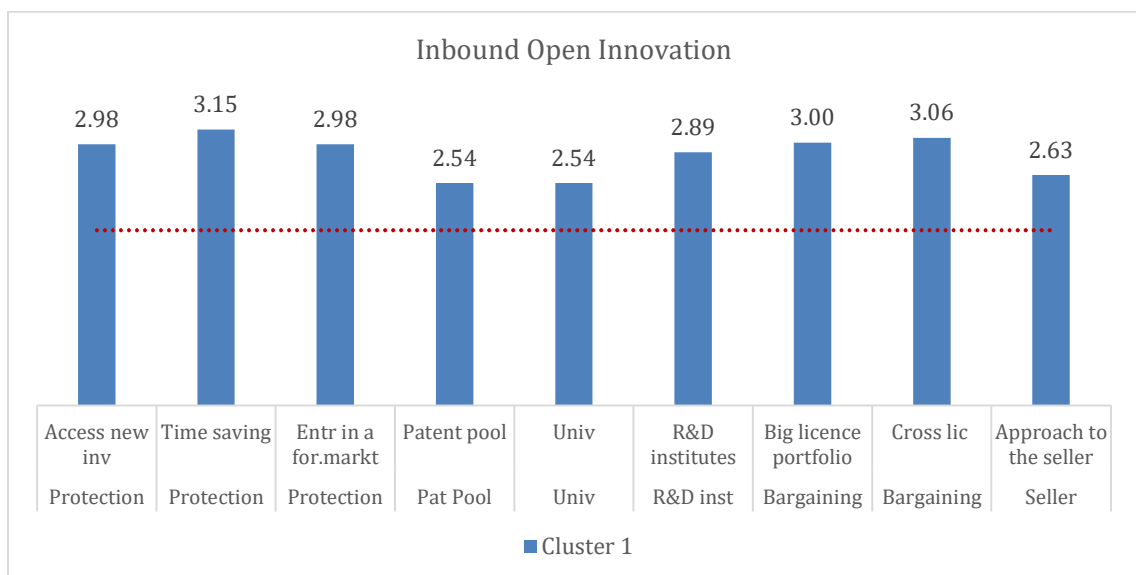
The patent application for use in open innovation processes shows that those companies are patenting for protection purposes; therefore they adopt a defensive patenting strategy with a motivation for patenting to protect their invention (2,94), to improve their image in the market (2,74), and to access in new markets (2,67). modalities

Graph- 5 Open innovation Exploitation strategies of cluster 1



The defensive strategy related to the implementation of active inbound open innovation process of the Cluster 1 companies is to use their patents internally for product development (2,56). The inbound process is mostly implemented by R&D contracts (3,14), licensing agreements (3,00), more specifically, the licensing-in acquisition is made by cross-licensing agreements (3,06). The outbound innovation process is implemented by M&A agreements (2,83), and making strategic alliances with other companies (2, 80).

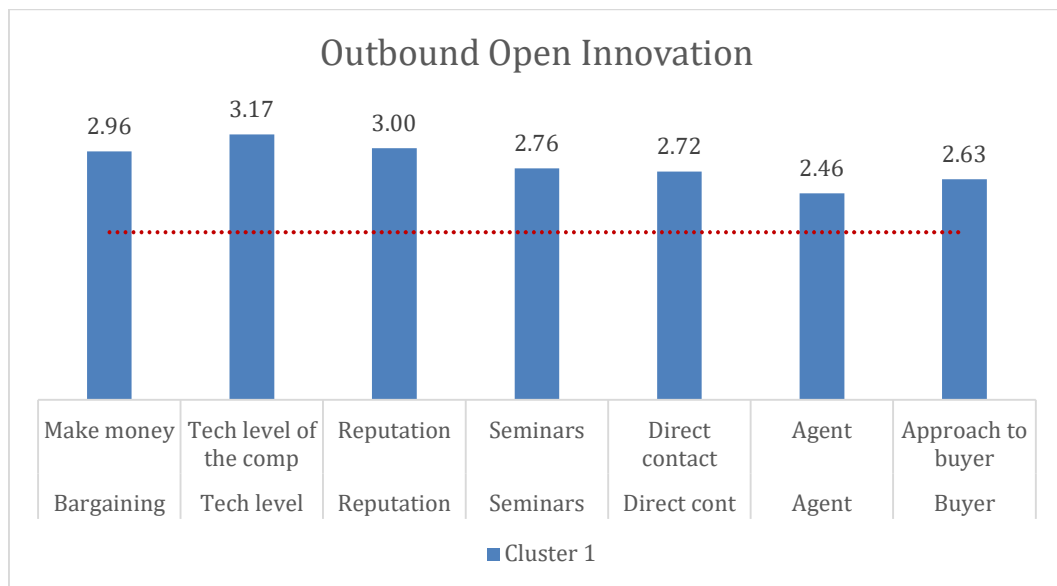
Graph- 6 Inbound Open Innovation of cluster 1



The defensive strategy of the companies in cluster 1 is achieved through the use of inbound open innovation. . This approach allows them to expand their portfolio (3,00),

negotiate cross-licensing agreements (3,06), and save time when entering the market (3,15). Those companies tend to use the inbound Open Innovation for having a quick access to a new invention (2,98) and to a foreign market (2,98). The inbound licensing or patenting implemented in several ways and from several partners. The Cluster 1 companies privilege more the R&D institutes (2,89), than the universities (2,54) and the patent pool participant companies (2,54) as inbound Open Innovation partner. The Cluster 1 companies does not hesitate to approach the license seller company (2,63) while inbound licensing.

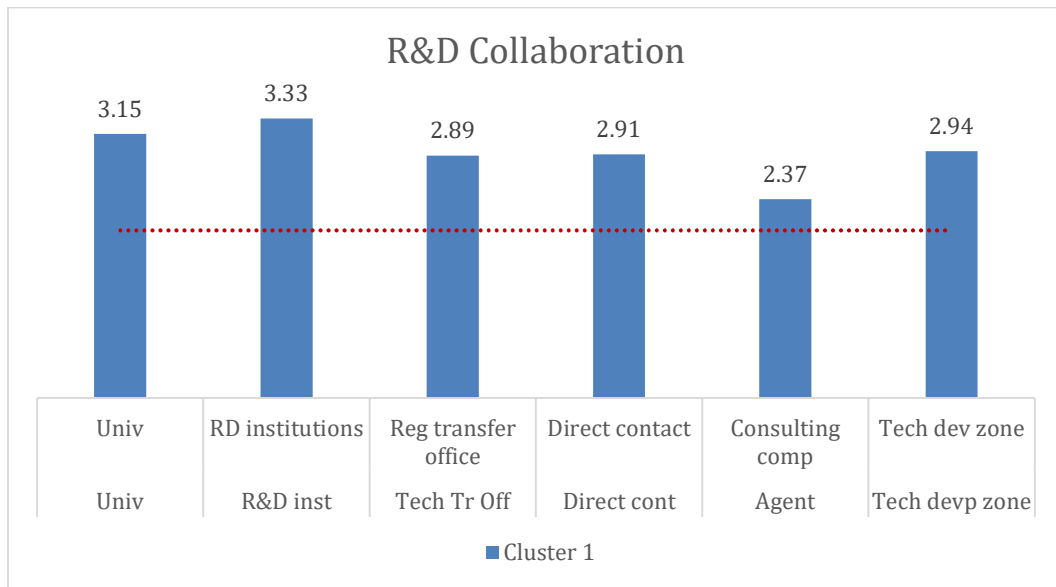
Graph- 7 Outbound Open Innovation of cluster 1



The defensive patent strategy does not mean not having licensing-out agreements. Chinese companies of this cluster use the outbound Open Innovation only for having additional revenue (2,96). These results lead to the conclusion that the companies in this cluster use open processes, especially outside-in modes and occasionally licensing-out for financial reasons.

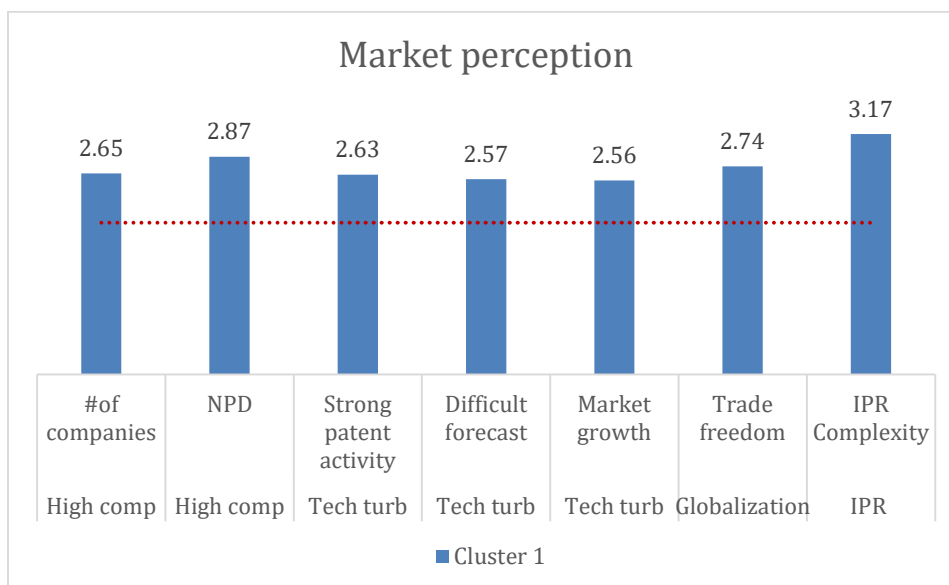
Besides that, the Cluster 1 companies consider the technology level (3,17) and the reputation (3,00) of the buyer company as **selection criteria** for outbound licensing. The Cluster 2 companies identify or reach their partners for outbound licensing, during the seminars (2,76), directly contacting the partner by themselves (2,72), or by using an intermediary as an agent (2,46). Also, those companies does not hesitate to contact the buyer company by themselves, they took initiative (2,63)

Graph- 8 R&D collaboration of cluster 1



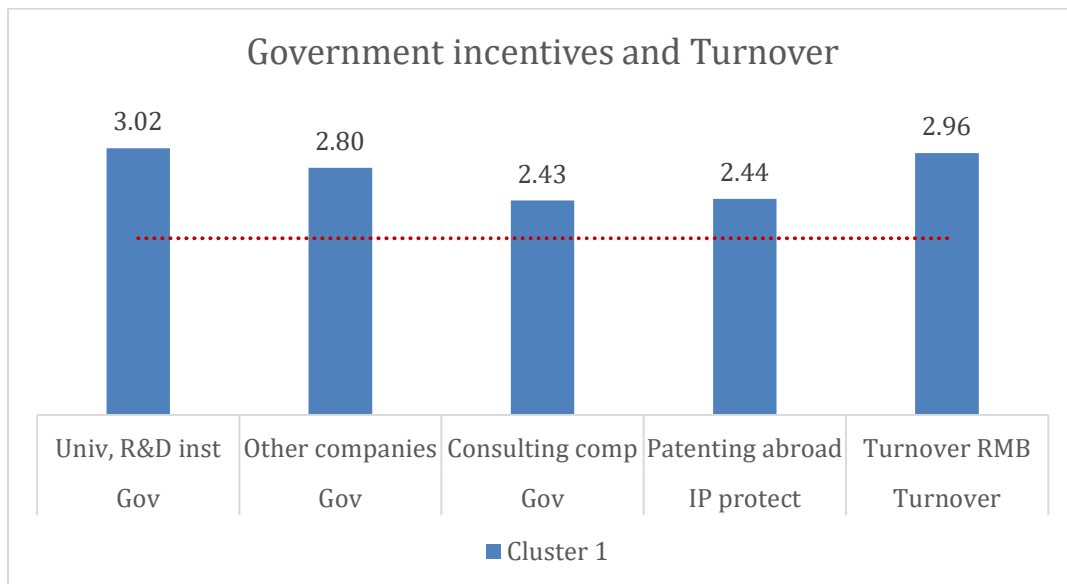
The companies in this cluster are actively using inbound Open Innovation process and they are using outbound licensing to get only additional revenue for the firm. Consequently, R&D collaboration is also seen as creating inbound open innovation activities. Companies in this group favoured partnerships with R&D institutions (3.33), universities (3.15), companies in technology development zones (2.94), direct contact with the partner (2.91), the regional transfer office (2.89) and consulting firms (2.37).

Graph- 9 Technology market environment of cluster 1



The Cluster 1 companies market perception show that those companies consider high competition in the market and technological turbulence. More specifically, the Cluster 1 companies find that the fast technological development in the market push the companies for making NPD (2,87), and there are too many companies in the market (2,65). On the other hand, the technological turbulence variables show that the companies in this cluster consider that there is trade freedom (2,74), there is a high rate of patent activity in their market (2,63), there is a difficulty to forecast the where will be the major technology in 3 years (2,57), and the market has a high growth rate (2,56). Those companies consider that the IPR is getting complex (3,17).

Graph- 10 Government promotion of cluster 1



The government incentives are important for the cluster 1 companies, mostly the promotion for working with Universities and R&D institutes (3,02). The government promotions are also considerable for working with other companies for R&D purposes (2,80), and for soliciting consulting companies for R&D activities (2,43). The Cluster 1 companies use actively abroad patenting as a protection tool (2,44), and they are big companies with a high turnover rate (2,96).

Nevertheless, this group of companies' coefficients for external use of patents are higher than the second group of companies, namely, use of patents for M&A (2.8) and Alliance with a foreign company (2.79), having the initiative to approach the buyer company (2.6), increasing absorptive capacity by collaborating with universities (2.53) and R&D institutes (2.88) by using the government incentive (3.019), and patenting abroad (2.44). All those variables have

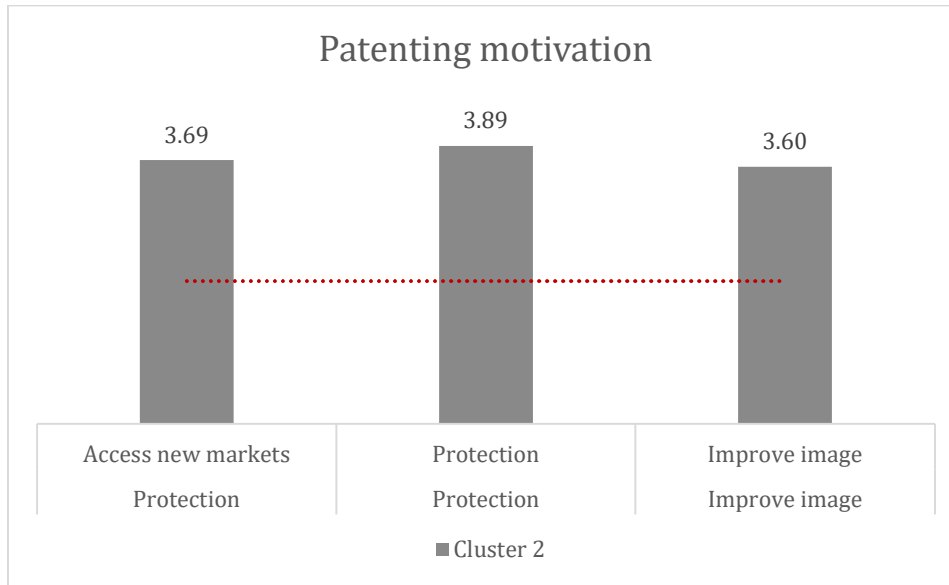
a higher coefficient than the second group of companies. Those variables show that the companies use protective and defensive patenting strategies because of the competitive market conditions. However, despite the high volatility in the market conditions and the high competition level (2.5), companies are willing to use their patents outside the company by establishing M&A alliances and alliances with foreign companies, besides using patents to gain additional money by increasing licensing revenues.

7.2. Internal patent exploitation and low level of Open processes companies

The cluster 2 with high internal exploitation (protection) values and low values for using patent as a bargaining tool, can be considered “a defensive patent strategy, internal patent exploitation and low level of open processes” cluster. Cluster 2 is composed of a total of 75 companies whose distribution according to their governance is as follows; 28 private (37,3), 36 public (48%), and 11 public/private (14,7). As seen above, the Cluster 2 companies regroups 58,1% of the companies, which are mainly public high-tech companies, established before 1980, and active nearly in every region of China. The private companies in this cluster also established mainly after 1980, active in eastern China. However, they are more active in exportation, compared to the public companies in this cluster. We see that, the majority of this cluster are public, high-tech companies, established mostly before 1980, active in approximately every region and specifically concentrated in machinery and equipment industry in northern China. For this reason, the government incentives are less important than the cluster 1 companies. Respectively, the support to collaborate with University and R&D institutes, to work with other companies or to protect at international level are less important than cluster 1 companies. Those companies have also more than 1 R&D related department. However, they are not active in export compared to cluster 1 public companies (as well as private companies).

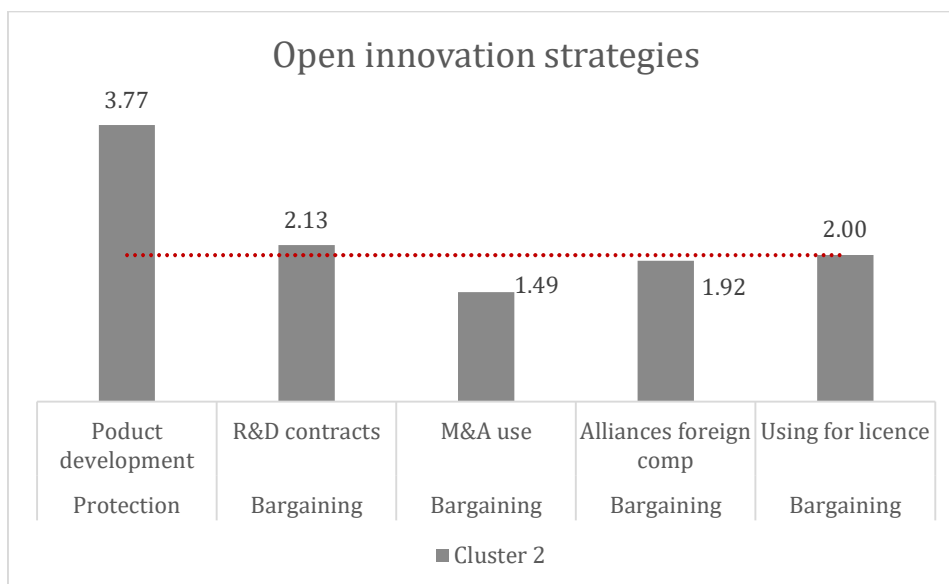
On the other hand, private high-tech companies in cluster 2, are also mostly established after 1980, active specifically in Eastern China, and in computer, electronic and optical products, machinery, and motor vehicles industries. Those private high-tech companies are active equally in the 10-50% export range (26,67%), however, they are more active than the rest of the public companies in the “less than 10% export” range. They are also less active than cluster 1 private companies in export.

Graph- 11 Patenting motivation of cluster 2



The cluster 2 companies adopt a defensive patenting strategy with a high motivation for patenting to protect their invention (3,89), to access in new markets (3,69), and to improve their image in the market (3,60). The results indicate that those companies are using more “defensive” patent strategy than the companies in the first cluster.

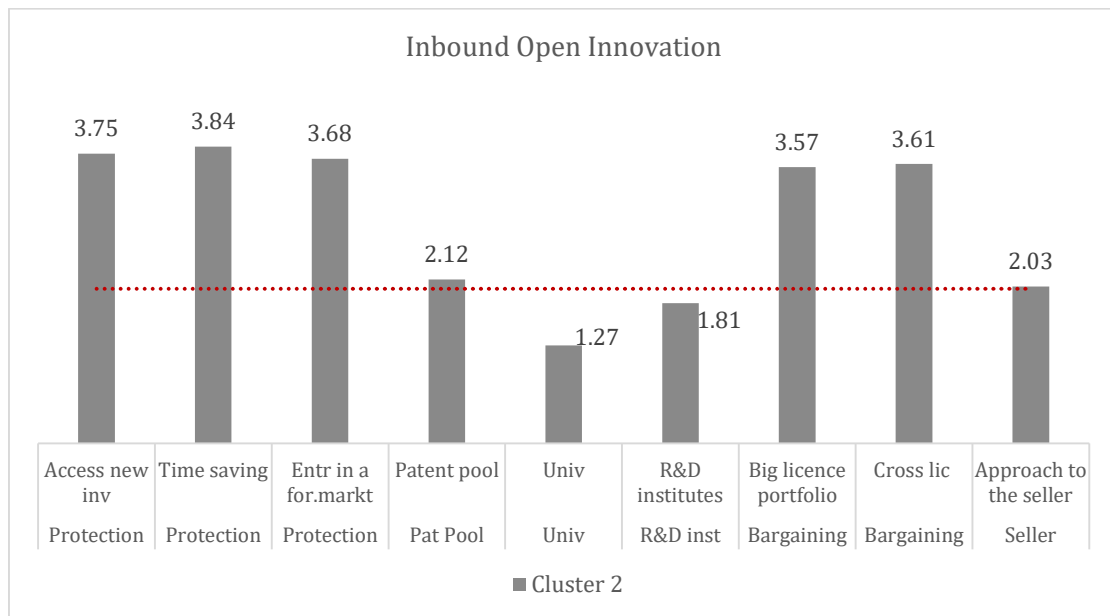
Graph- 12 Open Innovation strategies of cluster 2



The cluster 2 companies with high protection purpose mean value, can be considered “internal oriented but defensive patenting” cluster with low level of openness. Companies in Cluster 2 utilize patents for internal purposes, primarily to support the development of their new products (3,77). In contrast to Cluster 1 companies, they rely less on patents for external open processes

such as R&D collaborations (2,13), M&A agreements (1,49), and alliances with foreign companies (1,92). Moreover, regarding the inside-out processes the cluster 2 companies can be considered with more closed innovation processes compared to cluster 1 companies. These companies have low licensing process (2,00) with the exclusive aim to generate additional revenue and to use in cross-licensing.

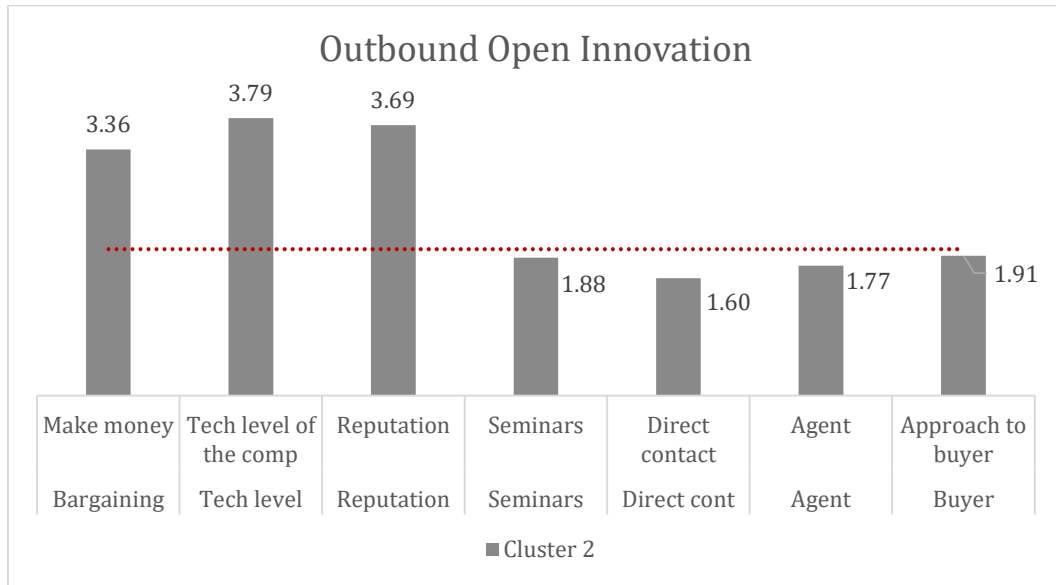
Graph- 13 Inbound Open Innovation of cluster 2



Compared to cluster 1, the companies in this cluster use inbound Open Innovation as a tool to save time for getting in the market (3,84), to have a quick access to a new invention (3,75), to enter in a foreign market (3,68). Those companies tend to use the inbound Open Innovation for having a large patent portfolio (3,57), and making cross-licensing agreements (3,61). These companies have a weak licensing process that aims to improve product portfolios (2,00), mainly through cross-licensing.

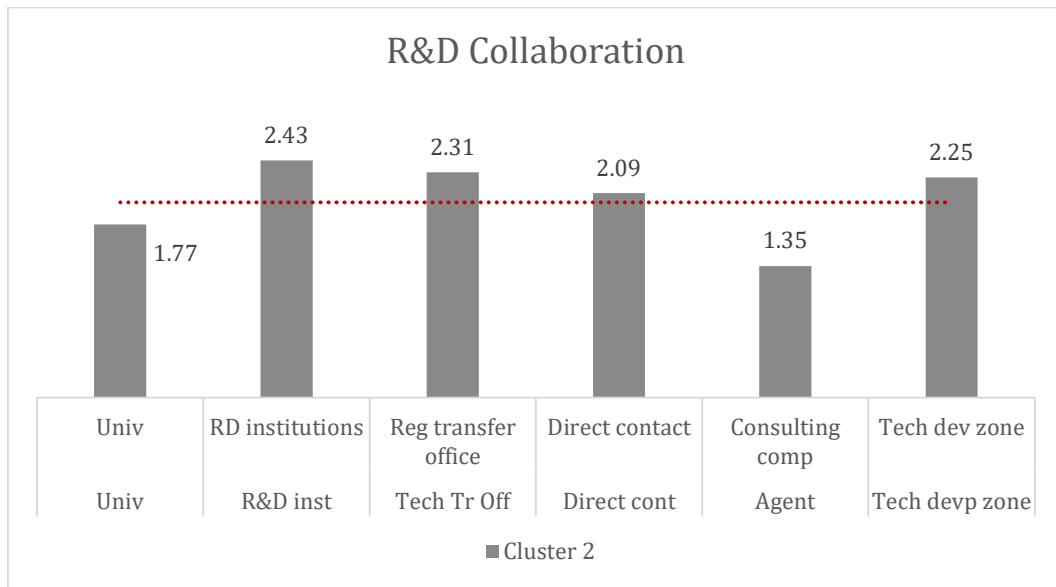
The inbound licensing or patenting implemented in several ways and from several partners. The Cluster 2 companies prefer the patent pool participant companies (2,12) as inbound Open Innovation partner. However the R&D institutes (1,81), or universities (1,27) are not considered as much as patent pool companies (2,12) as a partner. The Cluster 2 companies does not hesitate to approach the license seller company (2,03) while inbound licensing.

Graph- 14 Outbound Open Innovation of cluster 2



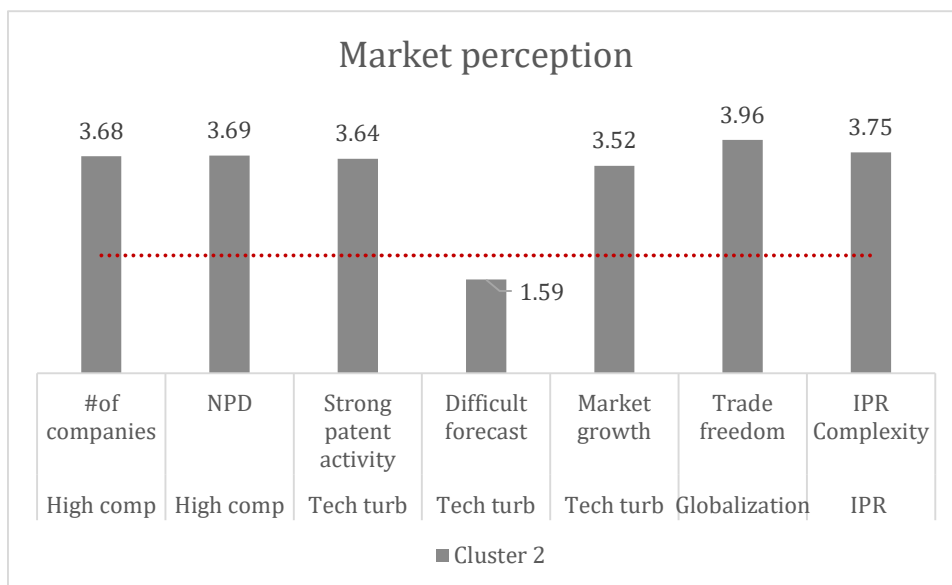
The Cluster 2 companies consider important the technology level (3,79), and the reputation (3,69) of the buyer company as a selection criteria while outbound licensing. Nevertheless, when coming to the identification of the outbound partner, the cluster 2 companies remain reluctant and not very open compared to cluster 1 companies openness to identify and contact the partner. They are less likely to use the seminars (1,88), directly contacting the partner (1,60), or by using an intermediary as an agent (1,77). However those tools are not very much important for outbound process of those companies. Also, those companies remain hesitating to contact the buyer company by themselves (1,91). Furthermore, in terms of internal-external processes, cluster 2 companies have more closed innovation processes than cluster 1 companies. The cluster 2 companies' reasons for licensing-out is to generate revenues (3,36) and this reason remains higher than the cluster 1 companies.

Graph- 15 R&D collaboration of cluster 2



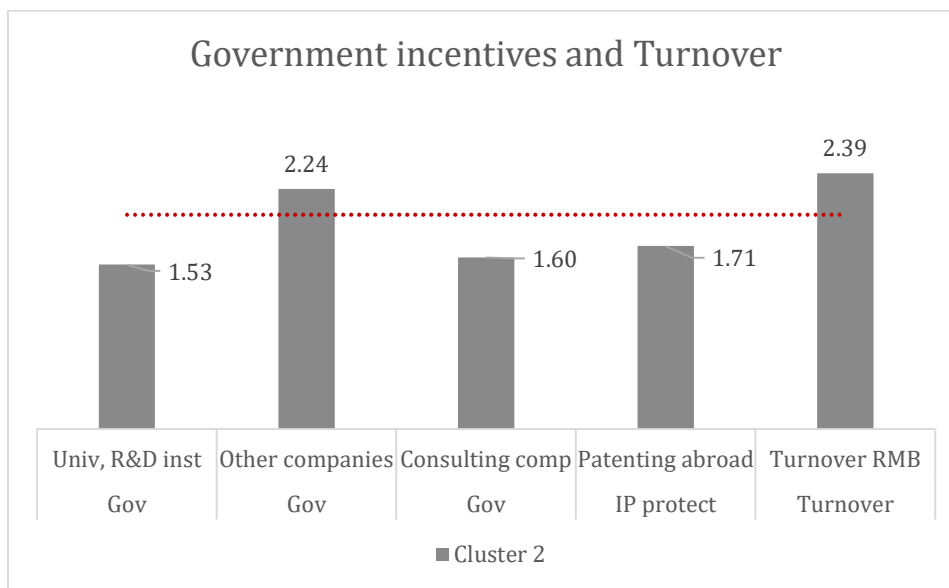
The companies in this cluster are actively using inbound Open Innovation process and they are using outbound licensing to get only additional revenue for the firm as Cluster 1 companies. The R&D collaboration is also considered as a way to create inbound Open Innovation activities. The companies in this cluster privilege the R&D institutions (2,43), regional transfer office (2,31), technology development zone companies (2,25), direct contact to the partner (2,09). However, universities (1,77) and consulting companies (1,35) are not very much important for the companies in this cluster.

Graph- 16 Technology market environment of cluster 2



The Cluster 2 companies market perception show that those companies consider high competition in the market and technological turbulence. More specifically, the Cluster 2 companies find that the fast technological development in the market push the companies for making NPD (3,69), and there are too many companies in the market (3,68). On the other hand, the technological turbulence variables show that the companies in this cluster consider that there is trade freedom (3,96), there is a high rate of patent activity in their market (2,64), and the market has a high growth rate (3,52). However, the technological improvement is quite predictable (1,59), Those companies consider that the IPR is getting complex (3,75).

Graph- 17 Government promotion of cluster 2



In this cluster, the government incentives are less than necessary for the cluster 1 companies since most of this cluster are public companies. The promotion for working with other companies for R&D purposes (2,24) is the only promotion considered necessary by those companies. Remaining promotions, namely working with Universities or R&D institutes (1,53) or consulting companies (1,60), are not regarded as interesting or maybe occasionally used by those companies. Patenting abroad is not a suitable alternative protection for those companies (1,71) as it is for Cluster 1 companies, but they are also big companies with a high turnover rate (2,96).

We see that, the majority of this cluster are public, thig-tech companies, established mostly before 1980, active in approximately every region and specifically concentrated in machinery and equipment industry in northern China. Those companies have also more than 1

R&D related department. However, they are not active in export compared to cluster 1 public companies (as well as private companies).

On the other hand, private high-tech companies in cluster 2, are also mostly established after 1980, active specifically in Eastern China, and in computer, electronic and optical products, machinery, and motor vehicles industries. Those private high-tech companies are active equally in the 10-50% export range (26,67%), however, they are more active than the rest of the public companies in the “less than 10% export” range. They are also less active than cluster 1 private companies in export.

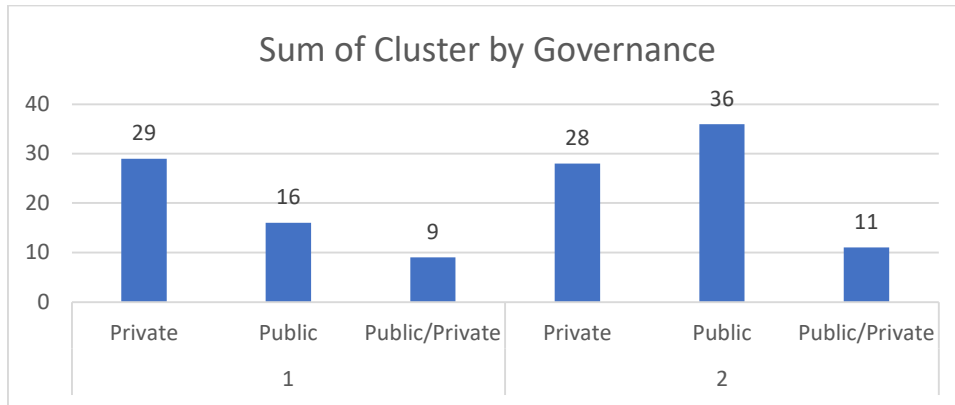
The results show that both groups of companies have protective behaviour. Nevertheless, the second group of companies' coefficients for external use of patents via outbound or inbound OI modalities are lesser than the first group of companies, namely, use of patents for M&A (1.4) and Alliance with a foreign company (1.9), having the initiative to approach the buyer company (1.9), increasing absorptive capacity by collaborating with universities (1.2) and R&D institutes (1.8) by using the government incentive (1.5), and patenting abroad (1.7). All those variables have a lesser coefficient than the first group of companies. The high volatility in the market conditions and the high competition level (3.6), companies hinder the willingness to use their patents outside the company by establishing M&A alliances and alliances with foreign companies, besides using patents solely to gain additional money by increasing licensing revenues. In conclusion, our results indicate that cluster 2 companies have a defensive patent strategy, using patents for internal product development, with a low level of openness, particularly through an outside-in process to enrich internal product development, and low licensing activity for revenue.

7.3. Main characteristics of cluster 1 and cluster 2

Governance of clusters

Our analysis shows that cluster 1 is composed of a total of 54 companies, which are 29 private (53,7%), 16 public (29,6%), and nine public/private (16,7%) companies. Cluster 2 is composed of a total of 75 companies whose distribution according to their governance is as follows; 28 private (37,3), 36 public (48%), and 11 public/private (14, 7).

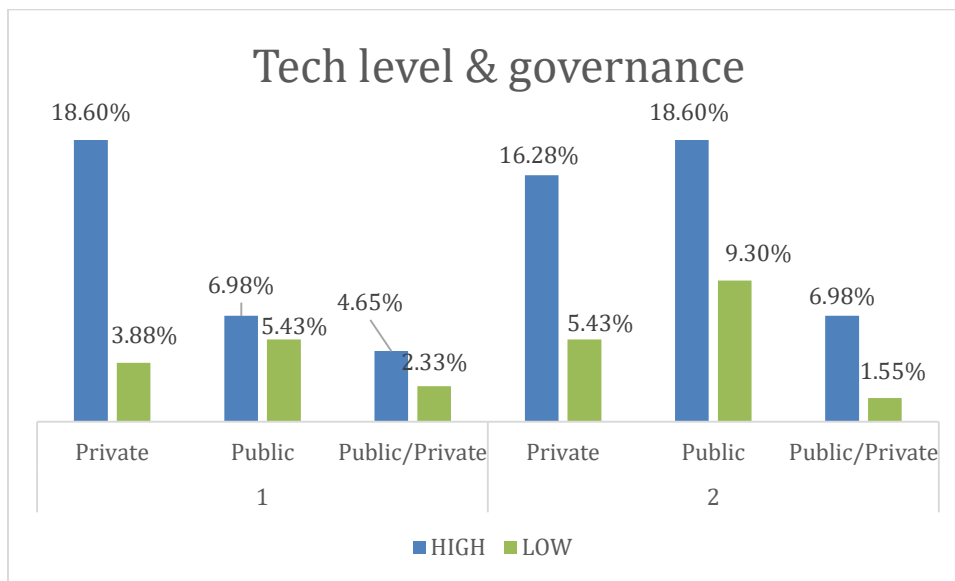
Graph- 18 Governance comparison



Technology level of clusters

Then we put a second breakdown of high-tech and low-tech in our analysis.

Graph- 19 Governance type vs Technology level comparison

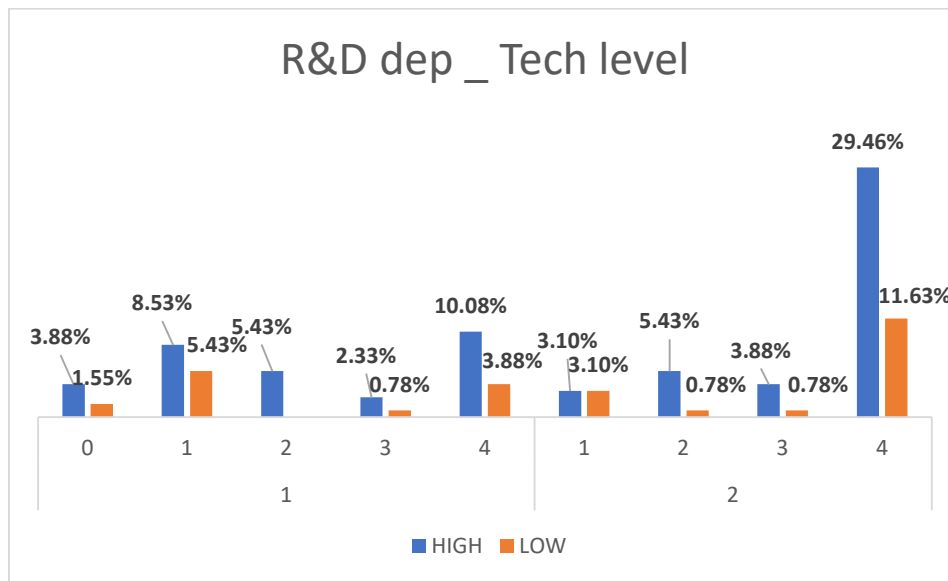


Concerning cluster 1 the high-tech companies comprise 18,60% private, 6,98 % public, and 4,65% public/private. Respectively, the Cluster 2 companies distribution in high-tech is 16,28% private, 18,60 % public, and 6,98% public/private. We also see that the low-tech companies in this cluster are distributed as follows: 9,30% private low-tech companies, 14,73% public low-tech companies, and 3,88% public/private companies. We can conclude that cluster 2 exhibits a higher percentage of public companies in both high-tech and low-tech industries. However, when comparing cluster 1 to cluster 2, it is evident that cluster 1 has more private high-tech companies than cluster 2.

R&D department engagement of clusters

Among the high-tech companies, 39,53% stated that they have four different R&D-related departments (R&D department, patent department, license department, and patent law department). 6,20% stated that they have three different departments, 10,85% stated that they have two different R&D-related departments, 11,63% stated that they have an R&D department, and 3,88% didn't answer this question.

Graph- 20 R&D department vs Technology level comparison



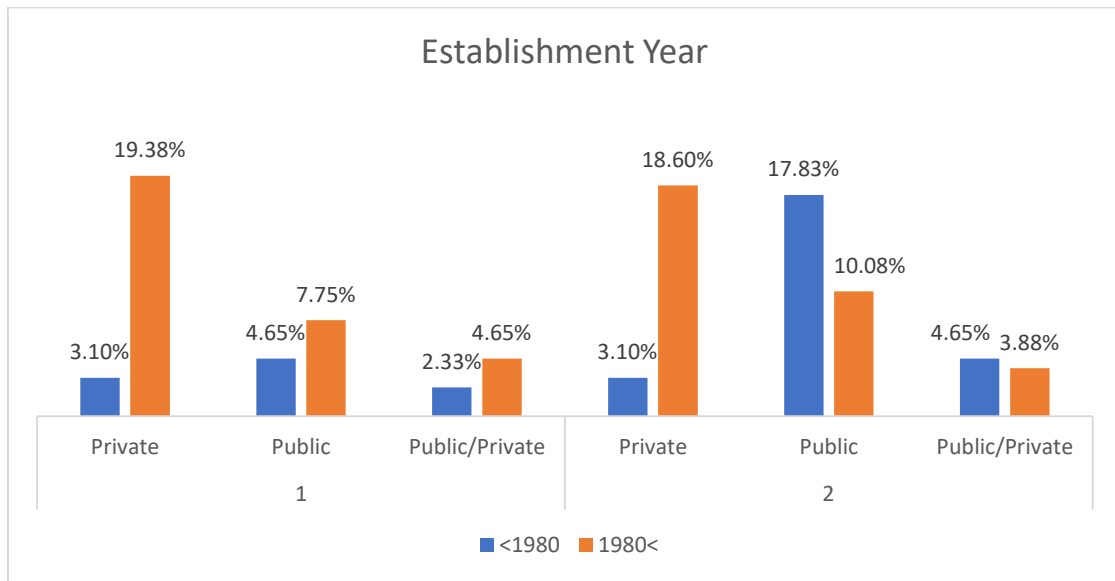
The low-tech companies in this cluster also stated that they have R&D-related departments as follows: 15,50% stated that they have four different departments (R&D department, patent department, license department, patent law department), 1,55% stated that they have three different R&D related departments, 0,78% replied that those companies have two different R&D related departments, 8,53 % stated that they have R&D department only, and 1,55% doesn't answer to this question.

In conclusion, we can say that the majority of high-tech companies in cluster 2 are more involved in R&D by evidence than by the number of their related R&D departments.

Establishment year of clusters

When looking to the establishment year of the companies, we can see that 64,34% established after 1980, and remaining 35,66% established before 1980.

Graph- 21 Establishment year comparison

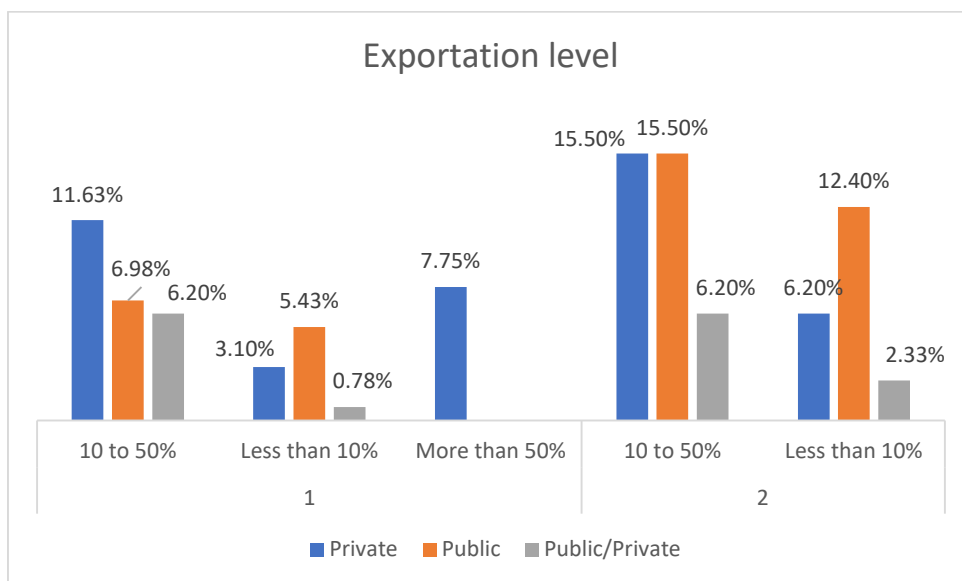


The breakdown show that the majority of our sample consist of private high-tech companies established after 1980. We can say that private-sector companies grew strongly after 1980 in both groups. In the public sector, however, most public-sector companies created after 1980 are in cluster 2.

Exportation level of the clusters

We observe that all cluster companies, especially private companies are active in exportation.

Graph- 22 Exportation level vs Company governance type comparison



Companies that the share of exportation revenues compose 10 to 50% of their turnover are in total of two clusters: 27,13% private companies, 22,48% public, and 12,40% public/private companies. 7,75% of the companies stated that their exportation rate compose higher than 50% of their turnover.

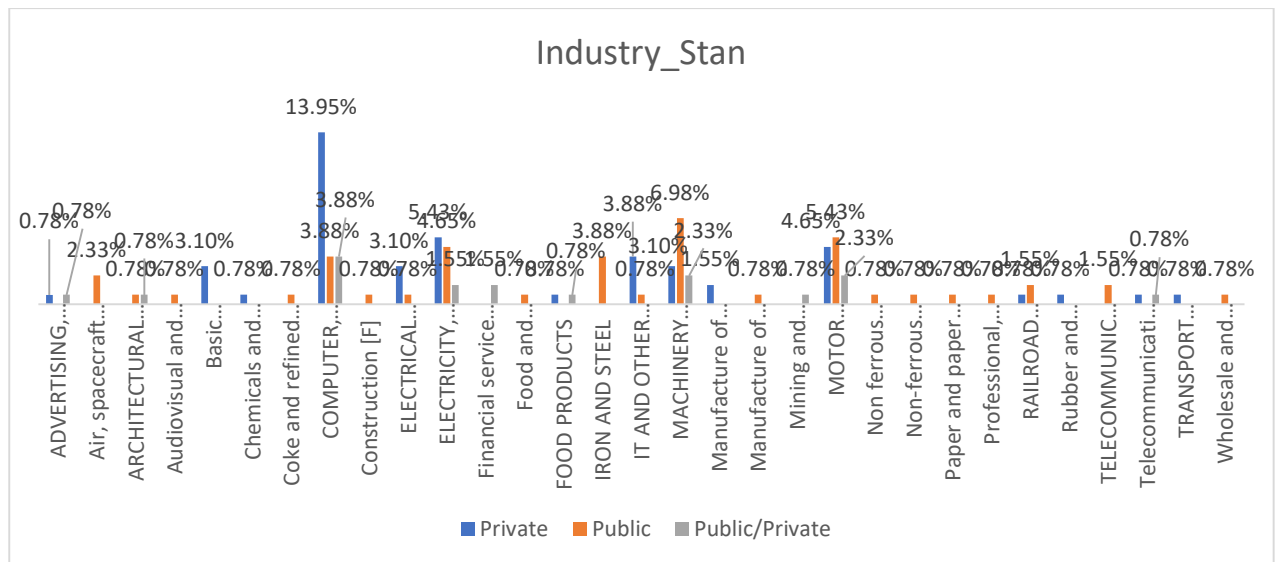
Companies which their exportation rate doesn't exceed 10% of their turnover in total are classified as follows: 9,30% private, 17,83% public, and 3,16% public/private companies.

We can see that cluster 1 comprises companies active in exporting in both the public and private sectors. As for cluster 2, there is significant export activity in both the public and private sectors. If we compare the two groups, we can see that Group 1 has more companies that generate over 50% of their sales from exports.

Industry-STAN breakdown of clusters

When we analyse the industry breakdown in this cluster, we see that, public companies are active in almost every industry in our sample. However, private companies concentration is on the computer electronics and optical products industry.

Graph- 23 Industry breakdown according to Company governance type

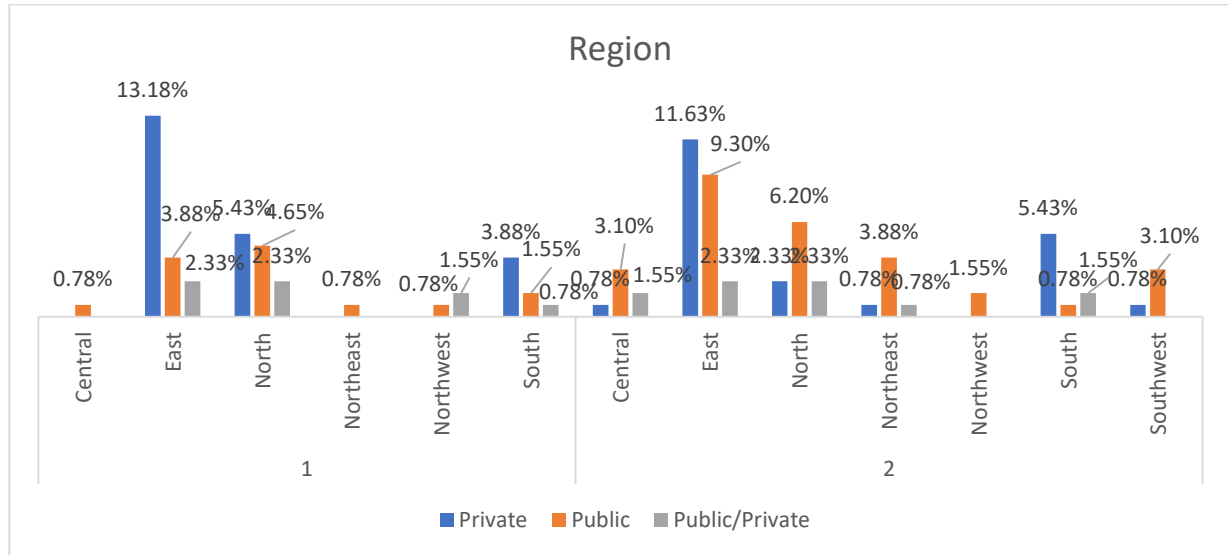


We can conclude that private companies are concentrated in the IT and electronics sectors, but the public sector dominates the machinery, iron and steel, and automotive industries.

Regional dispersion of clusters

We can see that our sample is concentrated from eastern, northern and southern region companies.

Graph- 24 Region breakdown according to Company governance type



More specifically, we've found that in cluster 1, the majority of the companies established after 1980, and mostly private companies from this group are located in the Eastern part of China. Then it comes the northern China as the second region where the cluster 1 companies concentrated most. Again for cluster 2, we see that the private companies which established after 1980 concentration is in the eastern part of China like in the cluster 1. However, we see also a concentration of companies which established before 1980 both in northern and eastern part of China. We also find a concentration of older companies in this cluster.

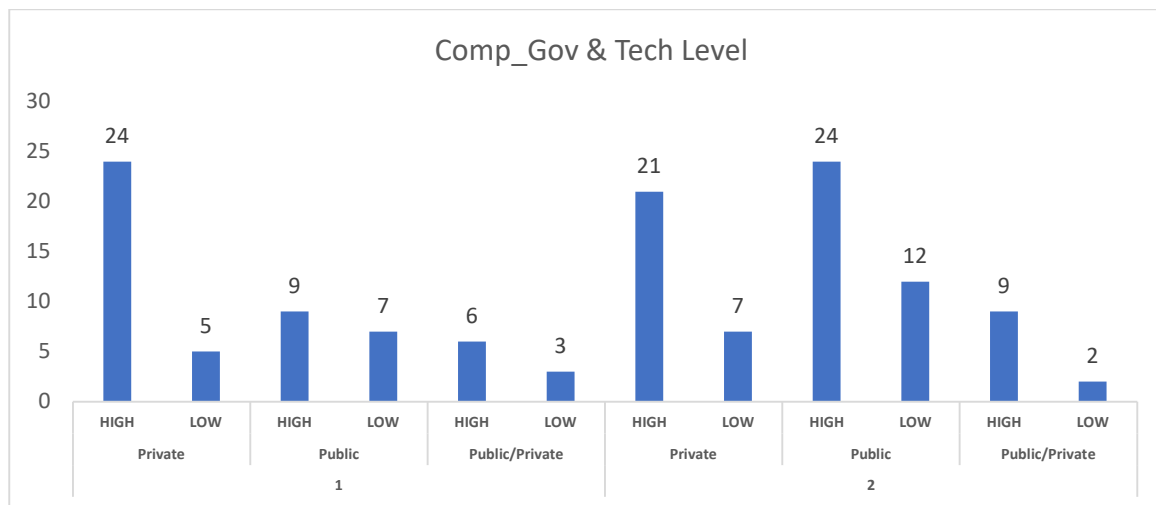
We can conclude that In groups 1 and 2, we found that private companies created after 1980 are concentrated in the eastern part of China. Companies created before 1980 are also concentrated in northern and eastern China. Older companies are also concentrated in Group 2. Public and private companies created after 1980 are concentrated in both groups in eastern, northern and southern China. It can also be said that state-owned companies are present in all regions, while private companies are mainly concentrated in both groups' east and south of the country.

Industry and establishment year of clusters

When we've break down the companies according to their technology level which we used the classification of UN's classification standard (STAN 1). First we've breakdown the

technology levels as UN classification standards, namely: 1) High R&D intensive activities 2 digit definition, 2) High- and Medium-high R&D intensive activities 2 digit definition, 3) Medium-high R&D intensive activities 2 digit definition, and 4) Low technology level companies. In order to simplify this breakdown, we then regroup the first tree technology level under one group that we named “high-technology companies” and remaining “low technology companies”. Therefore, we’ve seen that the majority of the breakdown belong to high tech industries.

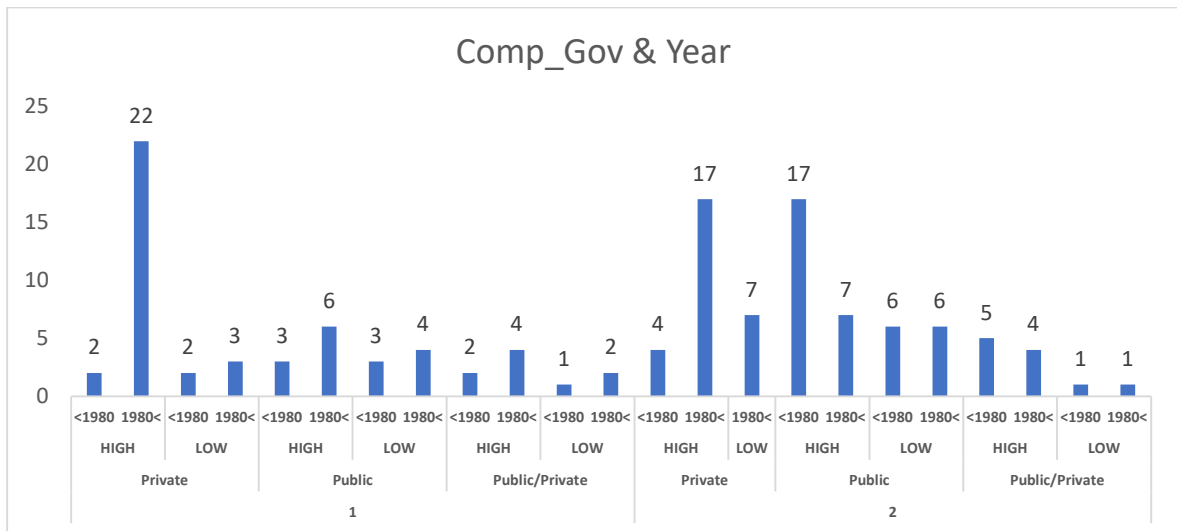
Graph- 25 Company governance & Technology level comparison of groups



The year 1980 and 2001 has a special importance in the China’s history. As a reminder, China became a member of WIPO (World International Patent Organization) in 1980. It is the beginning of a transition from closed to open economy for China in the innovation and it’s protection domain. Second, in 2001, China entered in WTO. We can observe the effect of these two adhesion from the increasing number of company establishments after 1980.

Accordingly, we’ve realized that the number of private high-tech companies established after 1980 are higher in both clusters. In cluster 1, mostly high-tech private companies established after 1980 dominates the cluster (22 companies), in other words, private companies dominates this cluster (29 companies). In cluster 2, we are seeing that the majority of private high-tech companies established after 1980 dominates this cluster’s private breakdown (34 companies). However, the public governance companies have the highest number in this cluster, and when we look at their break downn about esabishment year, we can see that the majority of high-tech public companies established before 1980 (34 companies).

Graph- 26 Company governance & Technology level & establishment year comparison of groups

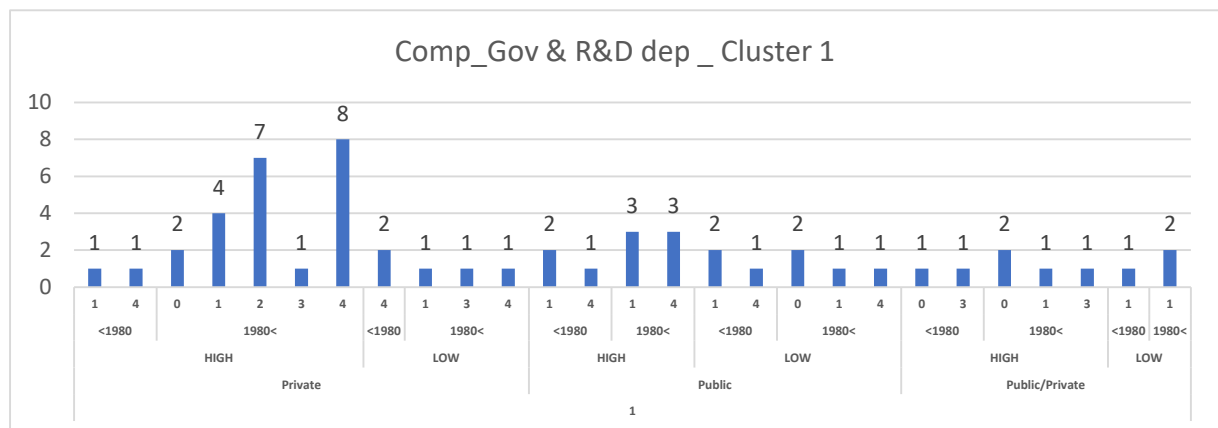


We can conclude that the number of private high-tech companies created after 1980 is higher in both groups. However, public governance companies are most numerous in group 2, with most high-tech public companies established before 1980.

Industries and R&D management department of clusters

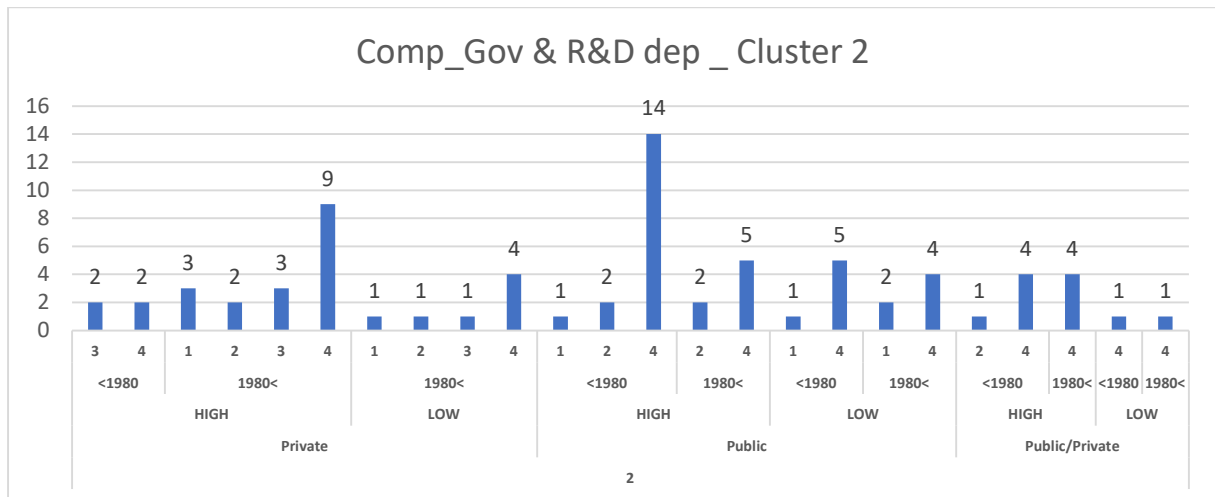
We’ve then analyse the breakdown of R&D management departments. In our survey we’ve asked the companies if they have one or more R&D management related departments, namely: R&D department, patent department, licence department, patent law department. In order to simplify our analysis, we’ve given equal score for every department (1) and sum-up the total of those in order to regroup under every cluster. Accordingly, our breakdown gave the following results in the table below.

Graph- 27 Company governance & Tech. level comparison of groups, establishment year and R&D department of group 1



We can see that in the cluster 1, the high-tech private companies have different R&D related management departments. By order of department numbers, in cluster 1, 8 public, 6 private, and 4 public/private companies mentioned only one R&D department. 7 private companies mentioned at least 2 R&D related management department. 2 private and 2 public/private companies mentioned that they have a combination of 3 R&D related department and finally 12 private, 6 public companies in cluster 1 mentioned that they have all four R&D related management departments. Only 7 companies stay reluctant for this question and doesn't give any information.

Graph- 28 Company governance & Technology level comparison of groups, establishment year and R&D department of group 2



In cluster 2, all companies responded to this question. Accordingly, we can see that 4 companies in public, 4 companies in private governance group replied that they have at least 1 R&D related management department. 4 public, 3 private and 1 public/private companies mentioned that they have 2 different departments for R&D management. 6 private companies mentioned that they have 3 R&D related management companies. Finally, 28 public, 15 private and 10 public/private companies replied that they have all four departments.

In conclusion, private high-tech companies in Group 1 have more than one R & D-related department, and this dominates Group 1. Nevertheless, Group 2 shows that in both public and private companies, the number of R&D departments is higher than in Group 1. In the following part of our research, we are going to study in detail the typology of each group.

Conclusion of Chapter 7

This chapter reveals the cluster analysis of our research and responds to our second research question, “What types of Chinese companies adopt the open innovation model and engage in patent exploitation?” In order to respond to this question, we introduced different variables respectively: motivations for protection; patent strategy (internal exploitation by the company, external exploitation: licensing-in/out or patent selling/buying); motivations for open innovation inbound and outbound processes; type of the partner (universities, R&D institutions, consulting companies). Moreover, we involved a few variables describing companies: patent activity (patent protection at national and international levels), trade freedom, New Product Development (NPD), market turbulence, IPR management complexity, the use of government financial incentives, and company turnover. The cluster analysis provides us with two groups of companies:

- First cluster: External oriented patent exploitation and active open process
- Second cluster: Internal patent exploitation and low level of open process

The Cluster 1 companies, active mainly in Eastern China, regroup 41,9% of the companies. This cluster is composed mostly of private high-tech companies established after 1980. We observe that the public companies in this cluster were also established after 1980. Public companies are generally established in northern and eastern China. The public companies are mostly active in the motor vehicles industry but less active in exportation than private companies in this cluster.

The companies in the cluster 1 are active in exportation. They are very active in R&D and have more than one department dedicated to R&D and patenting (at least 1 R&D department). The results show that the Cluster 1 companies have a defensive patenting strategy dominated by protective motivations for patent application. Their main motivation for patent application remain protecting the invention (2,9), improvement of their image (2,7), and access in new markets.

Despite using both internal and external exploitation of the patents, the mean values of the inbound and outbound Open Innovation motivation variables show that this cluster is focused on active inbound Open Innovation.

The results of cluster 1 show that the patenting motivation of the companies in this cluster is defensive behaviour. The defensive strategy is achieved through an inbound open innovation strategy. Inbound open innovation motivations are accessing new markets, saving time, and entering a foreign market. Inbound open innovation is implemented in several ways and with different partners, such as R&D institutes, universities, and companies in the patent pool. Nevertheless, the defensive patent strategy is not an obstacle to implementing outbound open innovation. The companies in Cluster 1 are licensing-out their patents to earn additional revenue. The companies pay attention to the technology level and the partner's reputation in this cluster. Identifying and reaching the partner occurs during seminars, using an agent or directly contacting the partner. Companies in this cluster do not hesitate to enter into a direct relationship for a possible collaboration.

R&D collaboration is also considered a way to create inbound open innovation activities. The companies in this cluster privilege the R&D institutions, universities, technology development zone companies, regional technology transfer offices, consulting companies and direct contact with the partner.

The market perception for the Cluster 1 companies is highly competitive. The high competition in the market appears through the high number of companies in the market, highly developed new product development activities (NPD) and patenting activities, and difficulty forecasting the market development in 5 years. The companies in this cluster find that their market growth is fast, and the trade freedom in the market positively impacts this growth. They also found that IPR protection became complex in China. The government S&T policy has a positive effect on this cluster. The incentives for universities or R&D institutions to collaborate with other companies or consulting companies are highly appreciated in this cluster. Patenting abroad is considered a way to protect the IP outside the country. The companies' turnover shows that the cluster 1 companies are large.

The Cluster 2 companies, private companies, are active in Eastern China and were established after 1980. They are more active in exportation than public companies in the same cluster but less active than Cluster 1 companies. The public companies in this cluster outnumber the private companies, which were established before 1980. The mean values of the cluster analysis show that the companies in this cluster adopt a defensive patenting behaviour like Cluster 1 companies and are much more active in inbound Open Innovation than outbound Open Innovation. The results show that Cluster 2 is more closed compared to Cluster 1.

The results show that the patenting motivation mean values of the companies in cluster 2 are higher than the cluster 1 companies and show defensive behaviour through adopting an inbound open innovation strategy. Outbound licensing is realised only for generating additional revenue, and the companies in this cluster have a lesser mean value of using patents for M&A or alliance with a foreign country. The results show that an inbound open innovation strategy also achieves the defensive strategy. The motivations for inbound open innovation are accessing new markets, saving time, and entering a foreign market. Nevertheless, the mean value of those motivations is higher than the cluster 1 companies. Implementing inbound open innovation is mostly made by collaborating with patent pool companies as partners. The universities and R&D institutions are not considered as important as patent pool companies.

The defensive patent strategy does not hinder the outbound open innovation for this cluster either. Companies in cluster 2 use licensing out to generate additional revenue, which is very important compared to cluster 1 companies. The partner company's technology level and reputation are much more important for this cluster than the cluster 1 companies. Partner identification is less likely to be made during seminars, direct contact, or by using an agent compared to cluster 1 companies.

R&D collaboration is also considered a way to create inbound open innovation activities for this cluster. The companies in cluster 2 privilege the R&D institutions, technology development zone companies, regional technology transfer offices, and direct contact with the partner. Nevertheless, compared to cluster 1 companies, universities and consulting companies are less important.

The market perception for the Cluster 2 companies is also competitive. The high competition in the market appears through the large number of companies in the market, highly developed new product development activities (NPD), and patenting activities. Similar to cluster 1, the companies in this cluster find that their market growth is fast, and the trade freedom in the market positively impacts this growth. They also found that IPR protection became complex in China as cluster 1 companies. However, forecasting the market development in 5 years is less important than it is for cluster 1 companies.

The government S&T policy has nearly no effect on this cluster. The incentives for universities or R&D institutions to collaborate with consulting companies are less important than for cluster 1 companies. The only important incentive is the one the government gave for collaborating

with other companies. Patenting abroad is not considered important for those companies in this cluster. The companies' turnover shows that the cluster 2 companies are large companies as well.

The cluster analysis findings reveal that Chinese companies adopt a defensive strategy to patent and utilize inbound open innovation. However, these companies can still engage in outbound open innovation to generate revenue. Both market conditions and government policies influence the decision to embrace open innovation. Nonetheless, the intense market competition amplifies uncertainty and reduces trust among partner companies. As a result, potential partners' reputations and technological expertise become crucial considerations for Chinese firms. Nevertheless, further exploring the specific factors influencing decisions regarding open innovation within the Chinese context is essential. The following chapters will delve into these variables, examining their impact on patent decisions and their overall influence on strategies related to open innovation.

Chapter 8 Patent decision in Open Innovation processes

The Decision Tree analysis (CART analysis) helps to understand the influence of the independent variables on dependent variables. Those analysis processed in the IBM SPSS 26.

The decision tree of the dependent variable reveals the most important factors associated with the dependent variable, here the patenting reasons and exploitation types of the company, namely inbound and outbound open in ovation processes. Accordingly, in our study, this analysis will help us to see the most important variable in the decision of the patenting reasons and exploitation ways of the companies. In other words, we are going to analyse the factors that have the most influence on the decision-making process.

For each node of the decision tree, the right branch of the node without any node placed under (as terminal branches) is considered the decision path or rule of the dependent variable we seek to explain. The numbers at the bottom of the terminal branches indicate the mean of the rate in each data subset.

The first sub-chapter (sub-chapter 8.1) is dedicated to the patent decision and open innovation relationship.

The second sub-chapter (sub-chapter 8.2) is dedicated to the inbound and outbound open innovation processes and patent application relationships.

Below, the analysis of the decision tree is given by terminal nodes rules.

8.1. The link between patenting motivation and open innovation strategy

There are different motivations for patenting, which can be linked to different strategies. The results of the CART analysis provide us with the pathway of companies' patenting motivations in open innovation processes. In this section, the results are presented among companies' key decision paths according to the highest average value of the results.

a. Patenting for having access in new markets

This result shows that the patenting motivation for having access to a new market is highly influenced by inbound licensing for having access to a new invention for cost reduction and internal use of the patents.

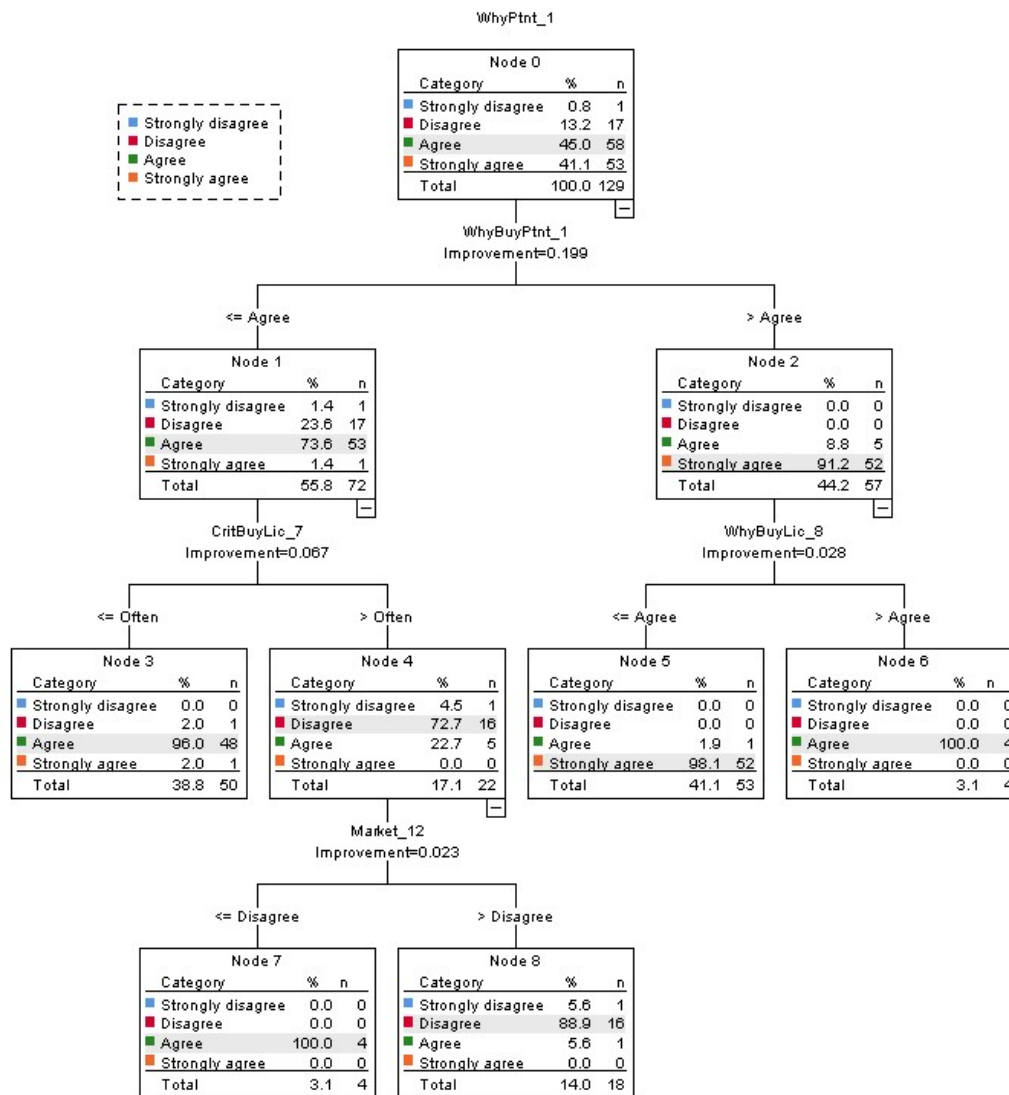
The table below shows the CART analysis dependent variable Access in new markets.

Table- 36 Access new markets in OI

	Estimation				Accuracy rate
	Strongly disagree	Disagree	Agree	Strongly agree	
True Strongly disagree	0	1	0	0	0.0
True Disagree	0	16	1	0	94.1
True Agree	0	1	56	1	96.6
True Strongly agree	0	0	1	52	98.1
Overall rate %	0.0	14.0	45.0	41.1	96.1

The analysis highlights the distribution of the accuracy rate : 0% strongly disagree, 94,1% disagree, 96,6% agree, 98,1% strongly agree.

Figure- 1 Patenting motivation in open innovation : Access new market



The decision tree of the dependent variable access new markets is given above. It shows that that patenting for accessing new markets has the highest relationship (first degree) with the inbound patenting for accessing a new invention, then the patent citation in the database of the acquired (purchased) licence and working as a subcontractor of licensor company , and third, the government guidelines for science and technology.

The cart analysis gave us five decision leaves as follows:

- 1- The companies who are “*patenting to have access in new markets*” and do not agree that they are “*inbound patenting for easy access to a new invention*” do not agree

that they took into consideration as a criterion the “*patent citation in the patent database*” (39%).

- 2- The companies who are “*patenting to have access in new markets*” and do not agree that they are “*inbound patenting for easy access to a new invention*” agree that they took into consideration as a criterion the “*patent citation in the patent database,*” and not agree that “*government offer guidelines for S&T activities*” (3%).
- 3- The companies who are “*patenting to have access in new markets*” and do not agree that they are “*inbound patenting for easy access to a new invention*” agree that they took into consideration as a criterion the “*patent citation in the patent database,*” and agree that “*government offer guidelines for S&T activities*” (14%).
- 4- The companies who are “*patenting to have access in new markets*” and agree that they are “*inbound patenting for easy access to a new invention*” do not agree that they are “*inbound licensing to work as a manufacturer for the licensor company*” (41%).
- 5- The companies who are “*patenting to have access in new markets*” and agree that they are “*inbound patenting for easy access to a new invention*” agree that they are “*inbound licensing to work as a manufacturer for the licensor company*” (3%).

The results indicate that the motivation to obtain patents to access new markets is strongly influenced by licensing-in. The licensing-in provides access to a new inventions at a reduced cost through the internal use of these patents.

b. Patenting to protect company business

This result shows that the patenting motivation for protecting the actual business is highly influenced by market conditions, more specifically by the high competition level in the market and the reputation of the partner company while outbound licensing.

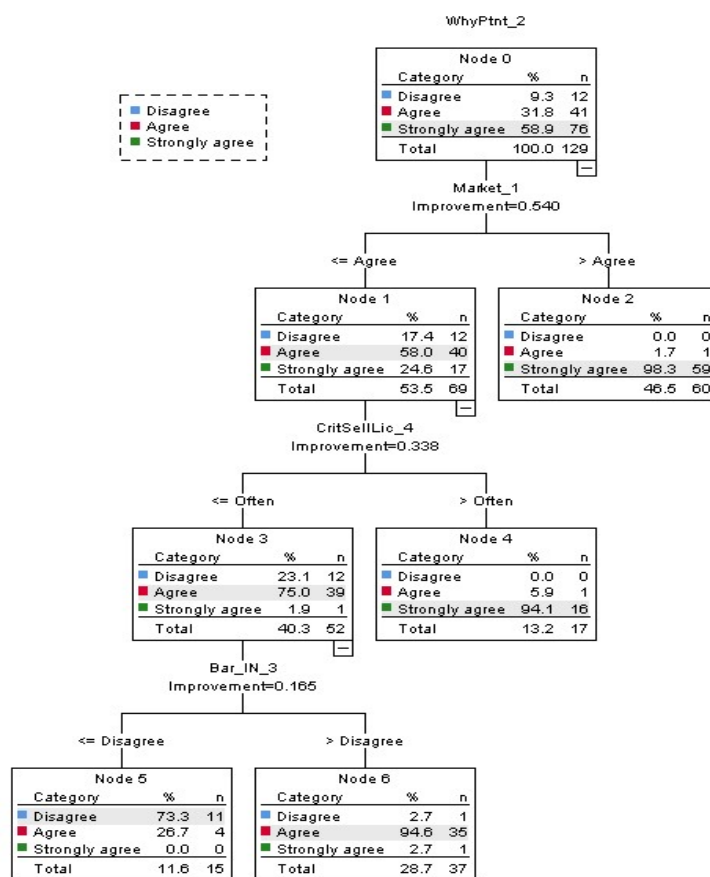
The below table shows the CART analysis of the dependent variable Protection. The analysis highlights the distribution of the accuracy rate: 91,7% disagree, 85,4% agree, 98,7% strongly agree.

Table- 37 Protection in OI

		Estimation			Accuracy rate
		Disagree	Agree	Strongly agree	
True	Disagree	11	1	0	91.7
	Agree	4	35	2	85.4
	Strongly agree	0	1	75	98.7
Overall rate %		11.6	28.7	59.7	93.8

The decision tree of the dependent variable (Protection) is given above. It shows that our dependent variable has the strongest relationship in the first (1st) order with (#of companies), the second-order (2nd) relationship with (Reputation of the comp), and the third-order (3rd) highest relationship is with (NIH). It is also observed that the independent variables (#of companies), (Reputation of the comp) and (NIH) split into two groups in terms of the dependent variable (Protection). The percentages of the groups are also given in the graphic below.

Figure- 2 Patenting motivation in open innovation : Protection



The cart analysis gave us four decision leaves as follows:

- 1- The companies who are "*patenting to protect business*" and do not agree that there are "*too many companies in our market*" do not agree that they took into consideration as a criterion the "*reputation of the buyer company while outbound licensing*," do not consider as a barrier "*we don't trust other companies' technological competences while inbound licensing*" (11%).
- 2- The companies who are "*patenting to protect business*" and do not agree that there are "*too many companies in our market*" do not agree that they took into consideration as a criterion the "*reputation of the buyer company while outbound licensing*", and consider as a barrier "*we don't trust other companies' technological competences while inbound licensing*" (29%).
- 3- The companies who are "*patenting to protect business*" and do not agree that there are "*too many companies in our market*", agree that they took into consideration as a criterion the "*reputation of the buyer company while outbound licensing*" (13%).
- 4- The companies who are "*patenting to protect business*" and agree that there are "*too many companies in our market*" (47%).

The findings indicate that market conditions, particularly the level of competition and the partner company's reputation in the case of outbound licensing, significantly impact the motivation to patent to protect company business. This result suggests that businesses are driven to protect their interests in response to intense competition and the perceived value of partnering with reputable companies. Therefore, those companies tend not to trust other companies' technological competencies for inbound licensing.

c. Patenting to block rivals

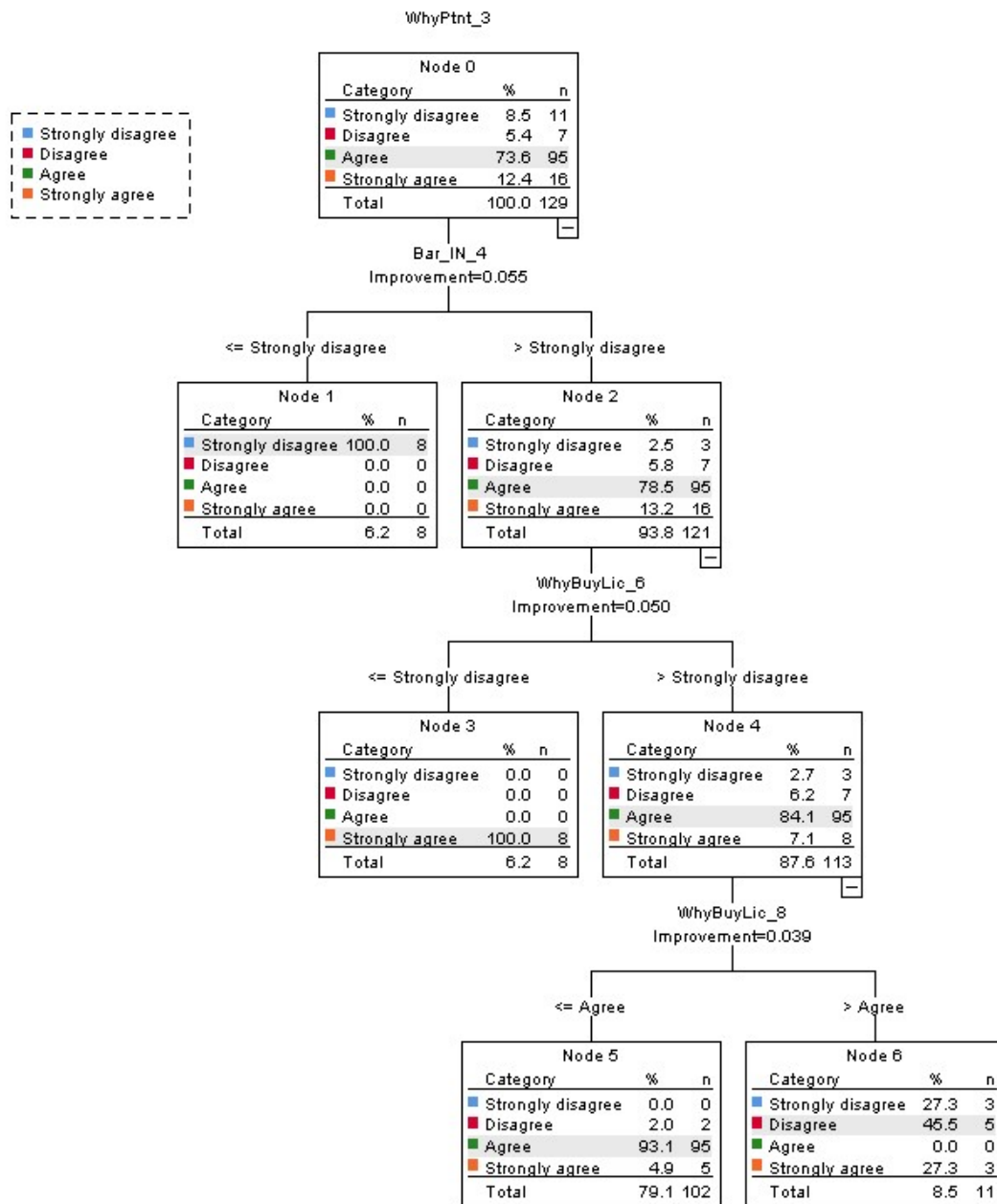
This result shows that the patenting motivation for blocking rivals from competing is highly influenced by the previous negative inbound experience of the company, which reduces the trust through external companies as partners and then by inbound licensing the proven technology from the market. The below table shows the CART analysis of the dependent variable block rivals in OI. The analysis highlights the distribution of the accuracy rate: 72,7% strongly disagree, 71,4% disagree, 100% agree, and 50% strongly agree.

Table- 38 Block rivals in OI

		Estimation				Accuracy rate
		Strongly disagree	Disagree	Agree	Strongly agree	
True	Strongly disagree	8	3	0	0	72.7
	Disagree	0	5	2	0	71.4
	Agree	0	0	95	0	100.0
	Strongly agree	0	3	5	8	50.0
Overall rate %		6.2	8.5	79.1	6.2	89.9

The decision tree of the dependent variable block rivals is given above. It shows that our dependent variable has the highest relationship with (Bad prev exp), the second variable with the highest relationship with (Use already succeeded tech), the third highest relationship is with (Subcontractor of licensor comp) independent variables. It is also observed that the independent variables (Bad prev exp), (Use already succeeded tech), and (Subcontractor of licensor comp) split into two groups in terms of the dependent variable (Block rivals). The percentages of the groups are also given in the graphic below.

Figure- 3 Patenting motivation in open innovation : Block rivals



The cart analysis gave us four decision leaves as follows:

- 1- The companies who are "*patenting to block our rivals to compete*" and do not agree that they have a "*bad previous inbound licensing experience*" (6%).
- 2- The companies who are "*patenting to block our rivals to compete*" and agree that they have a "*bad previous inbound licensing experience*", and do not agree that they are "*inbound licensing the already proved technology*" (6%).

- 3- The companies who are "patenting to block our rivals to compete" and agree that they have a "bad previous inbound licensing experience", agree that they are "inbound licensing the already proved technology", and do not agree that they are inbound licensing for "working as a manufacturer for licensor company that we bought the license" (79%).
- 4- The companies who are "patenting to block our rivals to compete" and agree that they have a "bad previous inbound licensing experience", agree that they are "inbound licensing the already proved technology", and agree that they are inbound licensing for "working as a manufacturer for licensor company that we bought the license" (9%).

This result shows that the patenting motivation for blocking rivals from competing is highly influenced by the previous negative inbounding experience of the company, which reduces the trust through external companies as partners and then by inbound licensing the proven technology from the market.

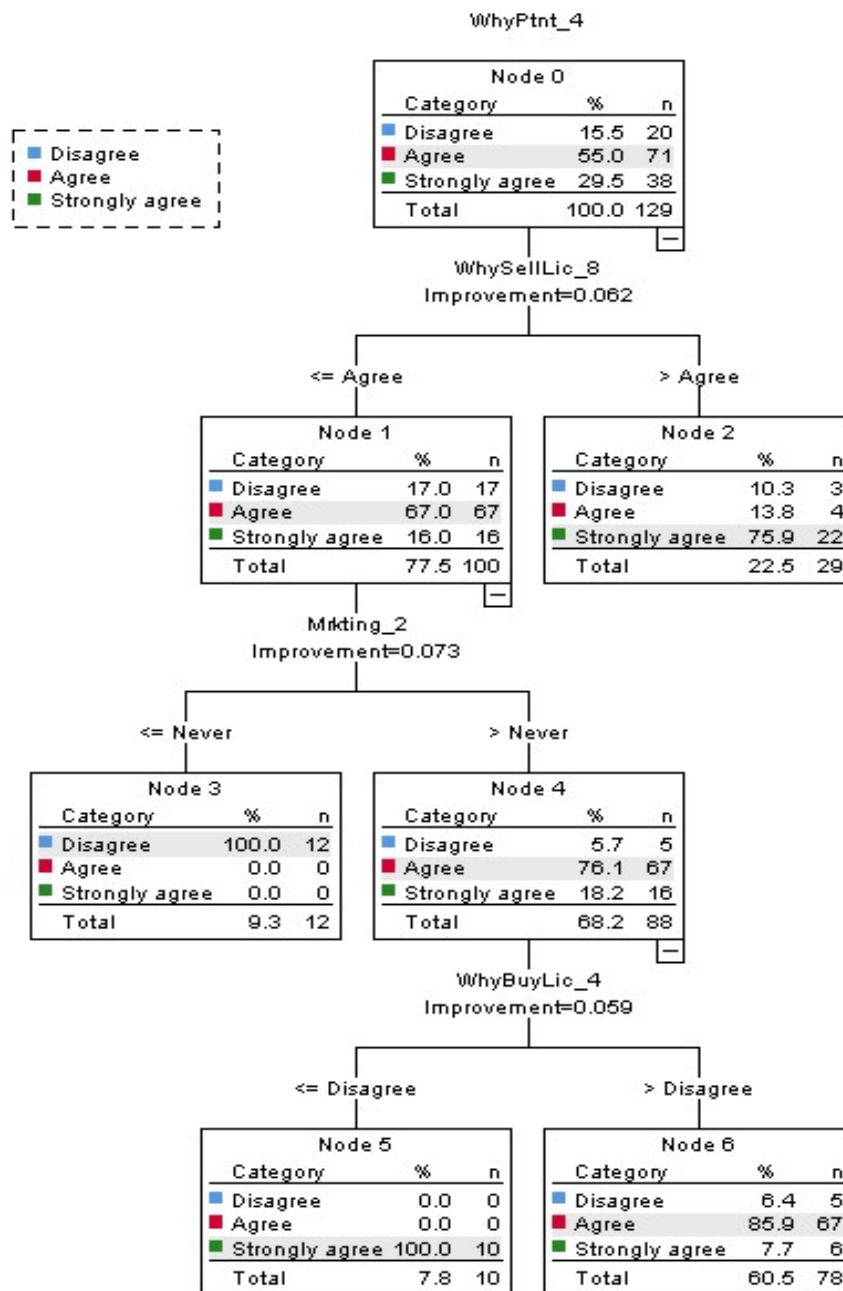
d. Patenting to reduce imitation risk

This result shows that the patenting motivation for reducing the imitation risk is highly influenced by outbound licensing to access foreign markets and presenting papers in seminars. The below table shows the CART analysis of dependent variable reduce imitation risk. The analysis highlights the distribution of the accuracy rate: 60% disagree, 94,4% agree, 84,2% strongly agree.

Table- 39 Reduce imitation risk in OI

		Estimation			Accuracy rate
		Disagree	Agree	Strongly agree	
True	Disagree	12	5	3	60.0
	Agree	0	67	4	94.4
	Strongly agree	0	6	32	84.2
Overall rate %		9.3	60.5	30.2	86.0

Figure- 4 Patenting motivation in open innovation: Reduce risk



The decision tree of the dependent variable reduce imitation risk is given above. It shows that our dependent variable has the highest relationship with (Access in foreign markets), the second variable with the highest relationship with (Seminars), and the third highest relationship is with (Cost reduction) independent variables. The cart analysis gave us four decision leaves as follows:

- 1- The companies who are "*patenting to reduce imitation risk*" do not agree that they are "*outbound licensing to access foreign markets*" and do not agree that they are using "*presentation of papers in seminars while identifying their partner*" (9%).
- 2- The companies who are "*patenting to reduce imitation risk*" do not agree that they are "*outbound licensing to access foreign markets*" and agree that they are using "*presentation of papers in seminars while identifying their partner*", do not agree that they are "*inbound licensing for cost reduction*" (8%).
- 3- The companies who are "*patenting to reduce imitation risk*" do not agree that they are "*outbound licensing to access foreign markets*" and agree that they are using "*presentation of papers in seminars while identifying their partner*", agree that they are "*inbound licensing for cost reduction*" (60%).
- 4- The companies who are "*patenting to reduce imitation risk*" and agree that they are "*outbound licensing to access foreign markets*" (22%).

Companies that apply for patents for their inventions to minimize imitation risk are generally seeking outbound licensing to enter foreign markets in open innovation process. Another aspect of their approach involves presenting papers at seminars while seeking potential partnerships. Furthermore, these companies also consider inbound licensing to reduce R&D costs. Using outbound and inbound licensing indicates a tendency towards adopting offensive-protective behaviour by these companies.

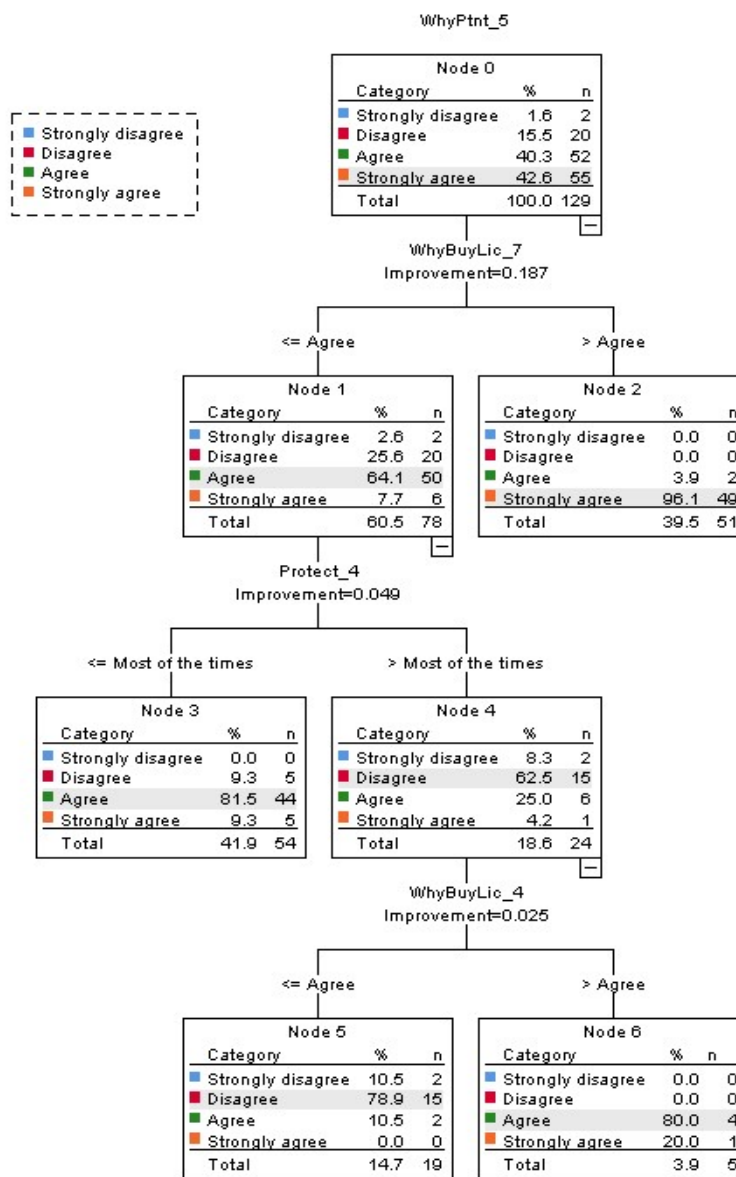
e. Patenting to improve image

This result shows that the motivation for patenting to improve the image is highly influenced by inbound licensing for entering a new market and then using patents as a defensive tool. The table below shows the CART analysis where of the dependent variable improve image. The analysis highlights the distribution of the accuracy rate: 0% disagree, 75 % agree, 92,3% strongly agree.

Table- 40 Improve image in OI

		Estimation				Accuracy rate
		Strongly disagree	Disagree	Agree	Strongly agree	
True	Strongly disagree	0	2	0	0	0.0
	Disagree	0	15	5	0	75.0
	Agree	0	2	48	2	92.3
	Strongly agree	0.0	0.0	6.0	49	89.1
Overall rate %		0.0	14.7	45.7	39	86.8

Figure- 5 Patenting motivation in open innovation: Improve image



The decision tree of the dependent variable (Improve image) is given above. It shows that our dependent variable has the highest relationship with (Enter in a foreign market), the second variable with the highest relationship with (Patents), the third highest relationship is with (Cost reduction) independent variables.

The cart analysis gave us four decision leaves as follows:

- 1- The companies who are "patenting to improve their image" do not agree that they are "inbound licensing to enter a foreign market" and do not agree that they are using "patents as a protection tool" (42%).
- 2- The companies who are "patenting to improve their image" do not agree that they are "inbound licensing to enter a foreign market" and agree that they are using "patents as a protection tool" and do not agree that they are "inbound for cost reduction" (14%).
- 3- The companies who are "patenting to improve their image" do not agree that they are "inbound licensing to enter a foreign market" and agree that they are using "patents as a protection tool" and agree that they are "inbound for cost reduction" (4%).
- 4- The companies who are "patenting to improve their image" and agree that they are "inbound licensing to enter a foreign market" (40%).

Companies that apply for patents to enhance their reputation are more likely to use inbound licensing to enter foreign markets by using this reputation in the inbound open innovation process. Another connection exists between patenting and using patents as a means of protection. Additionally, there is a third link between inbound licensing and cost reduction.

f. Patenting to measure Innovation performance

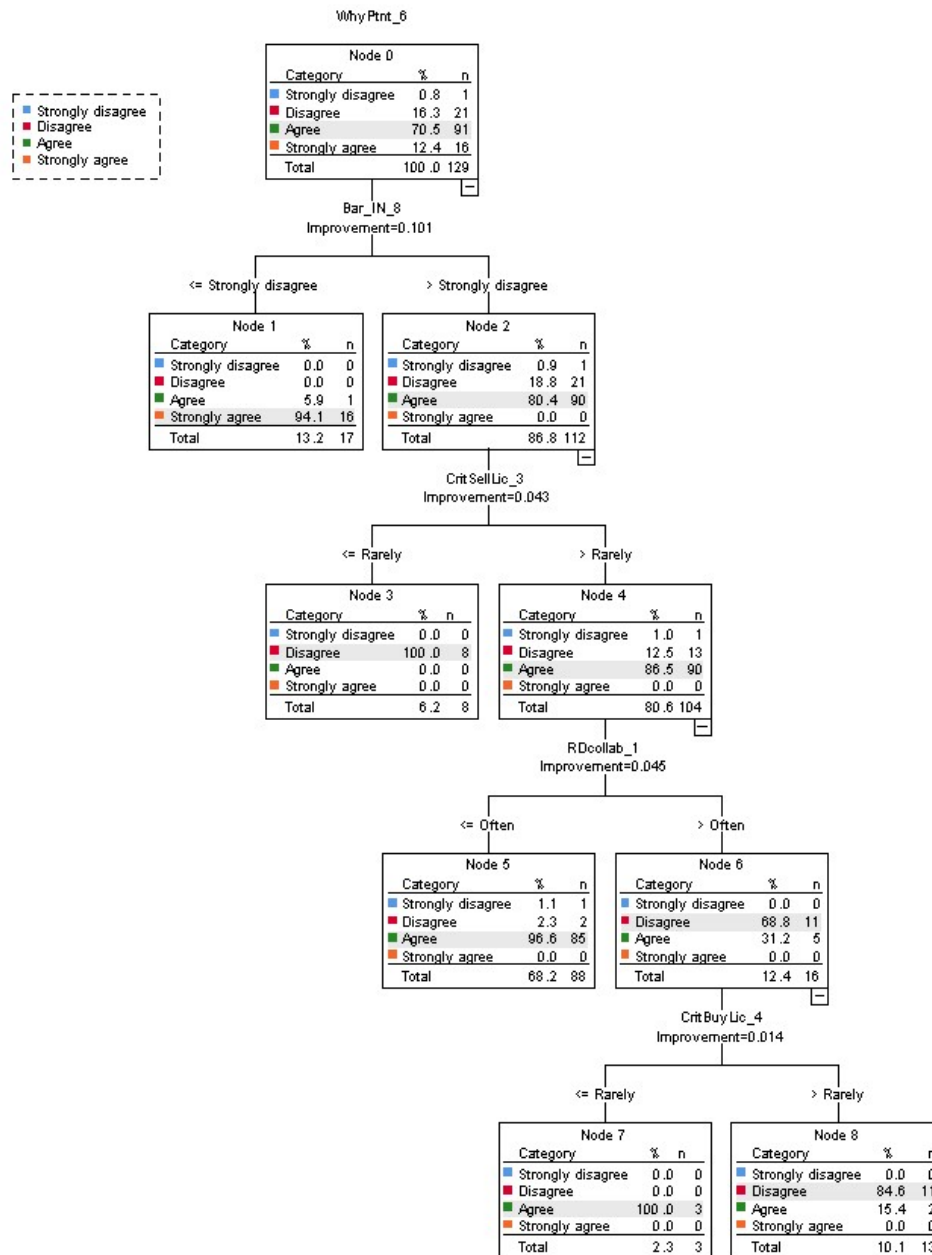
This result shows that the inbound barrier highly influences the patenting motivation for measuring the company's innovation performance, "no good technology offer for our company", and the technology level of the buyer company while outbound licensing. The below table shows the CART analysis of the dependent variable Measure innovation performance.

Table- 41 Measure innovation performance in OI

	Estimation				Doğruluk oranı
	Strongly disagree	Disagree	Agree	Strongly agree	
True Strongly disagree	0	0	1	0	0.0
True Disagree	0	19	2	0	90.5
True Agree	0	2	88	1	96.7
True Strongly agree	0.0	0.0	0.0	16	100.0
Overall rate %	0.0	16.3	70.5	13.2	95.3

The analysis highlights the distribution of the accuracy: 90,5% disagree, 96,7% agree, and 100% strongly agree.

Figure- 6 Patenting motivation in open innovation: Measure innovation performance



The decision tree of the dependent variable measure innovation performance is given above. It shows that our dependent variable has the highest relationship with (No good tech offer), the second variable with the highest relationship with (Tech level of the comp), the third highest relationship is with (Univ), and fourth highest relationship is with (Reputation) independent variables.

The cart analysis gave us five decision leaves as follows:

- 1- The companies who are “*patenting to measure innovation performance*” disagree that they are considering as a barrier “*we don’t see any good technology offer in the market for inbound licensing*”. (13%).
- 2- The companies who are “*patenting to measure innovation performance*” agree that they are considering as a barrier “*we don’t see any good technology offer in the market for inbound licensing*” and do not agree that they took into consideration the “*technology level of the buyer company while outbound licensing*” (6%)
- 3- The companies who are “*patenting to measure innovation performance*” agree that they are considering as a barrier “*we don’t see any good technology offer in the market for inbound licensing*” and agree that they took into consideration “*technology level of the buyer company while outbound licensing*” but not agree that “*we prefer collaborating with universities while doing R&D collaboration*” (68%)
- 4- The companies who are “*patenting to measure innovation performance*” agree that they are considering as a barrier “*we don’t see any good technology offer in the market for inbound licensing*” and agree that they took into consideration “*technology level of the buyer company while outbound licensing*” and agree that “*we prefer collaborating with universities while doing R&D collaboration*” but do not consider important “*the reputation of the licensor company while inbound licensing*” (2%)
- 5- The companies who are “*patenting to measure innovation performance*” agree that they are considering as a barrier “*we don’t see any good technology offer in the market for inbound licensing*” and agree that they took into consideration “*technology level of the buyer company while outbound licensing*” and agree that “*we prefer collaborating with universities while doing R&D collaboration*” and consider important “*the reputation of the licensor company while inbound licensing*” (10%)

Companies patenting their invention to measure innovation performance are more likely to consider the lack of good technology offers in the market for inbound licensing as a barrier. Another factor is the technology level of the buyer company for outbound licensing. Additionally, R&D collaboration with universities plays a role. The reputation of the licensor company is also significant for inbound licensing.

g. Patenting to motivate R&D department

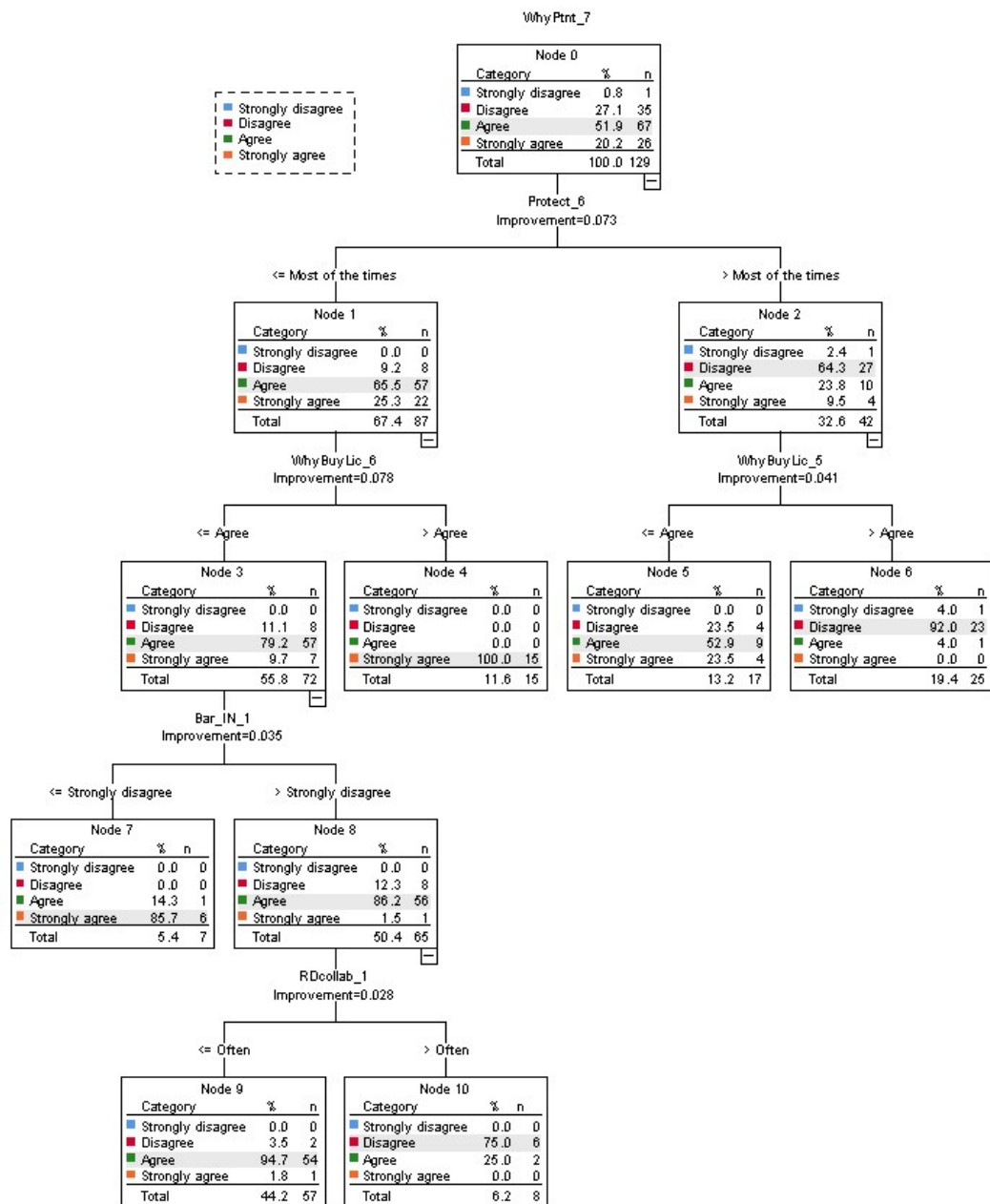
The result shows that patenting to motivate the R&D department is highly influenced by using the utility model as an alternative protection tool and inbound licensing of the proven technology. The below table shows the CART analysis of the dependent variable motivate R&D department. The analysis highlights the distribution of the accuracy rate: 82,9% disagree, 94% agree, 80,8% strongly agree.

Table- 42 Motivate R&D dep in OI

		Estimation				Doğruluk oranı
		Strongly disagree	Disagree	Agree	Strongly agree	
True	Strongly disagree	0	1	0	0	0.0
	Disagree	0	29	6	0	82.9
	Agree	0	3	63	1	94.0
	Strongly agree	0	0	5	21	80.8
Overall rate %		0.0	25.6	57.4	17.1	87.6

The decision tree of the dependent variable motivate R&D department is given above. It shows that our dependent variable has the highest relationship with (Utility model), the second-degree (Use already succeeded tech) and (Time saving), third-degree (Rival involvement), and fourth degree relationship is with (Univ).

Figure- 7 Patenting motivation in open innovation: Motivation of R&D department



The cart analysis gave us six decision leaves as follows:

- 1- The companies who are “*patenting to motivate R&D department*” disagree that they are considering “*using utility model as an alternative protection*”, and do not agree that they are “*inbound licensing the already proved technology*”, and do not agree that there is “*the risk that the licensor involve our R&D process*” (5%).

- 2- The companies who are “*patenting to motivate R&D department*” disagree that they are considering “*using utility model as an alternative protection*”, and do not agree that they are “*inbound licensing the already proved technology*”, and agree that there is “*the risk that the licensor involve our R&D process*” and do not agree that “*we prefer collaborating with universities while doing R&D collaboration*” (44%).
- 3- The companies who are “*patenting to motivate R&D department*” disagree that they are considering “*using utility model as an alternative protection*”, and do not agree that they are “*inbound licensing the already proved technology*”, and agree that there is “*the risk that the licensor involve our R&D process*” and agree that “*we prefer collaborating with universities while doing R&D collaboration*” (6%).
- 4- The companies who are “*patenting to motivate R&D department*” disagree that they are considering “*using utility model as an alternative protection*”, and agree that they are “*inbound licensing the already proved technology*” (12%).
- 5- The companies who are “*patenting to motivate R&D department*” agree that they are considering “*using utility model as an alternative protection*”, and do not agree that they are “*inbound licensing to reduce time to market*” (13%).
- 6- The companies who are “*patenting to motivate R&D department*” agree that they are considering “*using utility model as an alternative protection*”, and agree that they are “*inbound licensing to reduce time to market*” (19%).

Companies that patent their inventions to motivate their R&D departments are more likely to use utility models as an alternative form of protection. They also consider inbound licensing of proven technology and collaborate with universities for R&D collaboration to increase their internal R&D capacity. However, there is a risk of the licensor being involved in the company's R&D process.

h. Patenting for using as a negotiation tool

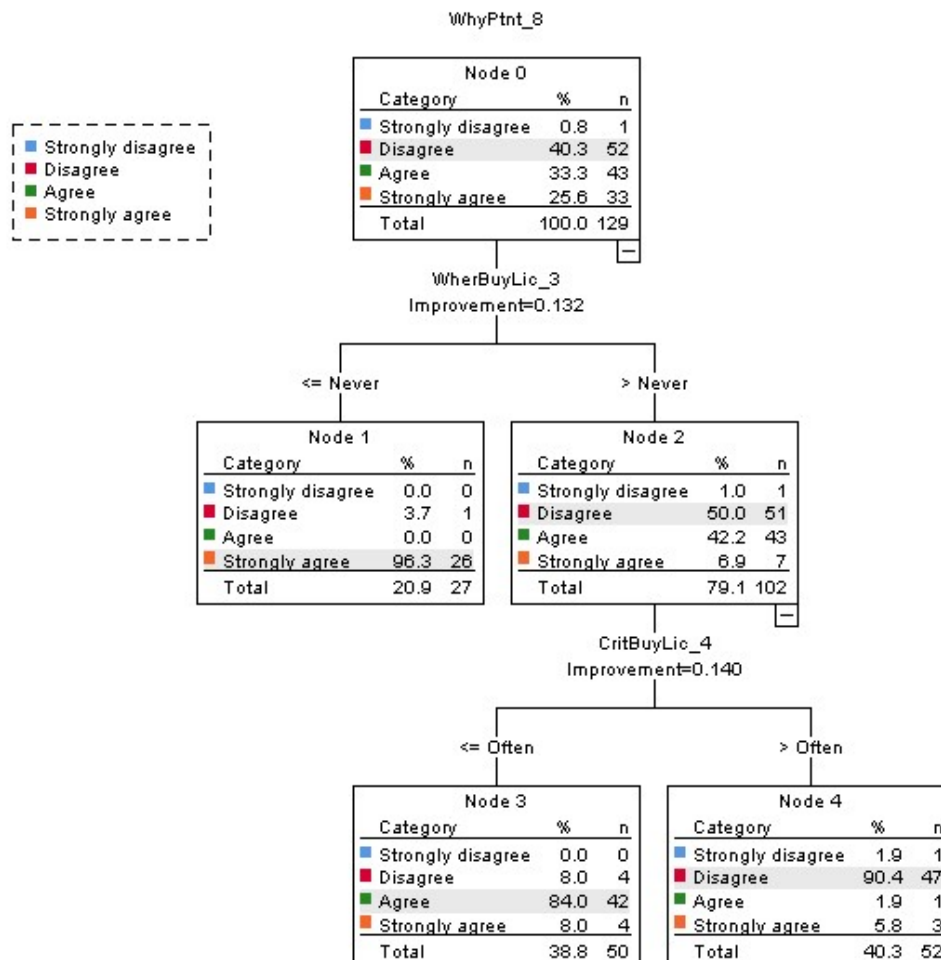
The findings indicate that the driving force behind using patents as a bargaining instrument for cross-licensing is affected by the inflow of licenses from R&D institutions and the reputation of external firms for inbound licensing. The below table shows the CART analysis of the dependent variable negotiation .

Table- 43 Negotiation in OI

		Estimation				Doğruluk oranı
		Strongly disagree	Disagree	Agree	Strongly agree	
True	Strongly disagree	0	1	0	0	0.0
	Disagree	0	47	4	1	90.4
	Agree	0	1	42	0	97.7
	Strongly agree	0	3	4	26	78.8
Overall rate %		0.0	40.3	38.8	20.9	89.1

The analysis highlights the distribution of the accuracy rate: 99;4% disagree, 97,7% agree, 78,8% strongly agree..

Figure- 8 Patenting motivation in open innovation: Negotiation tool



The decision tree of the dependent variable negotiation is given above. It shows that our dependent variable has the highest relationship with (R&D institutes), and the second variable has the highest relationship with (Reputation) independent variables.

The cart analysis gave us three decision leaves as follows:

- 1- The companies who are “*patenting for use as a negotiation tool for cross-licensing*” disagree that they are considering “*inbound licensing from R&D institutes*” (21%).
- 2- The companies who are “*patenting for use as a negotiation tool for cross-licensing*” agree that they are considering “*inbound licensing from R&D institutes*” and do not consider important “*the reputation of the licensor company while inbound licensing*” (39%).
- 3- The companies who are “*patenting for use as a negotiation tool for cross-licensing*” agree that they are considering “*inbound licensing from R&D institutes*” and consider important “*the reputation of the licensor company while inbound licensing*” (40%).

Companies patenting inventions as negotiation tools for cross-licensing are more likely to consider inbound licensing from R&D institutes. The reputation of the licensor company also plays a role in inbound licensing.

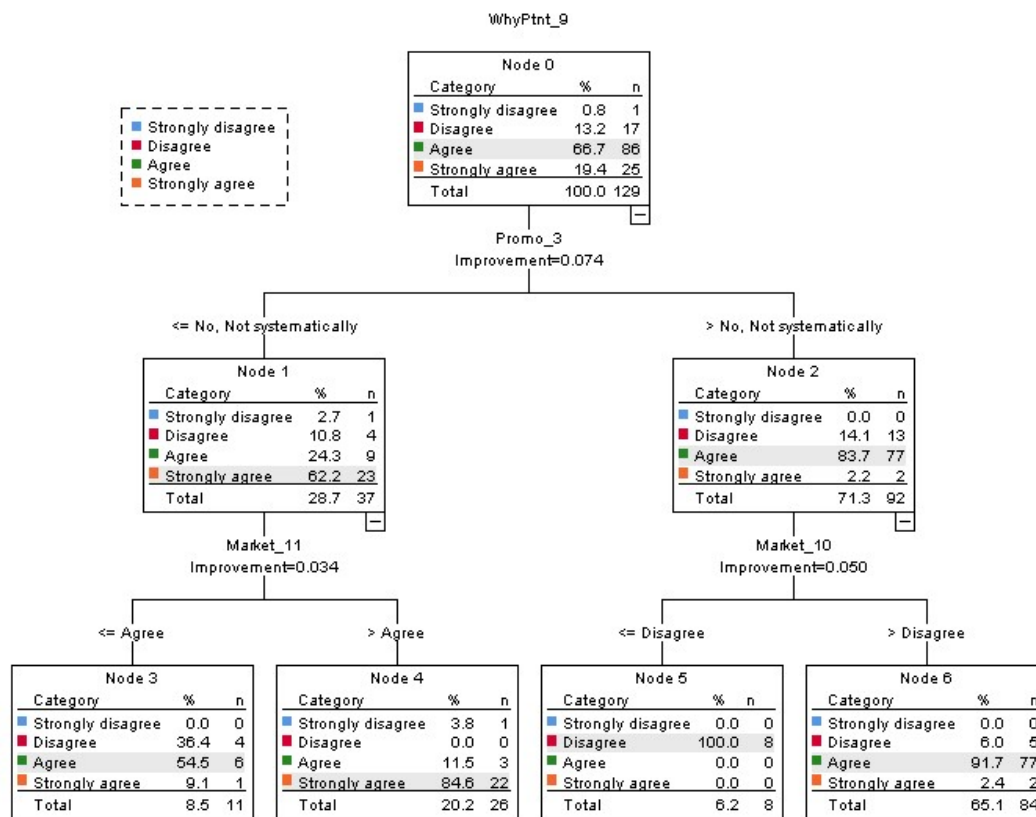
i. Patenting to build a strong portfolio

This result shows that the patenting motivation to have a strong portfolio is highly influenced by the government promotions for working with technology development zone companies and other government promotions to increase R&D activities. The table below shows the CART analysis of the dependent variable strong portfolio. The analysis highlights the distribution of the accuracy rate: 47,1% disagree, 96,5% agree, 88% strongly agree.

Table- 44 Strong portfolio in OI

	Estimation				Doğruluk oranı	
	Strongly disagree	Disagree	Agree	Strongly agree		
True	Strongly disagree	0	0	0	1	0.0
	Disagree	0	8	9	0	47.1
	Agree	0	0	83	3	96.5
	Strongly agree	0	0	3	22	88.0
Overall rate %		0.0	6.2	73.6	20.2	87.6

Figure- 9 Patenting motivation in open innovation: Strong patent portfolio



The decision tree of the dependent variable strong portfolio is given above. It shows that our dependent variable has the highest relationship with (Consulting comp), the second variable with the highest relationship (Gov. Financial) and (Gov. Tax).

The cart analysis gave us four decision leaves as follows:

- 1- The companies who are “patenting to build a strong patent portfolio” do not agree that “the government promoting us to work with consulting companies” and do not agree that “the government financial policy creates an advantage for us” (9%).
- 2- The companies who are “patenting to build a strong patent portfolio” do not agree that “the government promoting us to work with consulting companies” and agree that “the government financial policy creates an advantage for us” (20%).
- 3- The companies who are “patenting to build a strong patent portfolio” agree that “the government promoting us to work with consulting companies” and do not agree that “the government tax policy supports us to reduce R&D costs” (6%).

- 4- The companies who are “*patenting to build a strong patent portfolio*” agree that “*the government promoting us to work with consulting companies*” and agree that “*the government tax policy supports us to reduce R&D costs*” (65%).

Due to government promotion, companies seeking to build a strong patent portfolio are more likely to collaborate with consulting firms during inbound open innovation processes. Additionally, they benefit from the government's financial and tax policies, which provide advantages and reduced R&D costs.

j. Patenting for standard setting in the market

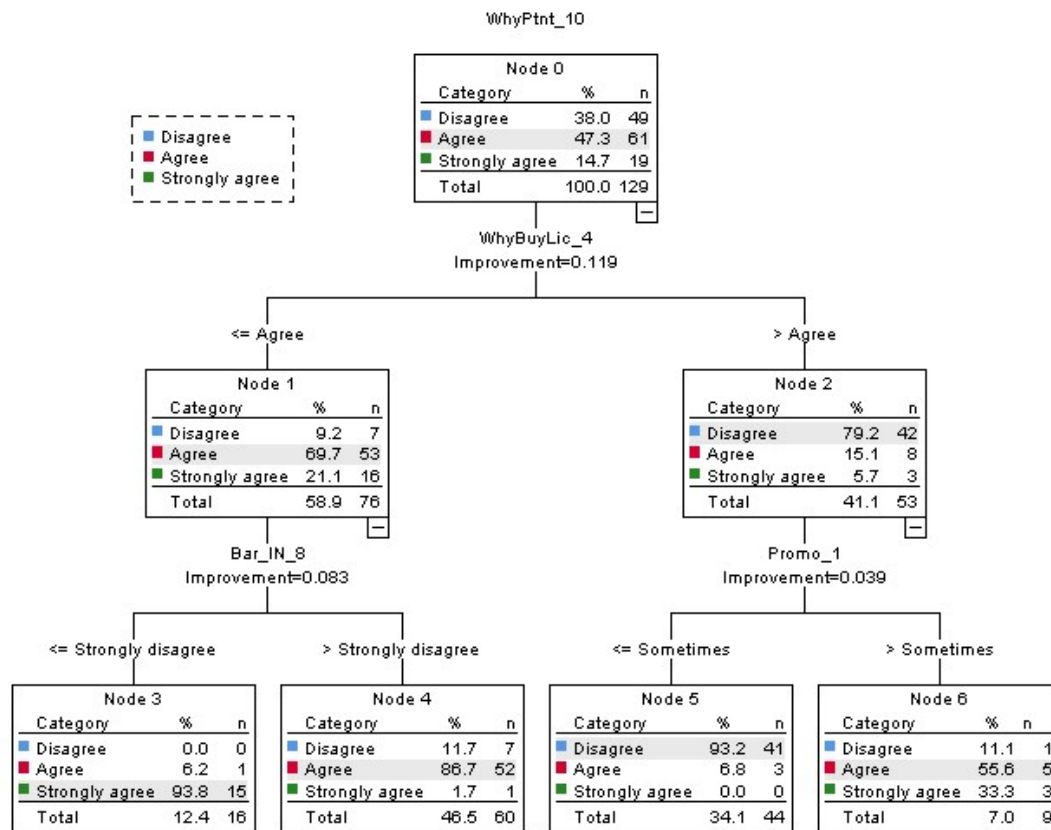
This result shows that the patenting motivation for standard setting is highly influenced by inbound licensing for cost reduction and government incentives to work with universities. The below table shows the CART analysis of the dependent variable standard setting. The analysis highlights the distribution of the accuracy rate: 83,7% disagree, 93,4% agree, and 78,9% strongly agree.

Table- 45 Standard setting in OI

		Estimation			Accuracy
		Disagree	Agree	Strongly agree	
True	Disagree	41	8	0	83.7
	Agree	3	57	1	93.4
	Strongly agree	0	4	15	78.9
Overall rate %		34.1	53.5	12.4	87.6

The decision tree of the dependent variable standard setting is given above. It shows that our dependent variable has the highest relationship with (Cost reduction), the second variable (No good tech offer) and variable (Univ, R&D inst).

Figure- 10 Patenting motivation in open innovation: Standardization



The cart analysis gave us four decision leaves as follows:

- 1- The companies who are “patenting for standard setting in the market” do not consider “inbound licensing for cost reduction” and do not agree that “there is no adequate technology for us in the market” (12%).
- 2- The companies who are “patenting for standard setting in the market” do not consider “inbound licensing for cost reduction” and agree that “there is no adequate technology for us in the market” (47%).
- 3- The companies who are “patenting for standard setting in the market” and consider “inbound licensing for cost reduction” and do not agree that “government promote us to work with universities , R&D institutes” (34%).
- 4- The companies who are “patenting for standard setting in the market” and consider “inbound licensing for cost reduction” and agree that “government promote us to work with universities , R&D institutes” (7%).

Companies patenting their invention for standard setting in the market are more likely to consider inbound licensing for cost reduction. Another factor is the lack of adequate technology in the market, which prompts the government to encourage collaboration with universities and research institutes.

k. Patenting to use government incentives

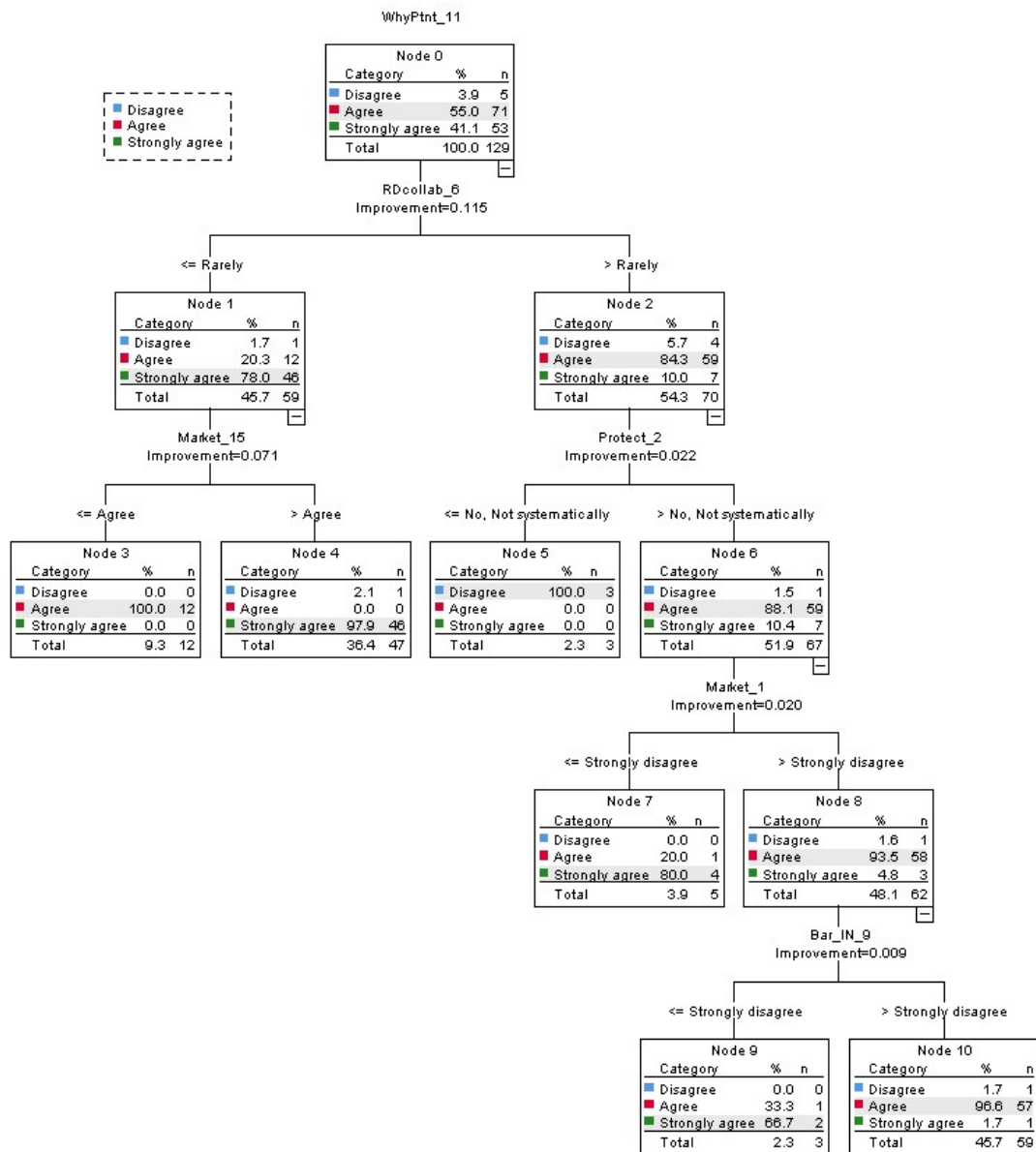
This result shows that the collaboration highly influences the patenting motivation to use government incentives in the technology development zone companies, the product complexity as an alternative protection tool, and the country's IPR complexity. The below table shows the CART analysis of the dependent variable use government incentives . The analysis highlights the distribution of the accuracy rate: 60% disagree, 97,2% agree, 98,1% strongly agree.

Table- 46 Use government incentives in OI

		Estimation			Doğruluk oranı
		Disagree	Agree	Strongly agree	
True	Disagree	3	1	1	60.0
	Agree	0	69	2	97.2
	Strongly agree	0	1	52	98.1
Overall rate %		2.3	55.0	42.6	96.1

The decision tree of the dependent variable use government incentives is given above and shows that our dependent variable has the highest relationship with (Tech devp zone comp), the second highest relationship with variable (IPR complexity) and variable (Prod complexity), the third highest relationship with variable (#of companies), and forth highest relationship with variable (Reduce innov capability).

Figure- 11 Patenting motivation in open innovation: Using government incentives



The cart analysis gave us six decision leaves as follows:

- 1- The companies who are “patenting to use government incentives” do not consider “collaborate with the technology development zone companies” and do not agree that “the IP became more complex” (9%).
- 2- The companies who are “patenting to use government incentives” do not consider “collaborate with the technology development zone companies” and agree that “the IP became more complex” (37%).

- 3- The companies who are “*patenting to use government incentives*” consider “*collaborate with the technology development zone companies*” and do not consider “*product complexity as an alternative protection*” (2%).
- 4- The companies who are “*patenting to use government incentives*” consider “*collaborate with the technology development zone companies*” and consider “*product complexity as an alternative protection*” but do not consider that “*too many companies in our market*” (4%).
- 5- The companies who are “*patenting to use government incentives*” consider “*collaborate with the technology development zone companies*” and consider “*product complexity as an alternative protection*” and consider that “*too many companies in our market*” but do not consider that “*(inbound licensing) other companies' technologies may reduce our innovation capacity*” (2%).
- 6- The companies who are “*patenting to use government incentives*” consider “*collaborate with the technology development zone companies*” and consider “*product complexity as an alternative protection*” and consider that “*too many companies in our market*”, consider that “*(inbound licensing) other companies' technologies may reduce our innovation capacity*” (46%).

Companies patenting their invention for government incentives are more likely to collaborate with technology development zone companies. The complexity of intellectual property (as an outbound barrier) and the use of product complexity as an alternative form of protection increases the willingness for a patent to use government incentives. The competitive market structure and inbound licensing barrier, as the fear of licensing other companies' technologies may also reduce innovation capacity", are important motives for those companies.

8.2. The link between patent strategy and open innovation processes

a. Stocking patents for strategic use

This result shows that stocking the patents for strategic use is highly influenced by the high competition level in the market. Market conditions influence the adoption of open innovation. The companies' behaviour is related to protecting internal R&D capabilities and increasing it by inbound licensing. The below table shows the CART analysis where stocking for strategic use is used in the open innovation processes.

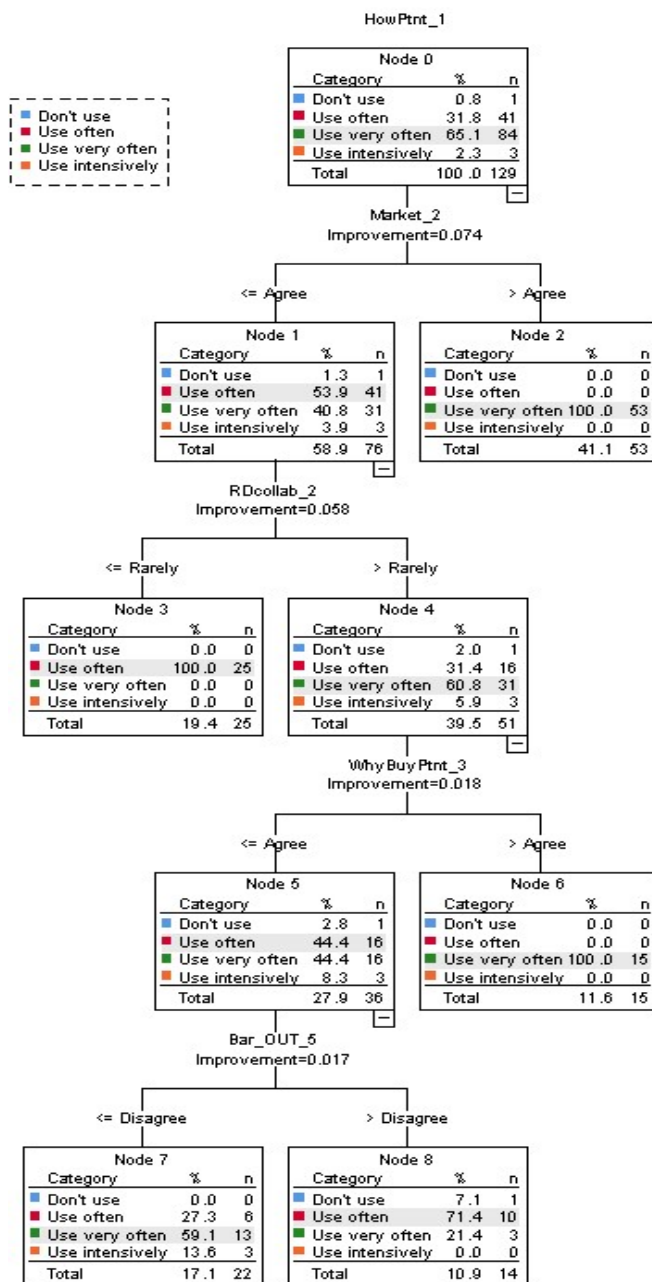
Table- 47 Stocking patents for strategic use in OI

		Estimation				Accuracy rate
		Don't use	Use often	Use very often	Use intensively	
True	Don't use	0	1	0	0	0.0
	Use often	0	35	6	0	85.4
	Use very often	0	3	81	0	96.4
	Use intensively	0	0	3	0	0.0
Overall rate %		0.0	30.2	69.8	0.0	89.9

When the accuracy classification rate of stocking for strategic use is examined as the dependent variable, we see that the distribution of the accuracy rate is 85,4% use often, 96,4% use very often, 0% use intensively.

The decision tree of the dependent variable stocking for strategic use is given above. It shows that our dependent variable has the highest relationship with variable (Strong patent activity), the second highest relationship with variable (RD institutions), the third-degree variable (Complementary tech), and the forth-degree relationship with variable (Not a part of our comp strategy).

Figure- 12 Patent strategy in open innovation processes : Stocking patents for strategic use



The cart analysis gave us 5 decision leaf as follows:

- 1- The companies who are “*stocking the patent for strategic use*” are more likely consider a “*strong patenting activity in their market*” (41% of those companies), whereas 59% don't consider as important as the first group.

- 2- The companies who are “*stocking the patent for strategic use*”, and *not consider a “strong patenting activity in their market”* are more likely not “*prefer to collaborate with public R&D institutions*”(19%)
- 3- The companies who are “*stocking the patent for strategic use*”, and *not consider a “strong patenting activity in their market”*, but more likely “*prefer to collaborate with public R&D institutions*”, are more likely “*inbound patenting the complementary technology*” (12%)
- 4- The companies who are “*stocking the patent for strategic use*”, and *not consider a “strong patenting activity in their market”*, but more likely “*prefer to collaborate with public R&D institutions*”, and more likely not “*inbound patenting the complementary technology*”, are more likely not agree that “*outbound licensing is not a part of our company strategy*” (11%)
- 5- The companies who are “*stocking the patent for strategic use*”, and *not consider a “strong patenting activity in their market”*, but more likely “*prefer to collaborate with public R&D institutions*”, and more likely not “*inbound patenting the complementary technology*”, are more likely consider that “*outbound licensing is not a part of our company strategy*” (17%)

Companies that strategically stock patents in the open innovation context are more likely to consider market turbulence very important and, therefore, seek to collaborate mostly with public R&D institutes for R&D collaboration and inbound licensing and avoid outbound licensing. This result suggests that the high R&D activity in the market influences Chinese companies' decisions regarding IP stocking.

b. Using patents internally for product development

This result shows that using the patents for new product development (NPD) internally is highly influenced by the high competitiveness level in the market. Market conditions influence the adoption of open innovation. Besides market conditions, companies which use their patents internally take into evidence the partner company's reputation to reduce any failure or uncertainty risk in the open innovation process.

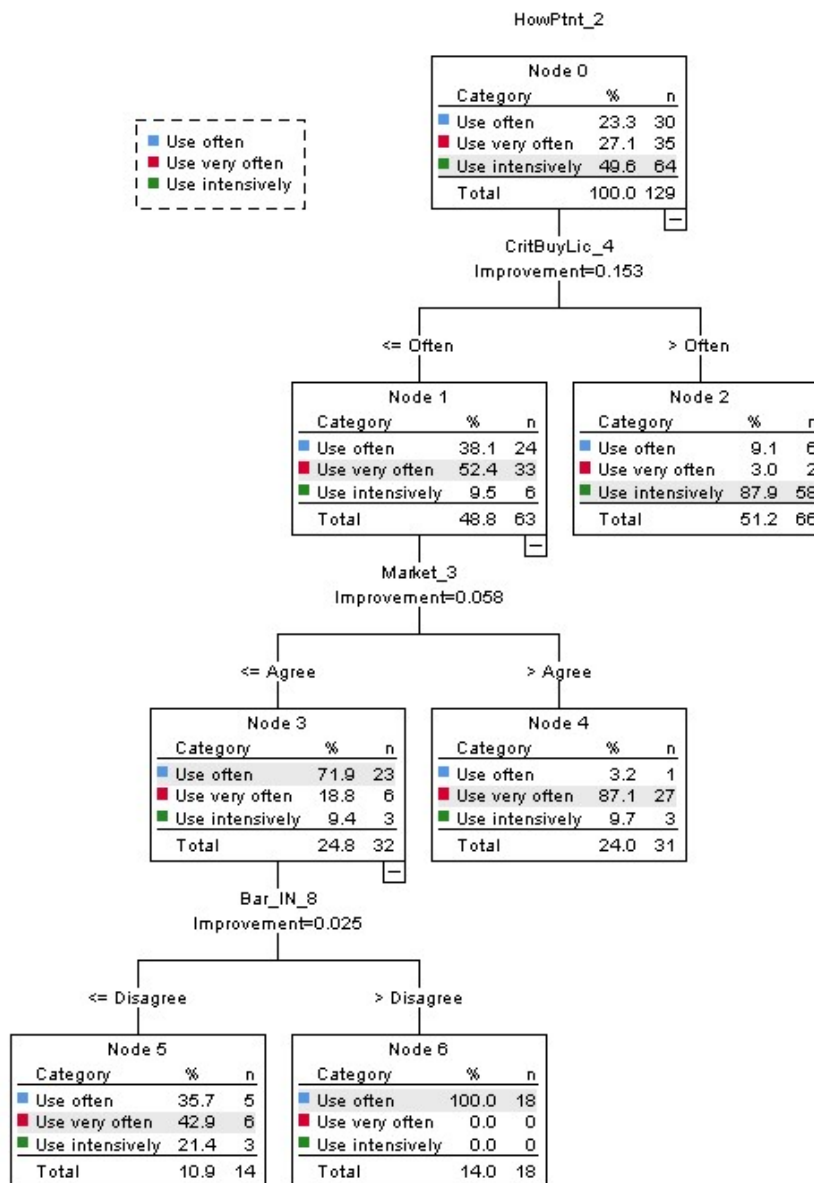
The below table shows the CART analysis of the dependent variable product development.

Table- 48 Product development in OI

		Estimation			Accuracy rate
		Use often	Use very often	Use intensively	
True	Use often	18	6	6	60.0
	Use very often	0	33	2	94.3
	Use intensively	0	6	58	90.6
Overall rate %		14.0	34.9	51.2	84.5

When the accuracy classification rate of the dependent variable “product development” is examined, we see that the distribution of the accuracy is: 60% use often, 94,3% use very often, 90,6% use intensively.

Figure- 13 Patent strategy in open innovation processes : Product development



The decision tree of the dependent variable product development is given above. It shows that our dependent variable has the highest relationship with variable (Reputation), second degree highest relationship with variable (NPD), and third degree with variable (No good tech offer).

The cart analysis gave us four decision leaf as follows:

- 1- The companies who are “stocking the patent for NPD use” are more likely to consider important “the reputation of the licensor company while inbound

licensing” (51% of those companies), whereas 49% don’t consider it as important as the first group.

- 2- The companies who are “stocking the patent for NPD use” and not consider important “the reputation of the licensor company while inbound licensing” are more likely to find that the market conditions are essential and “technological development in the market pushes us for NPD” (24%)
- 3- The companies who are “stocking the patent for NPD use,” and not consider important “the reputation of the licensor company while inbound licensing” and do not consider that the market conditions are essential and “technological development in the market pushes us for NPD” is not valid for them, are more likely find that “there is no adequate technology for us in the market” (14%)
- 4- The companies who are “stocking the patent for NPD use,” and not consider important “the reputation of the licensor company while inbound licensing” and do not consider that the market conditions are essential and “technological development in the market pushes us for NPD” is not valid for them, are more likely not agree that “there is no adequate technology for us in the market” (11%)

Companies that stock patents for internal use of NPD consider the reputation of the seller company during inbound licensing. Technological turbulence in the market drives them to focus on NPD. Reputation is crucial for buyer companies in the inbound open innovation process. Companies are more likely to use their patents for NPD when other companies in the market also engage in NPD, and there is a big technological change speed. However, reputation remains the primary criterion for inbound licensing, making "inadequate technology" a sufficient barrier. Ultimately, the company's reputation is of utmost importance.

c. Using patents for R&D contracts

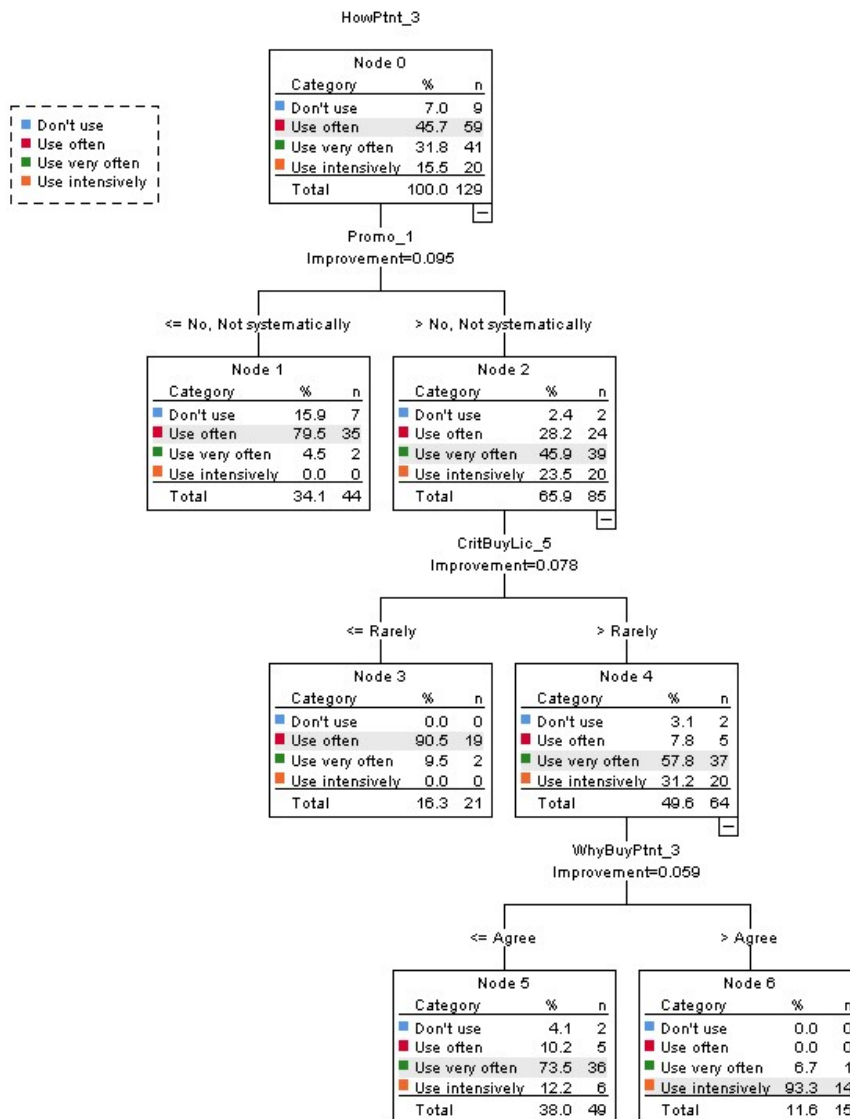
This result shows that externally using patents for establishing R&D contracts in inbound and outbound OI strategy is highly influenced by the government promotions for working with universities and increasing internal R&D capacity. The below table shows the CART analysis of dependent variable R&D contracts.

Table- 49 R&D contract establishment in OI

		Estimation				Accuracy
		Don't use	Use often	Use very often	Use intensively	rate
True	Don't use	0	7	2	0	0.0
	Use often	0	54	5	0	91.5
	Use very often	0	4	36	1	87.8
	Use intensively	0	0	6	14	70.0
Overall rate %		0.0	50.4	38.0	11.6	80.6

When the accuracy classification rate of dependent variable R&D contracts is examined, the accuracy rate is: 91,5% use often, 87,8% use very often, 70% use intensively.

Figure- 14 Patent strategy in open innovation processes : R&D contract establishment



The decision tree of the dependent variable 3 (R&D contracts) is given above. It shows that our dependent variable has the highest relationship with variable (Univ, R&D institutions), then the second highest relationship with (R&D collaboration potential), the third degree variable (Complementary tech). The cart analysis gave us four decision leaves as follows:

- 1- The companies who are “*using patents for R&D contracts with universities, R&D institutes or with other companies*” are more likely not agree that the “*government promote us to work with universities , R&D institutes*” (34% of those companies).
- 2- The companies who are “*using patents for R&D contracts with universities, R&D institutes or with other companies*”, and agree that the “*government promote us to work with universities , R&D institutes*” are 66% of the companies. Among these, who are not agree that it is important “*the potential collaboration possibility with the licensor company while inbound licensing*” are (16%)
- 3- The companies who are “*using patents for R&D contracts with universities, R&D institutes or with other companies*”, and agree that the “*government promote us to work with universities , R&D institutes*”, and agree that it is important “*the potential collaboration possibility with the licensor company while inbound licensing*”, but not agree that “*we are inbound patenting the complementary technology*” are (38%)
- 4- The companies who are “*using patents for R&D contracts with universities, R&D institutes or with other companies*”, and agree that the “*government promote us to work with universities , R&D institutes*”, and agree that it is important “*the potential collaboration possibility with the licensor company while inbound licensing*”, and more likely agree that “*we are inbound patenting the complementary technology*” are (12%)

Companies that use their patents to establish R&D contracts for inbound open innovation are more likely to consider government promotions for working with universities and R&D institutes. The potential R&D collaboration with the licensor company while inbound licensing, followed by inbound patenting of complementary technology, are also important motivations for the companies using their patents for R&D contracts in the inbound open innovation process.

d. Using patents in a patent pool

This result shows that using patents in a patent pool is highly influenced by the inbound open innovation barrier, which is that external technologies are complex and create a barrier to

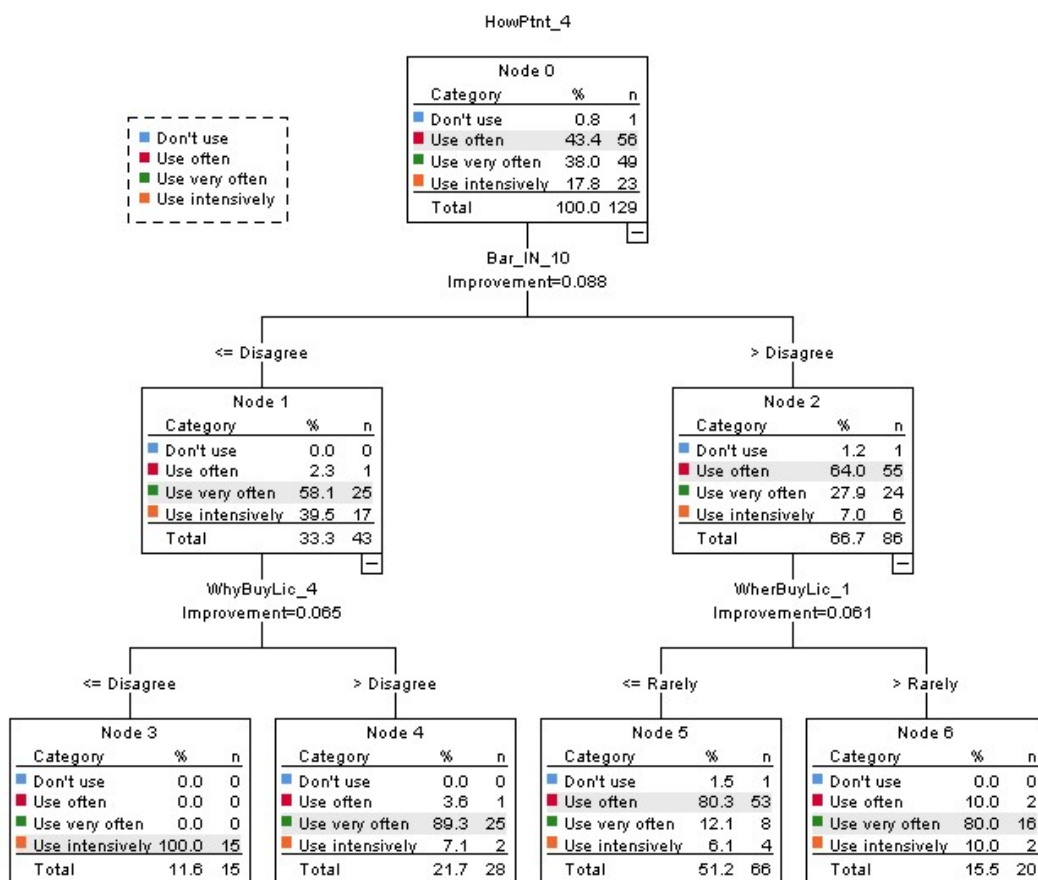
inbound licensing. Therefore, participation a patent pool for inbound licensing is more secure, reducing uncertainty and licensing costs. The below table shows the CART analysis of the dependent variable used in a patent pool.

Table- 50 Participation in a patent pool in OI

		Estimation				Accuracy rate
		Don't use	Use often	Use very often	Use intensively	
True	Don't use	0	1	0	0	0.0
	Use often	0	53	3	0	94.6
	Use very often	0	8	41	0	83.7
	Use intensively	0	4	4	15	65.2
Overall rate %		0.0	51.2	37.2	11.6	84.5

When the accuracy classification rate of dependent variable participation in a patent pool is examined, the accuracy rate is: 94,6% use often, 83,7% use very often, 62,5% use intensively.

Figure- 15 Patent strategy in open innovation processes : Participation in a patent pool



The decision tree of the dependent variable (participation in a patent pool) is given above and shows that our dependent variable has the highest relationship with (other tech are complex for us), second degree with (Cost reduction) and (patent pool)

The cart analysis gave us four decision leaves as follows:

- 1- The companies who are “*using patents in a patent pool*” are more likely agree that “*other technologies are complicated for us*” (67% of those companies). The companies who are “*using patents in a patent pool*”, and are agree that “*other technologies are complicated for us*”, are more likely “*inbound licensing from a patent pool*” (12%)
- 2- The companies who are “*using patents in a patent pool*”, and are agree that “*other technologies are complicated for us*”, but not agree to “*inbound licensing from a patent pool*” are (51%)
- 3- The companies who are “*using patents in a patent pool*” and not agree that “*other technologies are complicated for us*” (33% of those companies). Split in two leaves. The companies who are “*using patents in a patent pool*”, and not agree that “*other technologies are complicated for us*”, are more likely use “*inbound licensing for cost reduction*” (22%)
- 4- The companies who are “*using patents in a patent pool*” and not agree that “*other technologies are complicated for us*”, but not agree that they’re using “*inbound licensing for cost reduction*” are (11%)

Companies using their patents in a patent pool are more likely to perceive other technologies as being too complex for them as a barrier to inbound licensing. These companies also have a secondary relationship with inbound licensing for cost reduction and obtaining licenses from a patent pool during inbound open innovation processes.

e. Using patents for joint venture or M&A

This result shows that using patents for a joint venture or M&A agreement is highly influenced by the reputation of the partner company. At the same time, outbound licensing reduces uncertainty and provides information about the partner company but also uses lead time advantage as an alternative tool for protection and collaboration with universities to increase the R&D capacity of the company. The below table shows the CART analysis of dependent variable M&A participation.

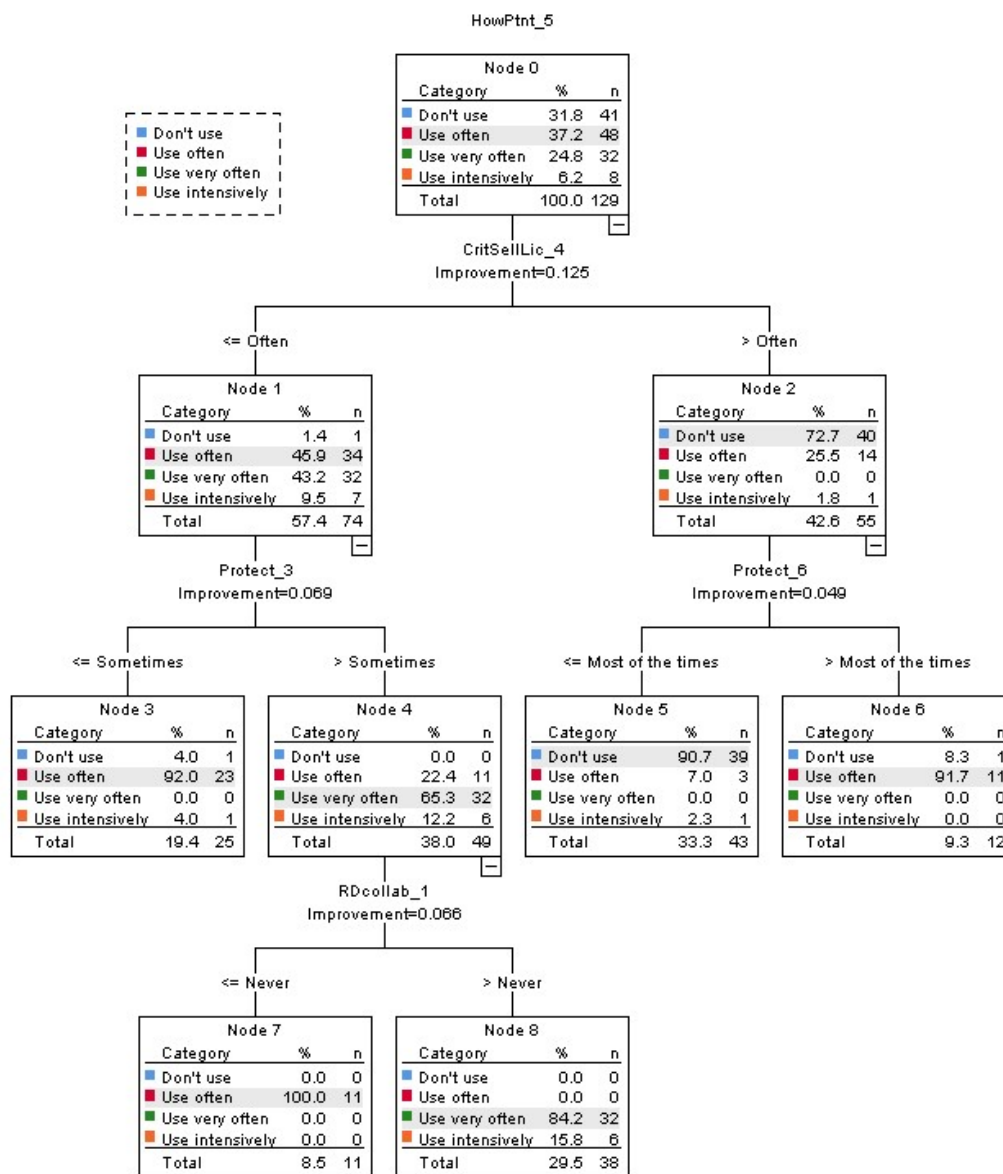
Table- 51 M&A agreement participation in OI

		Estimation				Accuracy rate
		Don't use	Use often	Use very often	Use intensively	
True	Don't use	39	2	0	0	95.1
	Use often	3	45	0	0	93.8
	Use very often	0	0	32	0	100.0
	Use intensively	1	1	6	0	0.0
Overall rate %		33.3	37.2	29.5	0.0	89.9

When the accuracy classification rate of dependent variable M&A participation is examined, the accuracy rate is: 95,1% do not use, 93,8% use often, 100% use very often, 0% use intensively.

The decision tree of the dependent variable M&A participation is given above. It shows that our dependent variable has the highest relationship with (Reputation of the comp), second highest relationship with (Lead time adv) and (utility model), and third-degree relationship with (Univ).

Figure- 16 Patent strategy in open innovation processes : M&A agreement participation



The cart analysis gave us five decision leaves as follows:

- 1- The companies who are “using patents for joint venture or M&A” and not agree that the “reputation of the licensee company is important while outbound licensing”, are more likely not agree that “using lead time advantage as an alternative protection” (19%).
- 2- The companies who are “using patents for joint venture or M&A” and not agree that the “reputation of the licensee company is important while outbound licensing”, but are agree that “using lead time advantage as an alternative protection”, are more

likely not agree that “*we prefer collaborating with universities while doing R&D collaboration*” (8%).

- 3- The companies who are “*using patents for joint venture or M&A*” and not agree that the “*reputation of the licensee company is important while outbound licensing*”, but are agree that “*using lead time advantage as an alternative protection*”, are more likely agree that “*we prefer collaborating with universities while doing R&D collaboration*” (30%).
- 4- The companies who are “*using patents for joint venture or M&A*” and agree that the “*reputation of the licensee company is important while outbound licensing*”, are more likely not agree that “*using utility model as an alternative protection*” (33%).
- 5- The companies who are “*using patents for joint venture or M&A*” and agree that the “*reputation of the licensee company is important while outbound licensing*”, are more likely agree that “*using utility model as an alternative protection*” (10%).

Companies using their patents for M&A prioritize the reputation of the licensee company in outbound licensing. They also benefit from lead time advantages and utility model use for alternative protection. Additionally, they engage in R&D collaborations with universities.

f. Using patents for long term alliances with foreign companies

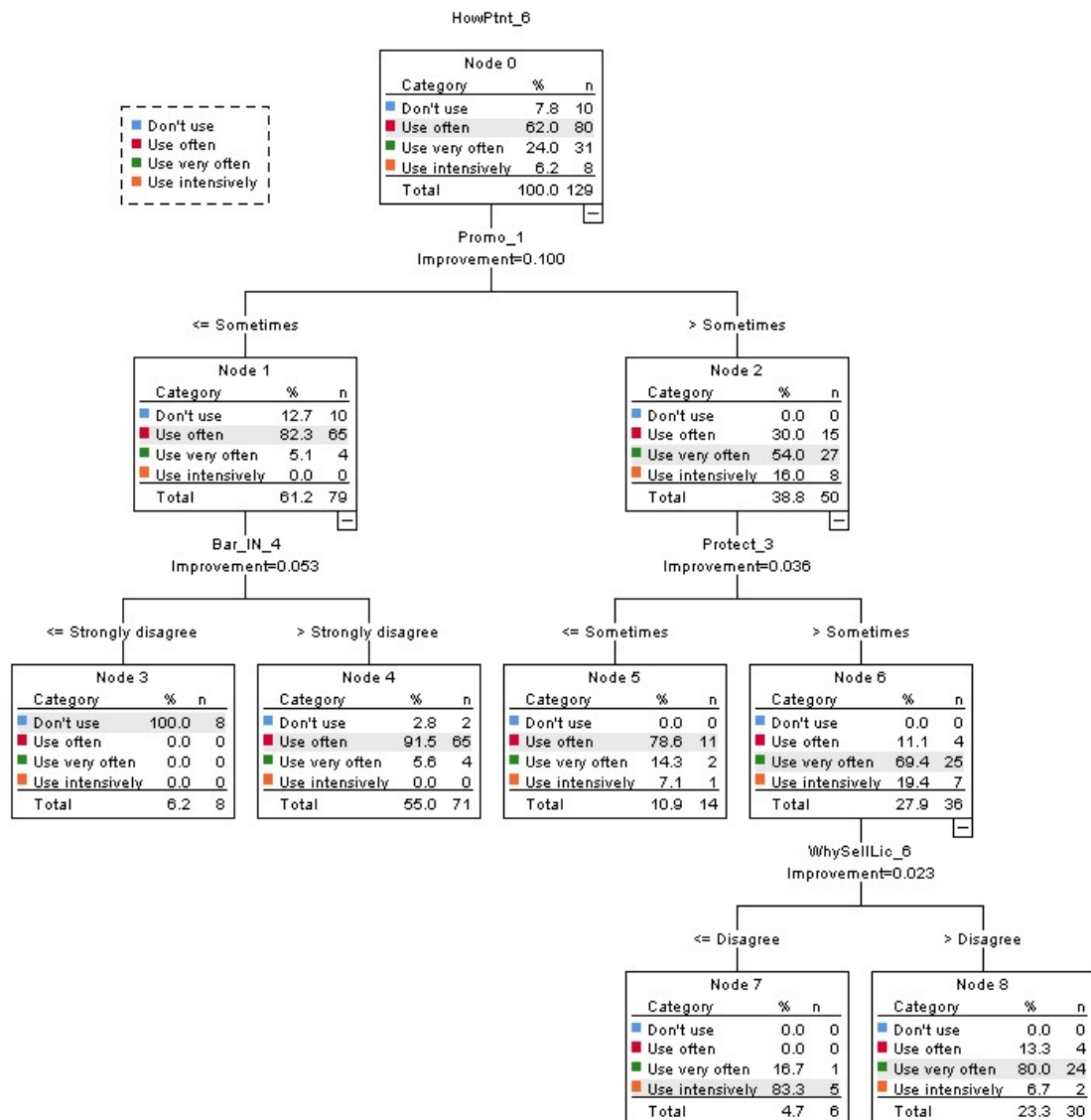
This result shows that using patents for long-term alliances with a foreign company is highly influenced by government promotions to work with R&D institutes or universities. However, having a bad previous inbound licensing experience is an important barrier for those companies. The below table shows the CART analysis of dependent variable alliances with foreign comp.

Table- 52 Alliances with foreign companies in OI

		Estimation				Accuracy rate
		Don't use	Use often	Use very often	Use intensively	
True	Don't use	8	2	0	0	80.0
	Use often	0	76	4	0	95.0
	Use very often	0	6	24	1	77.4
	Use intensively	0	1	2	5	62.5
Overall rate %		6.2	65.9	23.3	4.7	87.6

When the accuracy classification rate dependent variable alliances with foreign comp is examined, the accuracy rate is: 80% do not use, 95% use often, 77,4% use very often, 62,5% use intensively.

Figure- 17 Patent strategy in open innovation processes : Alliances with foreign companies



The decision tree of the dependent variable (alliances with foreign comp) is given above. It shows that our dependent variable has the highest relationship with (Univ, R&D inst), the second highest relationship with (Bad prev exp) and (Lead time adv), the third degree with (working as a subcontractor).

The cart analysis gave us five decision leaves as follows:

- 1- The companies who are “*using patents for long term alliance with foreign company*” and not agree that the “*government promote us to work with universities or R&D institutes*”, are more likely agree that they have a “*bad previous inbound licensing experience*” (55%).
- 2- The companies who are “*using patents for long term alliance with foreign company*” and not agree that the “*government promote us to work with universities or R&D institutes*”, are not agree that they have a “*bad previous inbound licensing experience*” (6 %).
- 3- The companies who are “*using patents for long term alliance with foreign company*” and agree that the “*government promote us to work with universities or R&D institutes*”, are more likely not agree that they are using “*lead time advantage as an alternative protection*” (11%).
- 4- The companies who are “*using patents for long term alliance with foreign company*” and agree that the “*government promote us to work with universities or R&D institutes*”, and agree that they are using “*lead time advantage as an alternative protection*”, are more likely not agree that they are “*outbound licensing to their subcontractor company*” (5%).
- 5- The companies who are “*using patents for long term alliance with foreign company*” and agree that the “*government promote us to work with universities or R&D institutes*”, and agree that they are using “*lead time advantage as an alternative protection*”, are more likely agree that they are “*outbound licensing to their subcontractor company*” (23%).

Companies that use their patents externally in the open innovation process for long-term partnerships with foreign companies also tend to prioritize government support in collaborating with universities or R&D institutes. Another factor influencing their decision is a barrier to inbound open innovation: the negative past experiences of inbound licensing. Those companies are also using the lead time advantage for protection. Additionally, these companies may engage in outbound licensing to collaborate with subcontractors.

g. Using patents for licensing purpose

This result shows that using patents for licensing-out is highly influenced by the initiative to approach the partner company for inbound and inbound licensing from independent companies.

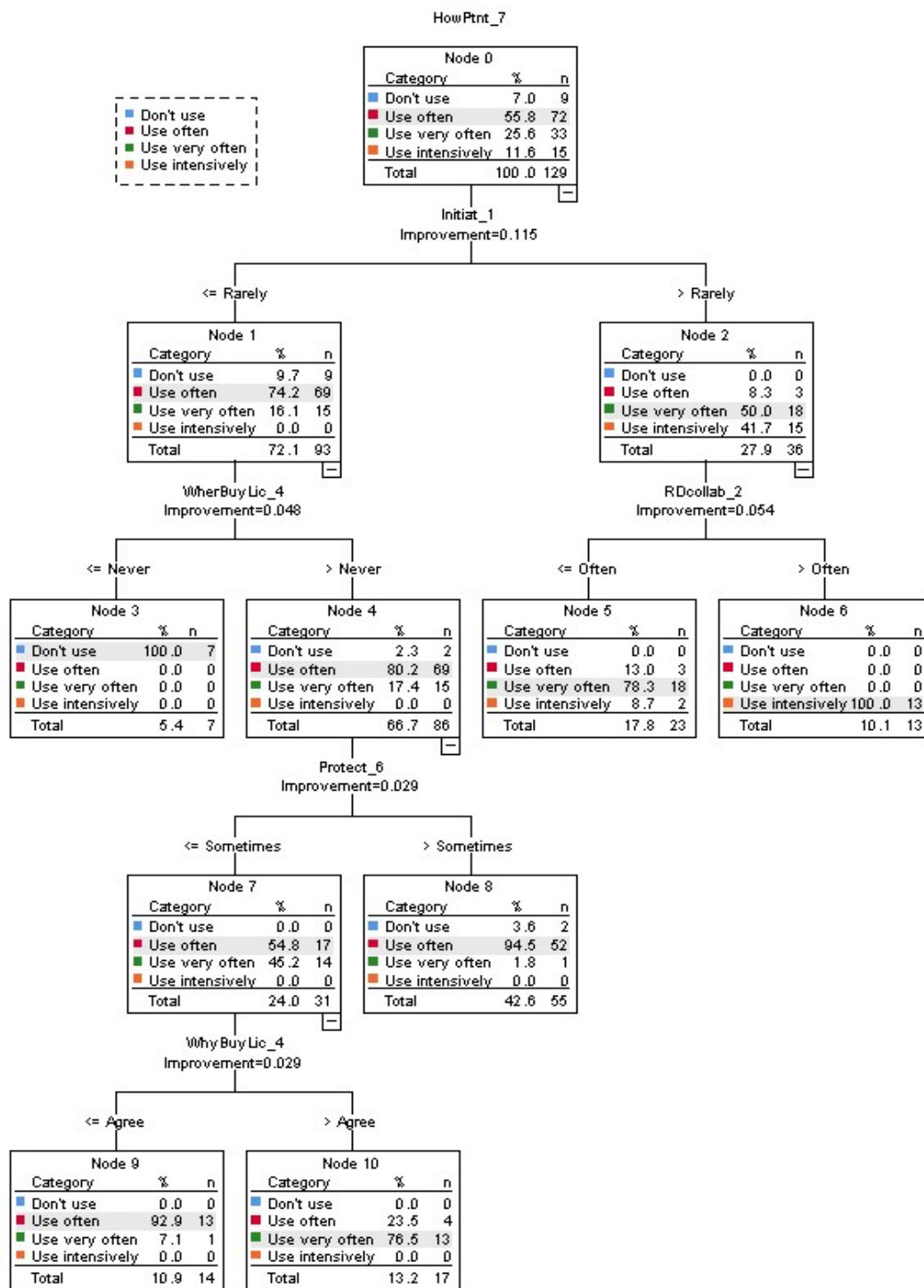
The table below shows the CART analysis of dependent variable using for licence activities.

Table- 53 Using for licensing activities in OI

		Estimation				Accuracy rate
		Don't use	Use often	Use very often	Use intensively	
True	Don't use	7	2	0	0	77.8
	Use often	0	65	7	0	90.3
	Use very often	0	2	31	0	93.9
	Use intensively	0	0	2	13	86.7
Overall rate %		5.4	53.5	31.0	10.1	89.9

When the accuracy classification rate of dependent variable used for licence activities is examined, the accuracy rate is: 77,8% do not use, 90,3% use often, 93,9% use very often, 86,7% use intensively.

Figure- 18 Patent strategy in open innovation processes : Using for licensing



The decision tree of the dependent variable using for licence activitie is given above. It shows that our dependent variable has the highest relationship with (approach to the seller), the second highest relationship with (other comp) and (RD institutions), the third highest degree

relationship with (utility model), and the fourth-degree highest relationship with (Cost reduction).

The cart analysis gave us six decision leaves as follows:

- 1- The companies who are “*using patents for licensing*” and not agree that they “*took initiative to approach to the licensor company while they are inbound licensing*”, not agree that they are “*inbound licensing from independent companies*” (5%).
- 2- The companies who are “*using patents for licensing*” and not agree that they “*took initiative to approach to the licensor company while they are inbound licensing*”, agree that they are “*inbound licensing from independent companies*” not agree that they are “*using utility model as an alternative protection*”, and not agree that they are “*inbound licensing for cost reduction*” (11%).
- 3- The companies who are “*using patents for licensing*” and not agree that they “*took initiative to approach to the licensor company while they are inbound licensing*”, agree that they are “*inbound licensing from independent companies*” not agree that they are “*using utility model as an alternative protection*”, and agree that they are “*inbound licensing for cost reduction*” (13%).
- 4- The companies who are “*using patents for licensing*” and not agree that they “*took initiative to approach to the licensor company while they are inbound licensing*”, agree that they are “*inbound licensing from independent companies*”, and agree that they are “*using utility model as an alternative protection*” (43%).
- 5- The companies who are “*using patents for licensing*” and agree that they “*took initiative to approach to the licensor company while they are inbound licensing*”, not agree that they “*prefer R&D institutes for R&D collaboration*” (18%).
- 6- The companies who are “*using patents for licensing*” and agree that they “*took initiative to approach to the licensor company while they are inbound licensing*”, agree that they “*prefer R&D institutes for R&D collaboration*” (10%).

Companies using their patents for licensing-out in outbound open innovation process are more likely to approach licensor companies for inbound licensing. They also prefer R&D collaboration with independent companies and R&D institutes. Additionally, they consider using utility models for alternative protection and inbound licensing for cost reduction.

Conclusion of Chapter 8

This chapter reveals the CART analysis of our research, responding to our third research question: “What drivers influence patenting and patent exploitation strategies in open innovation processes in China? Are there specific features that influence Chinese patent exploitation strategy in China?”. To respond to our research question, this chapter includes two groups of results. The first group of results represents the link between patenting decisions and open innovation modalities (sub-chapter 8.1)The second part of results puts in evidence the impact of inbound and outbound open innovation processes on patent application strategy (sub-chapter 8.2).

Table- 54 Patenting motivation first degree relationships

Patenting motivations	Open Innovation practices	Open Innovation modality
Access in new markets	Inbound patenting for easy access to a new invention	Inbound OI
Block competition	Bad previous inbound licensing experience	Inbound OI- barrier
Protection of business	Don't trust other companies' technological competences for inbound licensing	Inbound OI- barrier
It reduce the imitation risk	Outbound licensing to access in foreign markets	Otbound OI
Improve image	Inbound licensing to enter a foreign market	Inbound OI
Measuring tool of internal performance	We don't see any good technology offer in the market for inbound licensing	Inbound OI- barrier
Reward mechanism	Inbound licensing the already proved technology ----- Inbound licensing to reduce time to market	Inbound OI
Negotiation	Inbound licensing from R&D institutes	Inbound OI R&D inst
Strong portfolio & Cross-licensing	The government promoting us to work with consulting companies	Inbound OI
Standard setting in the market	Inbound licensing for cost reduction	Inbound OI
Attract financial investors Use gov incentives	Collaborate with the technology development zone companies for R&D collaboration	Inbound OI- Tech devp zone comp

The first group's results provide different motivations for patenting in the open innovation process. We saw that companies who use patent applications to access new markets are more likely to use inbound patenting to ease access to a new inventions, reducing time and R&D

costs. Companies using patents to block their competitors will likely have a negative previous inbound licensing experience but still practice inbound open innovation. Companies using patents to protect their business are practising inbound open innovation, but the uncertainty about other companies' technology levels creates a barrier for those companies. Companies using patenting to reduce imitation risk and use monopoly power are more likely to solicit outbound licensing to access foreign markets. Patenting may improve a company's reputation and improve the market's image. Therefore, companies using patenting to increase their reputation are more likely to use inbound licensing to enter a foreign market.

The patents are also used internally as a performance measuring tool for R&D workers. Inbound barrier NIH is a potential barrier for companies that use patents for performance measuring. Besides, companies using patents for rewarding their R&D workers are more likely to invest in inbound licensing to reduce the time to market and be able to use a technology already used in the market, proving it is efficient.

Patents are also used for cross-licensing negotiations. Nevertheless, companies applying for patents to increase their negotiation force and use it in negotiations are more likely to collaborate with R&D institutes for inbound licensing. Similarly, companies patenting for use in cross-licensing negotiations are more likely to consider government promotions to work with consulting companies for inbound licensing.

Patenting is also used for standard setting in the market. Companies patenting for standard setting in the market are more likely to use inbound open innovation, specifically inbound licensing, to reduce their R&D expenses.

Finally, companies applying for a patent to benefit from government incentives are more likely to collaborate with the companies in the technology development zone.(Table- 54)

Table- 55 Patent strategy and inbound & outbound open innovation first degree relationships

Internal use of patents	Open innovation practice	Open Innovation modality
Stocking inside	Inbound patenting the complementary technology	Inbound OI
Use for NPD	The reputation of the licensor company while inbound licensing	Inbound OI - reputation
External Use of patents		
R&D Contracts	Potential R&D collaboration with licensor company is important	Inbound OI
Patent pool	Inbound licensing for cost reduction	Inbound OI
Joint venture & M&A	Reputation of licensee company is important while outbound licensing	Outbound OI- reputation
Long term alliance	R&D collaboration with R&D institutes	Inbound OI
Licensing	Took initiative to approach to the licensor company while they are inbound licensing	Inbound OI

The second group of results proves that the Chinese company's decision-making process is influenced by market conditions, competition and technological development. The companies are seeking government promotions for outbound open innovation and external exploitation of the patents. Reputation is important in the outbound open innovation process to reduce uncertainty. Nevertheless, the outbound open innovation process relies on a protective background such as government promotions, reputation, and inbound open innovation practices.

More specifically, the results prove that companies stocking their patents internally are more likely to inbound licensing the complementary technology. Similarly, using the patents internally for new product development is also considered a protective behaviour, so companies choose their inbound partner according to their reputation in the market.

The results show that companies using their patents externally for R&D collaboration establishments are more likely to choose their licensor company for inbound licensing as a potential R&D collaboration partner. When companies use their patents in a patent pool for cross-licensing, those companies are more likely to consider inbound licensing for cost reduction. The joint venture or M&A establishment can also use the patents externally. Companies that are using their patents to establish M&A or joint ventures are more likely to

pay attention to the reputation of the buyer company when they are licensing out their patents and choosing their outbound licensing partner according to the reputation of this company.

Companies using their patents in long-term alliances are more likely those companies who solicitude licensing out their patents for the subcontractor company. Finally, companies licensing out their patents are more likely not to hesitate to approach the licensor company when the company plans to buy licenses in the open innovation process.

The results show evidence that the Chinese companies have generally protective and defensive behaviour, relying on inbound open innovation practices by collaborating with R&D institutes or technology development zone companies. Nevertheless, we wre going to discuss those beghaviours in detail in the following chpter 9.

Discussion and Conclusion

Chapter 9 Synthesis of the results and discussion

This chapter is dedicated to discussing the results of our research and is composed of 3 sub-chapters. The first part, 9.1, is dedicated to discussing the results of the descriptive statistics. The descriptive statistics are intended to respond to our first research question: What are the patenting strategies of the Chinese companies in the open innovation process. In this part, we also discussed the patenting decision in the open innovation process, considering the existing literature.

The second part, 9.2, is dedicated to the discussion of the cluster analysis, in which we intend to respond to the second research question of our study: What forms of exploitation of patents do Chinese companies use in the open innovation process?

The third sub-chapter (sub-chapter 9.3) responds to our third research question: What type of companies incorporate open innovation process and patent exploitation? To respond to this question, we have conducted a decision tree analysis to see the important variables related to the decision-making of open innovation processes and patenting.

9.1. Patent management related to the Open Innovation strategy in China

In his speech in 2017 during the 19th National Congress, Xi Jinping stated that “(...) openness brings progress, while self-seclusion leaves one behind. China will not close its door to the world; we will only become more and more open. We should pursue the Belt and Road Initiative as a priority, give equal emphasis to ‘bringing in’ and ‘going global’, follow the principle of achieving shared growth through discussion and collaboration, and increase openness and cooperation in building innovation capacity” (Jinping, 2017). Chesbrough (2021) interprets “bringing-in” as inbound open innovation promotion and “going-out” as outbound open innovation. Again Chesbrough terms the approach of Chinese leaders as “Open Innovation with Chinese characteristics” (Chesbrough et al., 2021). For that reason, open innovation adoption is reflected in nearly all industries in China.

Our sample comprises 71% of manufacturing companies, while the remaining comprises various industries. The prevalence of manufacturing companies aligns with what has been observed in existing literature (Chesbrough & Brunswicker, 2013). However, China stands out with a unique situation where manufacturing dominates the country's industry. Chinese manufacturers are responsible for producing almost every item globally, earning China a reputation as the "world's factory" (Agarwala & Chaudhary, 2021). Electric, gas, steam, and air conditioning companies rank second in our sample after the manufacturing sector. Information and communication companies claim third place.

The age range of the sample companies in our study is quite varied. To establish a starting point for China's "opening-up" process, we consider 1980 as the date when China officially joined WIPO (World Intellectual Property Organization) (Cox, 2011). This is significant because it marks the approval of China's IP system by international companies and also represents the initial step towards open innovation for Chinese companies to obtain valuable patents that are internationally recognized (Fu, 2015). Fu (2015) provides a detailed explanation of how the opening up of the Chinese economy in 1979 attracted foreign direct investment (FDI) into China. This flow of investment further intensified during Deng Xiaoping's circuit to encourage foreign investors to come to China in 1992. As a result, more coastal areas in China became open to FDI, increasing both FDI and the number of companies operating there (Fu, 2015, p. 52). Consequently, we observe that most of our sample companies (64.34%) were established after 1980, while the remaining portion (35.66%) was established before that year.

In line with the theory, most companies participating in our study have a high level of technology (72.09%), while the remaining companies are considered low-tech (27.91%). Our sample includes both types of companies to ensure comprehensive representation. Furthermore, most of our companies are located along the north-south axes of the eastern coast, as well as in the central-southwest part of the region. There are several reasons for this concentration. Firstly, it can be attributed to trade activities that predominantly occur in coastal regions, creating a significant impetus for companies to innovate.

Additionally, foreign direct investment (FDI) and spillover effects have positively impacted these companies (Fu, 2015, p. 52). This concentration aligns with Deloitte's report (2019) findings, which highlight that innovation activities within Beijing, Tianjin, and Hebei primarily concentrate in the Beijing region from the north, whereas the Guangdong and Hong Kong region's innovation activities centre around southern areas. (Deloitte, 2019, p. 27) Moreover,

He et al. (2018) findings also align with this pattern as they highlight that patenting activities in China are largely concentrated within coastal areas (He et al., 2018).

However, it should be noted that all the companies in this study studied are large companies with many employees. This finding may be specific to Chinese companies because larger organizations typically have more resources available to fund their research and development (R&D) activities (Brunswicker & Vanhaverbeke, 2015) and patent applications. However, it is also worth mentioning that existing literature suggests smaller companies can exhibit greater flexibility in conducting R&D studies despite potentially limited resources (Brunswicker & Chesbrough, 2018; Brunswicker & Vanhaverbeke, 2015). It is important to highlight that each company has at least one department dedicated to managing R&D efforts within their organization. This further emphasizes the increased management costs associated with running such departments and underscores the need for financial stability similar to what larger corporations possess.

9.1.1. Patenting in Open Innovation

We have searched particular market attributes outlined in the literature in our search. Specifically, we have studied factors such as market turbulence, competition intensity, the impact of globalization, and government influence. Nevertheless, we have investigated the internal factors for Open Innovation adoption. Besides those, there was some information that we could not collect because of the confidentiality issue. Therefore, the internal factors remain limited by the company's age, geographical position, size and industry.

Table- 56 Internal factors for patenting

Internal factors	Distribution
Size	Large Companies
Age	67% after 1980 33% before 1980
Organsiational structure	63% Chinese Corp 31% Subsidiary of Ch Group 5% Subsidiary of foreign Group
Governance	%44 Private %40 Public %16 Public & private
Geographical	Concentration on coastal regions
Exportation	High
R&D department	Minimum 1 R&D department
Industry	71% manufacturing 12% Eletricity & gas 9% ICT

Protection choice in Open innovation

The findings indicate that patents and secrecy are the most preferred intellectual property (IP) protection (W. M. Cohen et al., 2000) This aligns with the choice of protection observed in emerging economies (Naughton, 2007, p. 351) Additionally, it is consistent with Gallié et al. (2012), which highlights that patenting is more prevalent among companies engaging in extensive research and development (R&D) activities (Gallié & Legros, 2012, p. 785). This highlights the significance of having at least one R&D management department within organizations to emphasize their commitment to R&D initiatives which aligns with the theory.

The companies have shown a preference for product or process complexity as a means of protection. This choice involves various components, including the production system, procedures, and raw materials. The successful integration of these components necessitates the ability to effectively use and manage them. As a result, it can naturally protect inventions (Gallié & Legros, 2012, p. 781).

Companies can gain an edge over their competitors by utilizing lead time advantage, especially in industries focused on product innovation (Aloini et al., 2017; Gallié & Legros, 2012, p. 781; Hurmelinna-Laukkanen & Puumalainen, 2007). Essentially, this means that the company is able to produce more quickly and efficiently than its rivals (Gallié & Legros, 2012, p. 781), which is particularly advantageous in a competitive market like China. This capability allows companies to stay ahead of the competition by improving production speed and overall efficiency.

Before filing a patent application, we also investigate alternative forms of protection. In our study, we considered applying for a utility model as well as pursuing foreign patent applications alongside the one in China. The use of utility models is widespread in China due to their affordable cost, ease of application, and speedy approval process compared to invention patents. This is especially advantageous for technologies with short lifecycles (Prud'homme, 2017). Although the protection period for utility models is limited to 10 years (Gassmann et al., 2021), different studies have highlighted that among countries incorporating utility models into their intellectual property systems, China leads the world as its largest user of utility model (WIPO, 2021a, p. 7). In terms of licensing technologies in China, utility model licenses are particularly popular. Most licensing agreements are reached within provinces, and there is a strong preference for in-licensing when it comes to utility models (Y. Wang, Li-Ying, et al.,

2015, p. 298). Thus, our findings align with these trends and indicate that respondent companies favor obtaining a utility model before pursuing an invention patent.

Patenting abroad, however, is not a very common practice for the respondent companies (Archontakis & Varsakelis, 2017)

We saw that informal protection tools are still used as a protection tool in China; more specifically, product complexity, secrecy and lead time advantage are used widely in nearly all companies. We saw that those protection tools are complementary for the Chinese companies, which aligns with the theory. The literature provides evidence that the combination of formal and informal IP protection tools is common in SMEs and, more specifically, young innovative SMEs (Veugelers, 2018, p. 126). The literature put evidence that in highly competitive markets where the imitation risk is high, the companies tend to use the lead time to delay imitation. Therefore, the benchmark between secrecy and lead time advantage with patents depends on the profit margins between formal and informal protection (B. Hall et al., 2014). Also, the use of utility models is widely adopted by the companies.

Table- 57 Protection Choice

Protection choice	Str Agree- Agree
Patent	63%
Secrecy	73%
Utility model	69%

External factors for patenting

Our survey results show that the field's competition level is high for all companies, except for monopolistic companies (6,8%) and for a minority company (7,75%).

Regarding the market turbulence, we had three questions about the patent activity in the market, NPD intensity, and technological forecast. For all questions, the results show that the respondents find the market quite competitive in terms of high patenting activity, high rate of NPD activity, and needing help to forecast the technology level of the market in three years. Only monopolistic companies and some niche industry companies (e.g., rice cooking) do not agree about the turbulence. However, the majority of the participant's perception is the high market turbulence, which is considered an essential factor in promoting open innovation activity (Popa et al., 2017).

Trade freedom or the globalization effect is an essential factor for open innovation (Fu, 2015, p. 6). We investigated the companies to see if they were in a position where they could work with international companies or if their market was open enough to international trade. Therefore, we asked if they have trade freedom in the market, significant market growth, working as a subcontractor of a foreign company, and exportation activities. Again, most respondent companies (more than 75% in total) agreed or strongly agreed with those questions. Trade freedom (Popa et al., 2017), subcontracting with a foreign company (Gassmann & Enkel, 2004), and exportation activities are crucial for open innovation adoption. However, in our field, some previous researches show the extra importance of “learning by licensing” and “trade push” for Chinese companies (Y. Wang et al., 2013; Y. Wang & Li-ying, 2015). Accordingly, we can say that the globalization effect is also approved in the open innovation adoption process of Chinese companies.

Not only as a specificity of our field includes a significant government effect because of historical and political reasons, but in the open innovation literature also, we see that the government incentives in R&D activities (Fu, 2015) and in.

IPR protection issues (Arora et al., 2002; Fu, 2015; Gambardella et al., 2007; Lichtenthaler, 2009b) government has an important role. We investigate the companies about those topics to see the government’s effect on open innovation activities. Respectively we investigate fiscal (Prud’homme, 2012, p. 88; Y. Wang, Ning, et al., 2015; Wei et al., 2017, p. 53), tax, and financial policy (Fu, 2015) incentives. The companies agree to those cost-reducing promotions that the government offers. The guidelines also are attractive promotions for the companies, according to their responses. However, educational incentives do not attract as much as other promotions. Nevertheless, 65% of the companies replied positively to the educational activities of the government. Accordingly, we can say that government has a vital incentive effect on open innovation and patenting activities (Fu, 2015; Savitskaya et al., 2010; Y. Wang, Zhou, et al., 2012).

Government incentives on patenting decision

Regarding government promotion activities, we investigated the preferences for collaboration. Specifically, we investigate the companies' preference for working with universities, research institutes, other companies, or consulting firms. Interestingly, our findings revealed that government incentives were more inclined towards fostering partnerships with other

companies rather than consulting firms. This suggests a certain level of hesitancy or reluctance on the part of participant companies when it comes to engaging external consultants or seeking assistance from private consulting entities. Another area we explored was intellectual property rights (IPR) strength. Overall, companies expressed agreement that the government should reinforce IPR protection measures. However, this increased emphasis on IPR also resulted in a more complex application process. Consequently, this complexity acted as a potential barrier for outbound open innovation initiatives, which is in line with the theory (Savitskaya et al., 2010)

Table- 58 External factors results for open innovation adoption

External factors	Details	Str Agree – Agree	Notes
Technology market influence	Market turbulence – industry speed	85% ~ 86%	
	Trade freedom – environment openness	85% ~	
	Government	85% ~	Partnership with other companies
	Technological turbulence	79%	
	Competition	84%	
	IP protection	88% ~ 99%	Abroad protection is not common

Patenting motivations in Open Innovation

The reasons behind seeking patents can be categorized into several motivations. Parallel to the literature, first and foremost, companies pursue patents to gain entry into new markets.

(W. M. Cohen et al., 2002). Another motivation is to protect their business interests (Blind et al., 2006; Holgersson & Granstrand, 2017) and reduce the risk of imitation (W. M. Cohen et al., 2000; Gassmann et al., 2010; Lichtenthaler, 2009b). Patents also serve as a means to block competition (Ayerbe, 2016; Ayerbe & Mitkova, 2013) and enhance the company's image (James et al., 2013; Pénin & Neicu, 2018). Companies use patents to measure their innovation performance and motivate their R&D departments internally (Blind et al., 2006; Holgersson & Granstrand, 2017). Additionally, patents are employed as a negotiation tool for cross-licensing (Blind et al., 2006; Holgersson & Granstrand, 2017), to establish a strong patent portfolio (Blind et al., 2006; Holgersson & Granstrand, 2017), and to set standard in the market (Blind et al., 2006; Holgersson & Granstrand, 2017) These actions give companies leverage in future

negotiations. Lastly, companies benefit from government incentives (Blind et al., 2006; Holgersson & Granstrand, 2017) while attracting external financial resources.

For all questions, the companies agree to our questions (Table 59). When looking in detail for “disagree” and “totally disagree”, responses came from either monopolistic or niche industry companies, aligning our responses to the theory.

Table- 59 Patenting motivations in Open innovation

Patenting motivations		
Access in new markets		91%
Prevention of copying & block competition & standard setting		
	Protection & prevention of copying	91%
	Standard setting in the market	62%
Negotiation & strong portfolio & cross-licensing		86% -59%
Improve image		83%
Measuring tool of internal performance	Reward mechanism	83%
Attract financial investors	Use gov incentives	96%

Patenting decision in abroad in Open Innovation

We investigate the criteria used by companies when filing patents abroad. One reason a company decides to patent overseas is that the patent holds value. Therefore, only valuable patents are chosen for international filing (Wunsch-Vincent et al., 2015). Additionally, we asked about the significance of market size (Schiffel Kitti 1978 in Liang & Xue, 2010), IPR protection (Y. Kim, 2009), low barriers to entry in the market, previous experience with transferring intellectual property in the same country (Lichtenthaler & Ernst, 2006), a high number of competitors in the market (Holgersson & Granstrand, 2017), and purely exploring new territories. However we couldn't collect enough response and excluded those questions from the analysis.

In order to determine the preferred countries of companies, we utilized the WIPO (2017) database. From this database, we identified the top five countries chosen by companies: USA, Germany, Japan, Korea, and France (WIPO, 2017). Our analysis revealed that Chinese companies prioritize patenting in the USA and Germany, followed by South Korea, France and Japan as their fifth choice when seeking patents abroad. These findings are generally consistent

with previous research, indicating that Chinese companies prioritize patenting in the USA first, followed by Europe, Japan, Korea, and Canada (Wunsch-Vincent et al., 2015). The responses obtained from our study (Table- 60) align closely with the rankings reported in previous studies (Ma et al., 2009).

Table- 60 Country ranking

Range Country	1	2	3	4	5	OTHER
USA	46	21	16	7	15	18
Japan	22	34	25	27	15	0
Germany	14	35	44	12	15	3
South Korea	19	17	14	48	19	6
France	10	11	21	20	46	15
Other	12	5	3	9	13	34
TOTAL	123	123	123	123	123	76

Portfolio composition

The significance of both the technology and patent age cannot be undermined (Caviggioli & Ughetto, 2016; Granstrand, 2004; Rosenzweig & Mazursky, 2014; Y. Wang, Li-Ying, et al., 2015). However, companies are hesitant to address inquiries regarding the age of their patent portfolios. Consequently, we were compelled to omit these questions from our research.

IP exploitation in the Open Innovation

Our results indicate that the companies appreciated internal exploitation modes such as using for NPD and stocking for strategic use (Mitkova & Ayerbe, 2004). However, external exploitation modes received different attention from our respondents. Using patents for R&D contracts and patents in a patent pool received moderate responses from our respondents. We can say that not all companies, but some seek to use patents for bargaining reasons. On the other hand, using a joint venture is less interesting for the companies. (For governance and the technology level of the companies also gave equally distributed graphs so we couldn't resume or characterise). However, using patents for long-term alliance purposes and also for licensing are more common for companies

Table- 61 Exploitation of patents

Internal use of patents		
	Stocking inside	67%
	Use for NPD	76%
External Use		
	R&D Contracts	48%
	Patent pool	57%
	Joint venture & M&A	31%
	Long term alliance	30%
	Licensing	38%

9.1.2. Open Innovation processes

All companies stated that they have previous inbound or outbound patenting/or licensing experience, as well as R&D collaboration activity, which confirms us while considering the responses of the respondent companies for the following questions.

Inbound open innovation

We investigate the motives behind the companies' engagement in inbound patenting. Specifically, we questioned whether they pursued inbound patenting to acquire access to a new inventions (Gassmann et al., 2018), blocking rivals (Grimpe & Hussinger, 2008; Holgersson & Granstrand, 2017), or obtain access to complementary technologies (Gassmann et al., 2018; Gassmann & Enkel, 2004; Spithoven et al., 2013). Our findings align with theories as the responses from the respondent companies confirm that all of these reasons are valid for their involvement in such activities (Gassmann et al., 2018; Gassmann & Enkel, 2004; Spithoven et al., 2013).

Regarding inbound licensing, we investigate the reasons behind companies' decisions. These motivations included the search to expand their portfolio (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016), gain access to complementary technologies (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016), making cross-licensing agreements (Davis, 2008), reduce R&D expenses (Gassmann et al., 2018; Gassmann & Enkel, 2004), to gain access to a new technology (Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994), acquire proved technology (Chesbrough & Crowther, 2006), expanding into foreign markets (Greul et al., 2018; Harhoff et al., 2014), and subcontracting licensor (Azzam et al., 2017; Gassmann & Enkel, 2004). We saw that these

responses supported existing theories except reducing R&D expenses and utilizing proven technology which had a disagreement rate of only 17%. Additionally it was observed that these respondents were primarily public companies operating within monopolistic markets.

Table- 62 Inbound Open innovation

Motives for inbound OI	Str Agree - Agree
Access to a new invention	98%
Blocking rivals	92%
Access to complementary technology	87% P- 92% L
Increase the portfolio	100%
Cross-licensing	95%
Reduce cost	70%
Reduce time to market	98%
Have access to an already approved technology	76%
Enter in a new (or foreign) market	99%
Subcontract the licensor	91%

Outbound open innovation

We also inquired why the companies engaged in outbound patenting activities. Specifically, we wanted to know to what extent their motivation for selling patents was influenced by various factors such as stopping related activities (Caviggioli & Ughetto, 2013; Monk, 2009; Zuniga & Guellec, 2009), selling of technology that is not part of the core technology (Caviggioli & Ughetto, 2013; Monk, 2009), or simply aligning with their overall business strategy (Caviggioli & Ughetto, 2013; Kutvonen, 2011). The findings reveal that the companies' responses regarding outbound patenting align with established theoretical frameworks.

Regarding outbound licensing, we investigate the reasons behind companies' decisions. These motivations included making money from patents (Gassmann & Enkel, 2004; Lichtenthaler, 2007; Zuniga & Guellec, 2009) to increase reputation (Lichtenthaler, 2007; Lichtenthaler & Ernst, 2007; Van De Vrande, de Jong, et al., 2009), cross-licensing (Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009), creating alliances (Kutvonen, 2011), standard setting (Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009), subcontracting other companies (Gassmann & Enkel, 2004), blocking rivals (Bianchi et al., 2014; Caviggioli & Ughetto, 2013), access to a new market (Caviggioli & Ughetto, 2013; Lichtenthaler, 2007), company strategy (Kutvonen, 2011). We find that these responses supported existing theories except for blocking rivals 45% disagree,

and 22% strongly disagree. We saw that most of those respondents are public companies already in a monopolistic position in the market.

Table- 63 Outbound Open Innovation

Motives for outbound OI	Str Agree - Agree
Stop related activity	62%
Acquiring a new company and selling unused patents	58%
Strategy (BM)	100%
Make money	97%
Increase reputation	90%
Cross-licensing	90%
Creating alliances	56%
Standard setting	86%
Subcontractor	72%
Blocking rivals	33%
Access to a new market	90%

Partner type

Based on the responses, we saw that the respondent companies initially approached other independent companies and R&D institutes more frequently for inbound licensing. They then turned to patent pool companies as potential partners for inbound licensing. Consulting companies were ranked third by the respondent firms as licensor partners. Lastly, universities were the least preferred option for inbound licensing partnerships.

When we study the breakdown of companies that stated “never” for universities to choose as a licensor and stated “never” for consulting companies, we see that the public-private company share is quite the same. However, the industries are mostly manufacturing and active in iron and steel, machinery and equipment..etc. Conversely, from the literature (Brunswick & Vanhaverbeke, 2015; Chesbrough, 2003a; Fu et al., 2016), collaboration with universities is not the first choice of Chinese companies. In a survey among Italian SMEs, Verbano et al. (2015) put evidence that the Italian SMEs chose “*universities and research centres, service companies supporting innovation, government bodies and agencies, clients, suppliers, competitors and enterprises operating in other sectors*”. Nevertheless, Chinese companies in our research show a different ranking and choose R&D institutes (government bodies) and independent companies, then patent pool companies in the second place, and consulting companies and universities in the last. We can explain this choice because of the learning difference between companies. To have a deeper understanding, a survey about the R&D centre

university collaboration choice shows that, Companies around Beijing, where the best universities in China are placed, prefer collaborating with universities, whereas companies around Shanghai, the commercial city, prefer R&D institutes (Chen & Kenney, 2007)

The literature shows that knowledge transfer in the machinery industry is somehow more common in machinery acquisition (F. P. Hochleitner et al., 2016) and collaboration with universities mainly at the beginning of the 20th century in Europe (Gerybadze & Slowak, 2008) for standard setting in the market. Both underline that collaboration with universities is essential for manufacturing companies while innovating. However, a recent cross-country study in Europe in SMEs (F. Hochleitner et al., 2020) shows that companies who collaborate to a lesser extent with government and universities tend to collaborate more with customers, suppliers, competitors or consultants (F. Hochleitner et al., 2020, p. 88). Those companies are classified as co-operators with a high level of openness compared to other companies.

Table- 64 Partner type

Partner types	Str Agree- Agree
Independent comp	46%
R&D institutes	43%
Patent pool company	32%
Univ	34%
Consulting	26%

R&D Collaboration partner

Lamberti et al. (2017) argue that comparing different information sources, such as collaboration, is a more efficient and target-oriented tool for knowledge exchange. They define collaboration as “*an active participation of the company with other enterprises or institutions on innovation activities*” (Lamberti et al., 2017). Manzini et al. (2014) interested in 5 dimensions of collaboration: the *partner’s* dimension, the forms of arrangements, the phases of the innovation with external partners, the organization of collaboration, and the result of the collaboration. The first step of the collaboration in their study is also called “collaboration breadth” and “collaboration depth” in the study of Manzini et al. (2014), which describes the collaboration partner diversity (the collaboration breath) and the collaboration intensity (collaboration depth). To find the collaboration breath, the authors proposed a combination of eight external partner options in a multiple choice scale to find the combination intensity of the

partners. For the collaboration depth, the authors questioned with a Likert scale question about their partnership intensity (Martinez et al., 2014). One other approach to collaboration partnership is the choice of collaboration level. Poot et al. (2009) argue that there is four collaboration level, such as internal collaboration within the enterprise group, horizontal collaboration with competitors, vertical collaboration with suppliers, clients or customers, and knowledge-intensive collaboration with consulting companies, universities, or R&D institutes (Poot et al., 2009). Du et al. (2014) emphasised partnership types in R&D collaboration. They divided the following two branches, *science-based partnerships* with universities, knowledge institutions (public R&D institutes or regional technology transfer offices in our work), and *market-based partnerships* with customers, suppliers or other companies like in our study (Du et al., 2014). In the same vein, Tether et al. (2008), in their research on R&D collaboration choices other than universities, consider private and public research organizations, consulting companies and public R&D institutes as alternative R&D collaboration partners, and other external sources (customers, suppliers, competitors etc.) (Tether & Tajar, 2008, p. 1080). Tether et al. (2008) define the role of consultants and other private research organizations as a source of external ideas they develop. However, they have observed elsewhere (Tether & Tajar, 2008, p. 1082) so they can help the companies to catch up quickly with the innovations of their rivals (p: 1083). The authors mentioned in the citation affirm that companies have the potential to engage in collaborative research and development with other companies.

On the other hand, mainly in emerging markets, the institutions such as universities, R&D institutions, regional technology transfer offices, or technology development zones have particular importance. Multiple authors put evidence that institutions positively affect emerging market companies by promoting innovation and increasing the willingness of those companies to engage in open innovation (Mitkova & Wang, 2015; Sun et al., 2016).

In our study, we have been interested only in the *partner choice* of the companies for a potential R&D collaboration, and we have found that respectively:

The most preferred collaboration choice is the R&D institutions, with a choice of 64% of the respondent companies, which aligns with the previous research.

The regional technology transfer office and technology development zone (Y. Huang et al., 2013) companies are the second most preferred R&D partner by the respondent companies considering the field specificities; it is also in line with the previous research.

In late 1970, when China started to change its economy from a closed to an open, capitalistic economy by promoting entrepreneurship and foreign investment, mainly the coastal zones (west-cost of China) profited and showed high investment and growth rates. However, the central regions, primarily rural regions, could only benefit a little from this new economic order. Accordingly, in 2006, to change this inequality, the Chinese government developed a new framework embracing the central regions and helping them be a part of independent innovation. Also announced later in the 2009-2015 development plan promoting the central region's economic development set out four initial goals: *“to accelerate economic development, focus on scientific and technological innovation for growth, achieve sustainable development through environment-friendly practices and promote social harmony through equality”* (National Development and Reform Commission of the PRC in Y. Huang et al., 2013, p. 829). The establishment and development of national science and technology parks, however, date before this promotion; in 1988, under the Torch program, which promoted the commercialisation, industrialisation, and internationalisation of new and high-tech products, also started the establishment of national industrial zones (Fu et al., 2021, p. 169; Yang & Lee, 2021). The national high-tech industrial zones gradually became High-tech Development Zone (HTDZ), National Independent Innovation Development Zone (NIIDZ) (Y. Huang et al., 2013), and finally, Science Parks and High-tech Zone (SPHZ) (Walcott in Fu et al., 2021, pp. 337–353). Those science parks have different names according to their specialities, such as “agri-tech demonstration zone, high tech industrial park, Torch high-tech industrial development zone”, or simply high-tech park or science park (p: 341). The first national high-tech industrial zone was launched in 1988 near Beijing, Zhongguancun Science Park. Following years, the establishment of science and high-tech parks increased slowly until the “South Trip” of Deng Xiaoping in 1992.

During this tour, Deng Xiaoping announced that the government aimed to promote domestic high-level start-ups to innovate. In 1993, the number of science parks increased by 24 more and 1993 reached 52. Then, it continued to increase slowly until the economic crisis in 2008. However, the 11th five-year plan (2006-2011), launched in 2006, targeted scientific improvement to become an innovative nation. By improving existing industrial zones, the

Chinese government increased those science parks from 56 to 88 in 2011 and 115 in 2014 (Yang & Lee, 2021). The authors argue that the concentration of those zones is mainly in coastal regions and not distributed equally all over China. Their research on R&D efficiency across science parks in China shows that R&D efficiency has fallen since the increase in science parks in 2011. Also, the older, more significant, or higher human capital does not increase efficiency but creates a negative relationship with R&D output.

Additionally, newly upgraded science parks in rural areas, where university-industry linkage is weak, and universities need to be better performers than big cities such as Beijing or Shanghai (Yang & Lee, 2021). However, in our research, the companies are already concentrated in coastal regions, so we could not see the difference between rural and coastal regions. Nevertheless, we can see that companies often respond to R&D collaboration with a regional technology transfer office or technology development zone company located in coastal regions, which aligns with the previous research.

Direct contact with other companies is the third option for the respondent companies. However, it is not a preferred choice at least by half of the respondent companies.

Universities came in fourth place.

Finally, came the consulting companies for finding R&D partners. However, the literature shows that consulting companies are also used very much for R&D collaboration (Lamberti et al., 2017; Martinez et al., 2014; Tether & Tajar, 2008). Our result does not align with the theory.

Table- 65 R&D collaboration partner

R&D collaboration partner	
Universities	41%
R&D institutions	64%
Regional tech transfer office	52%
Direct contact	48%
Consulting companies	23%
Tech development zone companies	52%

Partner selection criteria

We asked the companies the following criteria for inbound licensing: the company has to be a spin-off company (Chesbrough, 2003b; Gentile-Lüdecke et al., 2020; Gianiodis et al., 2010; Lichtenthaler, 2007; Savitskaya et al., 2010; Sikimic et al., 2016), the relevance of the licence seller companies technology and technology level of the firm (Cassiman & Veugelers, 2006; Chesbrough & Crowther, 2006), the reputation of the company (Y. Hu et al., 2015; Lamberti et al., 2017; Lichtenthaler & Ernst, 2007), potential R&D collaboration (Sampson, 2005), price (Fosfuri, 2006), patent citation : the patent citation considered as a value indicator of a patent (Blind et al., 2009)

Responses show that the most important criteria is the price. Fosfuri (2006) put evidence that companies compete not only in the market for products but also in the technology market. The price of the licenced technology is essential for the buyer (Fosfuri, 2006).

The firm's technology level and relevant technology follow the price as inbound licensing criteria (Cassiman & Veugelers, 2006; Chesbrough & Crowther, 2006). It means that the companies are seeking the same technology level from the seller, which is in line with the theory that companies in the same industry are more likely to choose the relevant technology from their licensor (Cassiman & Veugelers, 2006). When the technology level of the partner is much more critical for inbound licensors, it is also essential for outbound licensor companies to maintain a significant level of usage of the exploited technology. Our responses are in line with the theory.

The third important criterion appears the reputation of the licensor company. The theory shows that companies with a good reputation in a field use their reputation as a signal for buyers as potential knowledge suppliers (Lichtenthaler & Ernst, 2007, p. 39). Same for outbound open innovation, it is the most important criteria. We generalize this attitude about “trust” for dispersing the uncertainty between partners for outbound licensing counterparts (Barchi & Greco, 2018, p. 360). Hence, the respondent’s attitude is in line with the theory.

Licensing from a spin-off company and potential R&D collaboration with the licensor came in fourth place for the respondent companies. A technology spin-off company is mainly created to commercialize one or more developed technology outside the firm's primary business (Chesbrough, 2003b). Recent studies show that Chinese companies out-license actively from

their spin-off companies, which is also in line with the responses of the respondent companies (Gentile-Lüdecke et al., 2020).

Recent studies show that Chinese companies out-license actively from their spin-off companies, which is also in line with the responses of the respondent companies (Sampson, 2005). Accordingly, the experience in collaboration in inbound and outbound open innovation activities helps companies to increase their experience with their partner. It allows for deepening the relationship for R & D collaboration. The results confirm that the companies seek a potential R&D collaboration from inbound licencing with the partner.

Finally, patent citation came at the end as criteria while inbound licensing. In the literature, patent citation is considered a value indicator of a patent. Accordingly, if a patent has a purpose-protective motive rather than a strategic motive, then the citations of the patent must be high. In other words, blocking competitors by this patent will be accessible when the related patent's citations are high because numerous others will claim different aspects of the cited patent (Blind et al., 2009). Also, a patent citation is used for searching the history of a patent which gives essential information about the patent (Mitkova et al., 2010). It allows an understanding of the geographical diffusion of the knowledge exchange between international companies (Gomes-Casseres et al., 2006). Also, it shows that, according to the companies, it is evident that they pay attention to patent citation; however, it is slightly less important than the above criteria. The patent value and the patient's history are essential for the companies.

We asked the respondent companies the following “partner selection criteria while licensing-out.”

We asked the companies about the basic information on the market, such as the market size of the buyer company. We saw that market size is the second most crucial factor for the companies while outbound licensing.

The experience in R & D collaboration in inbound and outbound open innovation activities helps companies to increase their experience with their partner. It allows for deepening the relationship for R & D collaboration. The companies generally agree on that criteria, align with the theory (Cesaroni, 2004; Van de Vrande, 2013, p. 611).

Company affiliation is an essential factor which gives the image of a powerful and reliable company (Gulati, 1998, pp. 296–297). Also, company affiliation makes the interaction between the scientist easier when the scientific knowledge is complicated (Giuri et al., 2007).

Consequently, company affiliation can offer valuable insights to external parties. However, when it comes to acquiring licenses from foreign companies, affiliated firms in developing countries do not perform as well as their non-affiliated counterparts. The study highlights that being part of a group already provides R&D prospects. Therefore, non-affiliated enterprises with limited R&D opportunities in comparison to affiliated firms may experience and show better innovation performance (Elia et al., 2020, p. 714).

Table- 66 Partner selection criterias

Partner selection criterias	Str. Agree & Agree
Relevance of seller companies techn level & tech level of the firm	86%
Reputation of the company	87%
Potential R&D collab	69%
Price	88%
Patent citation	66%
Company affiliation	67%
Market size of the company	94%
Technology level	93%
Reputation	97%
R&D collaboration	84%

The partner contact

We asked the respondent companies how they are contacting the partner. Accordingly, we asked the respondent companies if they are using seminars or conferences (Cassiman & Veugelers, 2006; Laursen & Salter, 2004, 2006), commercials (Landry et al., 2013, p. 447), new R&D staff (Cassiman & Veugelers, 2006), direct contact with the buyer company (Landry et al., 2013, p. 447). Alternatively, using an agent or an intermediary to exploit IP (F. Hochleitner et al., 2020).

Commercials can be used as information diffusion channels for the market (Landry et al., 2013, p. 447).

Seminars or conferences are the gathering places of different researchers on the same topic. In ordinary conditions, R&D workers are generally in touch with their external alter egos

formally, where they cannot share very much besides formal topics, and sometimes with rival companies' R&D workers (W. M. Cohen et al., 2002).

New R&D Staff: In our research, we wanted to understand if new R&D staff hiring is an essential option for the respondent companies, even if it is not directly related to technology commercialisation. The results show that hiring new R&D staff is the most considered choice for the companies (Cassiman & Veugelers, 2006),.

Table- 67 Partner contact

The pre commercialization activities	
Using commercials	33%
Using seminars	40%
Hiring new R&D staff	65%
Direct contact	29%
Using intermediate agent	26%

Approaching to the partner directly

We investigate if the companies took the initiative to approach the license seller company while buying or the buyer company while selling licenses. In the literature, *external initiation* for external patent exploitation starts with a contact from a third party who approaches the company to address in the name of another company and, first, determine the value and the price of the patent—accordingly, an outbound licensing process start. Like *internal initiation* for the inbound open innovation process, the company's management starts researching potential buyer companies long before external exploitation. The company solicited the identification of potential buyer process by searching through patent portfolio reviews. When they decide to collaborate for inbound licencing with a company, they can contact the intermediary, or they can contact directly (Ziegler et al., 2013, p. 942)

Accordingly, we asked the companies if they took the initiative to approach the seller or buyer company. We saw that, for both options, companies would prefer to take the initiative to approach, and the results align with the theory.

9.1.3. Barriers for Open Innovation:

Inbound barriers

For inbound barriers, we investigate the following criterias

Licensor involvement in our business (NIH) creates a risk of marketing control in their research while realising an international licensing. The authors argue that the licensor company will lose the marketing control of the licensee's market for its product. Accordingly, the obvious risk for the licensor will be the loss of this market because of “*under-marketing*” (Johnson & Mottner, 2000, p. 181). We consider this possibility and add to the NIH syndrome in our research. From this point, companies may stay reluctant to share their technology in inbound or outbound activities (Coras & Tantau, 2014; Oumlil & Juiz, 2016; Sulaymonov & Du, 2020). We consider those two barriers included in NIH syndrome (Lichtenthaler & Ernst, 2006), and we assume that either for one or another reason, a company may stay reluctant to inbound activities under the guise of licensor involvement in their business.

We saw that only 55% of the respondent companies find licensor involvement a barrier to their inbound activities.

Licensor may license to our competitors oversea (NIH) can be understood as a lack of trust & misunderstanding between partners. In our research, we saw that 70% of the respondent companies consider licensor's oversea licensing to a competitor as an important barrier for inbound licensing.

The lack of trust through the external knowledge (NIH) create a barrier also. Since the NIH and NSH attitudes are related to human attitudes, it is natural that the lack of trust is also a part of those attitudes related to human attitudes. Previous research put in evidence the importance of trust in open innovation (Abu El-Ella et al., 2016; Corral de Zubielqui et al., 2019; Hasche et al., 2017)

However, the concept is a multidimensional construct and has been discussed by different authors in different areas of management sciences (Fulmer & Gelfand, 2011; Nestle et al., 2019; Rousseau et al., 1998). The first and widely used definition of trust is the one of Rousseau et al. (1998), “*trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another*” (Rousseau et al., 1998, p. 395). Zubielqui et al. (2019) harmonize a definition of trust and explain it as a psychological

state which is used as an assurance that the parties will respect and do not take advantage of the weaknesses of the other. At the same time, trust creates stability between partner and have a decreasing effect on opportunistic behaviour. Also, it is an enabler of collaboration and knowledge transfer without fearing the other's intentions (Corral de Zubielqui et al., 2019).

In the open innovation literature, Hasche et al. (2017) approach to the concept of trust in the open innovation process and focus on three antecedents of trust: contracts, competence, and goodwill (Sako 1992 in Hasche et al., 2017). The authors studied trust from the lens of start-ups and showed that the commitment to collaboration requires reciprocal trust to create a liable collaboration context.

In the same vein, Nestle et al. (2019) approach to trust from *an information asymmetries* angle and integrate the NIH and NSH attitudes. The authors put in evidence that trust with agglomeration are intensifying factor of collaboration within clusters (Nestle et al., 2019).

Like the previous question, the distrust of external knowledge is an important factor hindering inbound open innovation (Krapež et al., 2012).

Our research showed that 66% of the companies do not trust external knowledge while doing inbound activities.

The lack of trust bring the feeling of insecurity to the workers. In our research, we also saw that besides the lack of trust in external knowledge, the respondents are pretty secure while making inbound open innovation activities. We saw that 68% of the respondent companies do not agree that they don't feel secure while doing inbound activities.

A negative Open Innovation experience can hinder the open innovation. Our research showed that negative previous experience is an important but neglectable barrier for companies. Only 42% of the companies agreed or strongly agreed to this question. We conclude that the companies rarely had have a negative previous experience to hinder open innovation activities.

No promotion from the government considered as a hindering factor in the literature. According to a study conducted in Canadian SMEs, authors put in evidence that the government incentives for R&D are important for innovation rate specifically. In their sample from Quebec, the authors find that the R&D and innovation intensity fail because of the lack of government incentives, compared to Ontario and British Columbia (L. A. Hall & Bagchi-Sen, 2002)

In our research, we saw that the respondent companies are fully confident about government promotions. Only 8% of our companies stated agreed or strongly agreed with this question

When the negotiation is too long (Barchi & Greco, 2018; Van De Vrande, de Jong, et al., 2009) companies may cut the procedure. In our research, we saw that 73% of the companies are agree or strongly agree to this cost-increasing reason as a barrier. This question is the most important barrier, for the companies

Sometimes, companies cannot find a good technology for the company (Lichtenthaler & Ernst, 2006, p. 380). In our research, we saw that 47% of the companies agreed or strongly agreed to this question. Most companies don't complain about the technology match with the partner company.

It can Reduce internal R &D capacity NIH but acquired from external sources, it will not be considered as a “real innovation”. (Lichtenthaler & Ernst, 2006, p. 376). In our study, we saw that the companies agree or strongly agree at 43%, however, remaining companies are disagree about this reason;

Sometimes companies find that other technologies are complicated to use and to understand (Flor et al., 2021). 61% of the companies agree or disagree about this motif, but not an important return for the companies.

Licensing-in is challenging for most companies because of the high transaction costs (Flor et al., 2021). This motif is one of the important reasons which hinders open innovation. 70% of the companies agree or strongly agree about the high prices hindering the effect on open innovation.

Table- 68 Inbound barriers

Inbound barriers	Str. Agree- Agree
Licensor involvement	55%
Licensor license overseas	70%
Don't trust	66%
Don't feel secure	33%
Bad preview experience	42%
No promotion	8%
Too long negotiation	72%
No good tech for us	47%
Reduce internal R&D	43%
Other's tech is complicated	61%
Transaction cost	65%

Outbound barriers

The cost and the complexity of IPR may create a barrier for companies in weak appropriability regimes. The appropriability is “*the possibility the owner of a resource has to capture a return equal to more than the value created by the resource*”(Dahlander, 2005). The appropriability regime is the protection of intangible assets by IPR or by other legal mechanisms (Hurmelinna & Jauhiainen, 2004)

If the knowledge is difficult to imitate and can be protected by IPR, then the appropriability is strong. However, if the knowledge is easy to imitate, and the IPR cannot protect efficiently, then the appropriability regime is weak (Hurmelinna & Jauhiainen, 2004).

Savitskaya et al. (2010) explain this possibility: While strong IPR promotes transactions in the technology market, a weak appropriability regime creates a knowledge leakage and can create a barrier to open innovation adoption. Accordingly, a weak appropriability regime will harm firms’ in-house R&D by decreasing innovation performance. This effect can spread all over the industry by creating a global reduction in innovation investment. To avoid this effect, one can expect that a strengthening effort in IPR can promote in-house R&D. So, the company’s open innovation adoption may depend on the IPR strength, costs, and level of formal arrangement difficulties (Savitskaya et al., 2010).

In our research, we saw that 70% of the respondent companies find that the IPR complexity creates a barrier to outbound open innovation. Different from Savitskaya (2010) in our research, IPR complexity came in fourth place among other barriers, where Savitskaya found it the most critical barrier, which is related to the “*weak IP protection and the complexity of IPR, (...) and underdeveloped state of technology markets*”. We can say that this situation has developed since then, and IPR complexity is still considered a barrier to open innovation but not as considerable as before.

The contract can be observed as complex because of different aspects. The complexity is relevant and related to its’s cost of design, writing, implementation, control and enforcement between the partners (Hagedoorn & Heslen, 2009). However, Hagedoorn et al. (2009) tempt to define contract complexity by referring to Simon (1981) definition as “*a large number of parts that interact in a nonsimple way, ... (where) ...the whole is more than the sum of its parts, not in an ultimate but pragmatical sense that, given the properties of the parts and the laws of their interaction, it is not a trivial matter to interfere the properties of the whole*” (Simon, 1981).

The authors approach the complexity from objective & subjective measures and the cognitive load.

Respectively, the objective & subjective measures are the length of the contract, the number of pages, etc. The cognitive load is defined as the invested mental effort of a person to process information. Accordingly, the cognitive load of the contract is the extent to which the parties can understand the meaning of the contract in terms of the formulation of phrases or demanded tasks etc. Finally, the authors put in evidence that not only the length of the contract is a vital complexity measure, but the mental workload is the most critical complexity criteria (Hagedoorn & Hesen, 2009).

In the same vein, Reuer et al. (2007) attract attention to the complexity of contracts where the contracts are asset specific such as transaction-specific investments. The partner can pressure the company to capture more value (Reuer & Ariño, 2007). Therefore, the contracts became more complex to define in detail the responsibilities, precise rights and duties of the parties, which also increases the success of a contract (Hoffmann & Schlosser, 2001).

In our research, we saw that contract complexity is a significant barrier. Nevertheless, it came in fourth place with the IPR complexity. We interpret this result as the companies' increased investment in R&D and Patent law department investment. The companies have more than one R&D law department, which increases the educated and well-formed worker numbers and creates a qualified workforce to reduce the cognitive complexity of the contracts. However, it is still a barrier to open innovation.

The negative attitudes toward outbound open innovation are called Not sold (or shared) here (NSH) attitudes; the attitude that the portfolio is not for share (Bianchi et al., 2014) reflects a protective attitude toward external technology exploitation (Burcharth et al., 2014; Lichtenthaler et al., 2010). It is related to the fear of losing companies' internal knowledge of the company's competitive advantage. More specifically, Amann et al. (2022) put in evidence that the reason for NSH attitude can be related to three causes: first, as Burchart (2014) advocate that it is related to the companies innovation culture, norms, values or principles which blocks the exploitation of technology. The authors describe this attitude as follows "*If NSH exists in this context, employees feel that if the knowledge or technology cannot be exploited in their products or markets, it should not be exploited at all*" (Burcharth et al., 2014, p. 151). In their research on technology transfer from start-up companies to parent companies

in the USA and Sweden, Amann et al. (2022) describe a new motivation of NSH as the “*fear of giving without receiving*” (Amann et al., 2022).

Our research showed that 85% of respondent companies replied that their patent portfolio is not for share. We interpret this result as a reflection of corporate culture. First, Chinese companies have just started to open up their innovation process, and the heredity-closed country culture is also embedded in individuals who are a part of the company.

Amann et al. (2022) re-group the NSH factors and state as follows: (1) confidentiality unawareness, (2) depreciation of knowledge, and (3) desire to monetize the knowledge. Reciprocally, confidentiality unawareness means the lack of awareness about what is confidential and what is not. This lack of unconfidence creates anxiety in individuals. he anxiety causes the loss of autonomy of the individuals because of not knowing what is confidential and what is not.

Depreciation of knowledge is the insecurity about procedural knowledge like collecting big data from the products (e.g. connected cars information in the HQ, which “the idea of collecting this information” can be copied by the visitor company). However, individuals consider domain-specific knowledge the main asset and feel insecure about sharing.

Finally, *the desire to monetize knowledge assets means* the willingness to catch the value from knowledge assets, specifically from IP (Amann et al., 2022, p. 8)-

The company's licensing strategies are limited by the "not sold here" syndrome by admitting that it is not the company strategy, which negatively correlates with external technology exploitation. Our research shows that 63% of companies agree or strongly agree with this finding. These companies are not very receptive to incorporating outbound open innovation into their strategy. Nonetheless, these companies do engage in outbound open innovation practices.

Licensing can produce a loss of control over core competence because of *unintended* knowledge spillover. Trott (2008) explains this effect as *an information-sharing-knowledge-loss dilemma* (Trott in. van Beers et al., 2008, p. 140). According to Trott (2008), companies must establish suitable trust and control instruments to overcome this risk. However, the loss of control is a perceived risk by the parties. Kline (2003) attracts attention to the potential risk of licensing the crown-jewel technologies, in other words, the company's core technology. The author put in evidence that strategic licensing is a fruitful business model

by considering the cost and gain of this move. Therefore, Kline (2003) adds that strategic licensing, when sharing companies' core competencies with competitors, should *complement the enforcement of patent rights* to keep a hand on the licensed technology (D. Kline, 2003). Enkel et al. (2009) also put in evidence from a survey with 107 European companies that the loss of knowledge and loss of control, and high complexity (41%) mentioned by the respondents as a risk in open innovation activities (Enkel et al., 2009)

In our research, we saw that the respondent companies mostly fear losing control of their patents. 97% of the companies agree or agree to lose control of their patents while outbound practices.

Our research showed that 74% of companies agreed or strongly agreed that their technology is not sufficiently developed yet. We can say that the companies have a negative attitude about their knowledge potential or stay reluctant to share their knowledge because of not knowing for sure if their portfolio can be considered a valuable asset in the market compared to other companies. From this point of view, we can refer to Amann (2022) about the depreciation of knowledge, which individuals insecurity feeling about sharing their knowledge.

In our research, the difficulty of finding a buyer doesn't receive much interest. Only 39% of the companies agreed or strongly agreed with this question. It remains in the seventh position as a perceived barrier by the companies (Bigliardi & Galati, 2016; Enkel et al., 2009; Savitskaya et al., 2010; Van De Vrande, Vanhaverbeke, et al., 2009; Verbano et al., 2015)

Table- 69 Outbound barriers

Outbound barriers	Str. Agree- Agree
IPR Complexity	70%
Contract complexity	70%
Not for share	85%
Losing control	97%
Against company strategy	63%
Technology not yet developed	74%
Difficult to find buyer	39%
Lack of previous experience	65%

The lack of previous experience or negative experience remain an important barrier; 65% of the companies replied agree or strongly agree on this question. We can say that the lack of previous experience creates a barrier to technology exploitation (Hoffmann & Schlosser, 2001)

9.2. The strategies of Chinese companies for using IP in the context of open innovation

We use cluster analysis to identify different Open Innovation strategies and to put in evidence possible specificities of Chinese companies' Open Innovation strategies. For this purpose, the Cluster analysis is used to identify the companies' exploitation strategies. Our goal is not to find if there are any defensive or offensive exploitation groups but rather to put in evidence the specificities of those groups (Tkaczynski A. in Dietrich et al., 2017)

To identify different groups of companies using Open Innovation Strategies and the possible specificities of those strategies. The cluster analysis was previously adopted by (Bengtsson et al., 2015, p. 79) to describe the relationship between different dimensions of openness. The authors analyzed explorative and exploitative knowledge and put in evidence three clusters. Again, to explore the influence of open innovation in SME's organization strategies, Van de Vrande et al. (2009) used cluster analysis to find typologies of different clusters (Van De Vrande, de Jong, et al., 2009, p. 430). Lazzarotti et al. (2010) used Cluster analysis to find the Open Innovation modalities in practice in Italian SMEs (Lazzarotti et al., 2010, p. 15).

In our study, we've adopted cluster analysis to identify the specificities of the exploitation strategies. The results show that there are two clusters that we can define Cluster 1, “defensive patenting, externally oriented exploitation, but active inbound patenting” companies, and Cluster 2, “defensive patenting, internally oriented patent use, but low level of openness”.

9.2.1. Defensive patenting and externally oriented exploitation

The results show that the external-oriented companies, consisting of 41,9% of our companies, are primarily private high-tech companies. Those companies were established after 1980 when the Chinese government started the economic structure to a planned socialist economy and established the State Intellectual Property Office (SIPO, which changed the name to CNIPA) (Shiraishi & Sonobe, 2019, p. 119). We observe that those companies are active mainly on the East Coast of China, where the patenting activity is high (He et al., 2018) and are big companies with a high turnover.

The patenting motivation of the companies in this Cluster is mostly to patent to protect their invention (2,9) (Blind et al., 2006; Somaya, 2016), to improve their image as a technology leader in the market (Ayerbe & Mitkova, 2006), and to have access in new markets (W. M. Cohen et al., 2002). Ayerbe et al. (2008) define defensive patenting strategy mainly as protecting companies' business against competitors and allowing the company to exploit their patented invention freely. Accordingly, the main difference between offensive and defensive patenting strategies is the willingness to extract maximum value from the patent by generating rent from the invention out of licensing revenues and the explicit use of the patents externally, aiming to extract maximum value from the invention.

In our research, we saw that external oriented companies, besides protection and improving image, are also looking to access new markets by patenting. Despite the latent motivation, which shows that the companies are not 100% looking for protection while patenting, the participant companies use patenting more generally for defensive purposes.

The results of the exploitation choice of the externally oriented companies show both internal and external exploitation motivations. The internal use of patents is for new product development (NPD). We can explain this behaviour by the technology market perception of the participant companies about the competition that there is a high NPD level in the market, the trade freedom in the market, too many companies in the market, and the high market growth, and the technological turbulence which makes difficult to forecast the market conditions shortly. We can confirm that the market turbulence and high level of NPD, as well as R&D activities, have a positive impact on the Open Innovation adoption of the companies, as well as on the patenting behaviour, more specifically, about the protective patenting behaviour of the companies (Blind et al., 2006, p. 657; Blind & Thumm, 2004; W. M. Cohen et al., 2000; Holgersson & Granstrand, 2017; Mahdian & Shahin, 2020).

Accordingly, the results of the cluster analysis confirm the inbound open innovation motivations of the externally oriented companies as follows: inbound licensing for time-saving (Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994), inbound licensing for entering a foreign market (Greul et al., 2018; Harhoff et al., 2014), and inbound patenting to have access in the new invention (Gassmann et al., 2018; Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994). The results show that externally oriented companies create partnerships with R&D institutes and universities for inbound open innovation, which is in line with the theory (Galvao et al., 2019;

Greco et al., 2016, 2017) which advocates that the external knowledge sources of governmental institutions are the complementary information and research channels for companies.

Also, the externally oriented companies' inbound licensing motivation is for cross-licensing, inbound licensing to have a large portfolio and to be able to license from patent pools as an inbound partner. Our findings align with the theory where the researches show that cross-licensing is a special way of license exchange between partners where there is a risk of blocking by other companies by competitors' patents. In that case, companies are seeking to reinforce their position. Therefore, having a rich patent portfolio is extremely important for both parties (Cheng & Huizingh, 2014, p. 1238).

The external-oriented companies approach the license (or patent) seller company. At the same time, inbound licensing or patenting and consider patenting outside the country their invention as an alternative protection, which shows the external orientation of those participant companies compared to the second group of the companies of our analysis.

Besides protective reasons related to market conditions, the externally oriented companies perceive that the IPR in the country is becoming increasingly complex, which creates a barrier to outbound open innovation and negatively affects the outbound Open Innovation decisions of the participant companies. Nevertheless, there is a strong patenting activity in the market, which is also pushing those companies to apply for a patent, both for protective reasons and to use it for non-pecuniary activities of external exploitation of patents, as described below. As the previous researches show earlier, the IPR complexity in a market is a significant barrier to a company's open innovation activity because of the increase in paperwork and the engagement of the personnel in the company (Savitskaya et al., 2010). It creates a barrier to outbound open innovation. On the other hand, the strong patenting activity in the technology market also influences all the companies in the same market. It promotes patenting and innovative activities as a market requirement (Lichtenthaler, 2010) but does not inevitably reinforce open innovation activities (Laursen & Salter, 2006, p. 145). Our results align with the theory that the R&D intensity in the market also promotes the R&D activities inside the company. However, it is not proven that the companies are licensing their IP externally where the IPR complexity is important and creates a barrier to outbound open innovation.

Nevertheless, the results show that those companies also use external exploitation of their patents, mostly for licensing agreements, to gain additional revenues. The IPR complexity has

a reduced effect on outbound Open Innovation motivation; however, the external use of patents for R&D contract establishment, use for M&A and create alliances with foreign groups are strongly related to the Government incentives and the inbound open innovation practice of those companies rather than the willingness to exploitation of patents offensively and to opening-up externally. The results show that participant companies find that the government promotes companies to work with universities and R&D institutes, to work with other companies for R&D purposes, and to work with consulting companies. On the other hand, the R&D collaboration and alliances with other companies are considered outbound activities of the companies in the previous literature. Nevertheless, the literature considers those activities as inbound activities by the locus of Open Innovation, and the second is the collaboration level of the parties (Elmquist et al., 2009, p. 340). The locus of open innovation means where the innovation process is realized, and the collaboration level explains the degree of collaboration between the parties. Pinarello et al. (2022) studied inbound open innovation activities from the

locus and collaboration level of the Open Innovation. The authors explain the level of integration of Open Innovation in company-level analysis by a multiple case study analysis of inbound open innovation practices and put in evidence that joint ventures can be considered inbound activity (Pinarello et al., 2022). Therefore, we can say that the results of using the patents of this group of companies show the willingness to “innovation inside the boundaries of the firm”, and the locus of innovation stays inside the boundaries.

Therefore, the partnership for a possible R&D collaboration is essential for those companies because of the significant government incentives and government policies aiming to increase the incremental innovation capacity of the Chinese companies. Respectively, the externally oriented companies collaborated with universities and public R&D institutions, collaborated with technology development zone companies, and directly contacted the company’s regional technology transfer office, using a consulting company for R&D collaboration as an intermediary. The results align with the theory for those trying to increase their incremental innovation and absorptive capacity of the firm (Spithoven et al., 2013; Zahra & George, 2002).

The externally oriented companies identify their outbound licensing partners according to the buyer company’s technology level and the buyer company’s reputation. These results are in line with the theory which confirms that the technology level of the company is important for the absorptive capacity level of the company to use effectively the exploited technology

(Cassiman & Veugelers, 2006) and the reputation of the partner company to reduce the uncertainty about the partner company while creating a partnership for outbound licensing (Barchi & Greco, 2018, p. 360). The externally oriented companies use seminars, direct contact with the buyer company, or use an agent as an intermediary while identifying their partner. Those companies feel free to take the initiative to approach the buyer company.

The companies in this first group use patents for protection purposes, mostly to access new markets and for protection. They are also using the patents to improve their image in the market.

The exploitation of the patents is made internally and externally. The internal exploitation is for NPD and the establishment of R&D contracts. The R&D collaboration is particularly important for the companies in this cluster because the coefficients of R&D collaboration partners are significant only in this cluster. The collaboration partner choice results show that the companies in this cluster pay attention to collaborating with universities, R&D institutions, Regional technology transfer offices, technology development zone companies, consulting companies, or companies they contact directly.

The external exploitation of the patents is various. The companies in this cluster use their patents for M&A agreements, alliances with foreign companies, and license selling.

The open innovation modalities in this cluster show that they are active in inbound and outbound activities. Concerning inbound activities, the companies' motivation is time-saving by licensing a technology, having access to a new invention easily, and accessing a foreign market. The companies in this cluster use inbound open innovation to increase their portfolio to use this latter in cross-licensing. The companies in his cluster consider approaching the seller company.

The R&D collaboration and investments by patents for cross-licensing are important criteria to consider this cluster as a protective-closed innovator cluster.

Nevertheless, this cluster uses outbound innovation activities also. The only motive for licensing out is to have additional revenue. The technology level and the reputation of the partner company are important criteria for those companies. The companies in this cluster approach the partner using seminars, agents, or direct contact with the partner company.

The market perception shows that the companies in this cluster find the market competitive in terms of the number of competitors, NPD speed, intense patent activity, high market growth, and the difficulty in forecasting technological improvement in the market. The companies also consider the openness and globalization effect in the market by increasing trade freedom. Nevertheless, the companies consider the IPR complexity existing in the market.

9.2.2. Defensive patenting and internally oriented exploitation

The internally oriented group of companies is 58,1% of our companies and is composed mainly of public, high-tech companies established before 1980 and active in every region of China. Those companies are specifically concentrated in northern China's machinery and equipment industry and are big companies with a high turnover. Nevertheless, the private companies in this Cluster are established after 1980, active in eastern China. Their exportation level is around 10-50% of their turnover but remains lower than the previous cluster's private companies' exportation level.

The patenting motivation of an internally oriented group of companies is far more defensive than the previous group of companies. Respectively, those companies patent to protect their invention, access new markets, and improve their image. We saw that the companies in this cluster are also patenting for defensive purposes.

The exploitation choice of the companies is particularly to use patents internally for new product development (3,77). The reasons for the NPD activity in this cluster is more intense than in the first cluster, as well as the perception of the technology market dynamics, respectively the trade freedom in the market, IPR complexity, high NPD level in the market, high number of competitor companies in the market, strong patent activity, and high market growth of the technology market. As in the previous group, our results are in line with the theory which confirms that the high market dynamics (turbulence) promote NPD level and R&D activities of the companies and the patenting behaviour (Blind et al., 2006, p. 657; Blind & Thumm, 2004; W. M. Cohen et al., 2000; Holgersson & Granstrand, 2017; Mahdian & Shahin, 2020).

The inbound licensing motivation of those companies is to use inbound licensing for time-saving (Gassmann & Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994), , inbound patenting to access new inventions (Gassmann et al., 2018; Gassmann &

Enkel, 2004; Kapetaniou & Lee, 2019; Laursen & Salter, 2006; Rothwell, 1994). , to enter a foreign market (Greul et al., 2018; Harhoff et al., 2014).

Inbound licensing to use for cross-licensing and to have a big license portfolio which also confirms the theory for the importance of having a large patent portfolio to be able to sign cross-licensing agreements and to be able to use those portfolio as a bargaining chips for license exchange (outside-in,) from the partner's pprtfolio and the results show that this willingness of inbound licensing is higher than the first group of companies (Cheng & Huizingh, 2014, p. 1238).

However, the companies in this cluster consider R&D collaboration slightly less than the first group of companies. The companies in this group consider mostly R&D collaboration with universities (2,42), R&D institutes (2,3), technology development zone companies (2,25), and directly contacting the partner company. However, their collaboration willingness remains less than the externally oriented group of companies. For the same reasons, the governmental incentives positively impact R&D collaboration decisions; however, the promotions don't have the same influence on the group of companies since the majority of this cluster is composed of public companies. The companies in this group approach the licensing partner but less willingly than the first group of companies compared to the previous group of companies.

The external exploitation of this group of companies is only for use in the establishment of R&D contracts and for licensing. However, both reasons are far less than the first group of companies, which confirms that the company's openness level is lower than the first group.

The outbound licensing motivations of this group are only selling licenses to get additional revenue. This response is far higher than the first group of companies, which shows that the companies in this group consider the outbound open innovation, particularly IP licensing, as an additional revenue source and not open for other types of outbound open innovation modalities.

This group of companies identify their outbound licensing partners by the company's technology level (3,78) and the reputation of the buyer company (3,69). These results are in line with the theory confirming that the technology level of the company (Cassiman & Veugelers, 2006) and the reputation of the partner company reduce the uncertainty about the partner company while creating a partnership for outbound licensing (Barchi & Greco, 2018, p. 360) are important.

Since the group consists of mainly public companies, we saw that the government incentives are not as much influencer as the first group of companies. More specifically, internally oriented companies find that the government promotes working with other companies instead of governmental entities because it is not difficult for public companies to reach governmental entities such as R&D institutes and universities..

9.3. The specificities of these choice of exploitation of the patent portfolio

9.3.1. Patenting motivations and Open Innovation

The CART analysis in SPSS gave us the results of patenting reasons characteristics. We have studied these results according to the relationship order.

Investigating the different patenting motives gave us different patenting behaviour patterns. We have investigated five motives: protection, bargaining, improved image, internal reasons, and attracting financial resources. The protective patenting may be because of offensive or defensive reasons. Defensive reasons are to protect companies' monopolistic position, improve the image and set standards in the market to maintain the monopolistic structure. Whereas the offensive reasons aim to use the IP as much as possible externally to capture value from the IP. More specifically, the use of patents for cross-licensing, access to new markets, creating alliances etc considered an offensive use of patents (Ayerbe, 2016, p. 94).

Table- 70 Patenting motivation in open innovation

Use	First degree relationship	Second degree relationship	Third degree relationship	Fourth degree relationship	Patenting behaviour
Access in new markets	Inbound patenting for easy access to a new invention	The patent citation in the database while inbound licensing ----- Inbound licensing to work as a manufacturer for the licensor company	Government offers guidelines for S&T activities		Defensive- cost and time reduction to access in the market- internal use of licenses
Protect our business	Too many companies in our market	The reputation of the buyer company while outbound licensing	We don't trust other companies' technological competencies for inbound licensing		Defensive- market competition
Block our rivals to compete	Bad previous inbound licensing experience	Inbound licensing the already proved technology	Working as a manufacturer for licensor company that we bought the license		Defensive- lack of inbound experience and lack of trust- internal use of licenses
It reduce the imitation risk	Outbound licensing to access in foreign markets	Presentation of papers in seminars while identifying their partner	Inbound licensing for cost reduction		Offensive- cost and time reduction
Setting standards in the market	Inbound licensing for cost reduction	There is no adequate technology for us in the market ----- Government promote us to work with universities , R&D institutes			Defensive- cost reduction and increase internal R& - uncertainty through external knowledge
We are using as a negotiation tool for cross-licensing	Inbound licensing from R&D institutes	The reputation of the licensor company while inbound licensing			Defensive- Increase absorptive capacity- uncertainty through external knowledge- Not very open
To build a strong patent portfolio	The government promoting us to work with consulting companies	The government financial policy creates an advantage for us ----- The government tax policy supports us to reduce R&D costs			Defensive- Government influence to increase indigenous innovation capacity
Improve our image	Inbound licensing to enter a foreign market	Using patents as a protection tool	Inbound licensing for cost reduction		Defensive- Inbound licensing to access new market and cost reduction- Patenting
Measuring our innovation performance	We don't see any good technology offer in the market for inbound licensing	Technology level of the buyer company while outbound licensing	R&D collaboration with universities	The reputation of the licensor company while inbound licensing	Defensive- internal- increase absorptive capacity- reluctant to external knowledge
It motivates our R&D department and our researchers	Using utility model as an alternative protection	Inbound licensing the already proved technology - ----- Inbound licensing to reduce time to market	The risk that the licensor involve our R&D process	We prefer collaborating with universities while doing R&D collaboration	Defensive- Cost and time saving for IP protection- Increase absorptive capacity
To use government incentives	Collaborate with the technology development zone companies for R&D collaboration	The IP became more complex ----- Product complexity as an alternative protection	Too many companies in our market	(Inbound licensing) other companies' technologies may reduce our innovation capacity	Government policy to push companies working with Tech- devp zone cmp- increase indigenous innovation

Patent use for protection in the Open Innovation process

The protection motives are targeting the protection of innovation, maintaining monopoly power, blocking competitors, reducing imitation risk of the product, and standard setting in the market to maintain the monopoly advantage (Ayerbe & Mitkova, 2008; Holgersson & Granstrand, 2017). Below, the results of this behaviour are shown.

Patenting for having access to a new market

The companies patenting their invention “to access a new market” are more likely to consider “inbound patenting for easy access to a new invention.” The second relationship is with “the patent citation in the database while inbound licensing” and “inbound licensing to work as a manufacturer for the licensor company.” The third-degree relationship is with the “government offers guidelines for S&T activities.”

Using patents to access new markets can be considered offensive or defensive according to the behaviour under this choice. In this case, we can see that the companies willing to access new markets by patenting are more likely to consider increasing their R&D capacity by inbound licensing to reduce cost and decrease the time to market (Gassmann et al., 2018). Also, those companies consider the patent citation in the patent database as an essential criterion while inbound licensing external knowledge; they seek to understand the economic and technological value of the patent they buy (Jaffe & De Rassenfosse, 2017). Then, we observe that companies are more likely to have inbound licensing for working as a manufacturer for the licensor company, which limits the use of the license exclusively for one company’s production (Azzam et al., 2017). We can say that the use of patents to access new markets lies behind defensive-protective behaviour.

Patenting to protect company business

The companies patenting their invention to “protect business” are more likely to consider “too many companies in our market.” The second relationship is with “the reputation of the buyer company while outbound licensing.” The third-degree relationship is with “we do not trust other companies’ technological competencies for inbound licensing.”

Using patents to protect the business is considered a protective motive for patenting. In this research, we saw that companies using patents for protection perceive a high competence in the market, which positively affects open innovation (Lichtenthaler, 2009b). We observe that

those companies are more likely to consider the buyer company's reputation while selling the license to reduce uncertainty (Barchi & Greco, 2018, p. 360). However, inbound licensing is limited because of the lack of trust in technologies developed by other companies, and the uncertainty of the technology level of the seller company hinders inbound licensing (Oduro, 2020). We can say that the market turbulence, the high number of competitors, and the uncertainty push those companies to adopt defensive-protective behaviour.

Patenting to block rivals from competing

The companies patenting their invention "to block our rivals from competing" are more likely to consider "bad previous inbound licensing experience." The second relationship is with "inbound licensing the already proved technology." The third-degree relationship is with "working as a manufacturer for licensor company that we bought the license."

Blocking rivals is also considered a protective choice of patenting. In our research, companies using patents to block rivals are more likely not to have enough inbound licensing experience because of a negative previous experience (Dziurski & Sopińska, 2020, p. 318). At the same time, those companies also prefer to buy already proven technology to reduce the uncertainty and the time to market (Gassmann et al., 2018). Finally, inbound licensing for working as a subcontractor for the licensor company is also essential for those companies (Azzam et al., 2017). We can say that the negative previous inbound experience while hindering the inbound activity, does not limit the open inbound innovation. Those companies reduce the uncertainty risk by using already proven technology inbounding, and working exclusively for licensor companies, adopting defensive-protective behaviour.

Patenting to reduce imitation risk

The companies patenting their invention "to reduce imitation risk" are more likely to consider "outbound licensing to access foreign markets".

The second relationship is "presentation of papers in seminars while identifying their partner". The third-degree relationship is with "inbound licensing for cost reduction".

Reducing imitation risk is also considered a protective use of patents. Our study showed that companies patenting to reduce imitation risk are likelier to consider outbound licensing to access foreign markets (Lichtenthaler, 2007). Companies increase their knowledge when they have access to foreign markets, and outbound licensing creates new opportunities to partner

with the licensee and access new markets (Y. Wang, Roijakkers, et al., 2012). Those companies are more likely to use seminars to communicate their innovative activities and find a partner without rival involvement (Kutvonen et al., 2010; Landry et al., 2013, p. 447; Laursen & Salter, 2006). Finally, they are more likely to use inbound licensing for cost reduction (Gassmann et al., 2018; Spithoven et al., 2013). The outbound licensing to access new markets and inbound licensing to reduce R & D costs show that those companies are more likely to adopt offensive-protective behavior.

Patenting for standard setting in the market

The companies patenting their invention “for standard setting in the market” are more likely to consider “*inbound licensing for cost reduction*”. The second relationship is “*there is no adequate technology for us in the market*” and “*government promote us to work with universities , R&D institutes*”.

The standard setting is considered a defensive use of patents. Those companies use more likely inbound licensing for cost reduction (Gassmann et al., 2018; Spithoven et al., 2013) and do not consider inbound licensing by the pretext that there is no good technological offer for them. The theory put in evidence that the lack of experience may create a barrier for inbound licensing either because of lack of knowledge- internal knowledge is not enough to process external knowledge- (Bigliardi & Galati, 2016; Van De Vrande, de Jong, et al., 2009), or because of the uncertainty about the external knowledge (Lichtenthaler & Ernst, 2006, p. 380). We can say that the inbound licensing for cost reduction and barrier to inbound licensing can be considered defensive-protective behaviour.

Patenting for use as a negotiation tool for cross-licensing

The companies patenting their invention “as a negotiation tool for cross-licensing” are more likely to consider “*inbound licensing from R&D institutes*”. The second relationship is with “*the reputation of the licensor company while inbound licensing*”.

The companies using their patents as a negotiation tool in cross-licensing agreements are more likely to consider inbound licensing from governmental entities, such as R&D institutes, to increase their indigenous innovation and absorptive capacity (Brunswick & Vanhaverbeke, 2015; Fu et al., 2016). The reputation of the licensor company while inbound licensing is an important criterion while inbound licensing. As previously shown, reputation reduces uncertainty and is important for both parties for R&D collaboration (Lichtenthaler & Ernst,

2007; Van De Vrande, de Jong, et al., 2009). We can say that the inbound licensing for cost reduction and barrier to inbound licensing can be considered defensive-protective behaviour.

Patenting to build a strong patent portfolio

The companies patenting their invention “to build a strong patent portfolio” are more likely to consider “*the government promoting us to work with consulting companies*”. The second relationship is “*the government financial policy creates an advantage for us*” and “*the government tax policy supports us to reduce R&D costs*”.

According to the antecedents of this behavior, patenting to build a strong portfolio is considered in both an offensive and defensive attitude. If the company wants a strong portfolio to maintain its monopolistic position in the market as a standard setter, it is considered to have a defensive mindset. However, it is regarded as an offensive attitude if the company wants a strong patent portfolio to attract companies for cross-licensing. In our case, the companies using the patents to build a strong portfolio are more likely to consider the government promotions essential to working with consulting companies. The literature shows that consulting companies’ neutrality is critical to creating equilibrium between partner companies to establish sustainable communication and a partnership, especially during inbound licensing (Bianchi et al., 2016). The government’s financial policy and tax policy promotions were based on increasing the indigenous innovation potential of the companies in China (L. A. Hall & Bagchi-Sen, 2002). Those companies patenting to have a strong portfolio are looking to increase internal R&D capacity with the help of government incentives. Therefore, the government incentives to increase innovation activity (indigenous innovation) can be considered defensive-protective behaviour.

Patenting to use government incentives

The companies patenting their invention “to use government incentives” are more likely to consider “collaborate with the technology development zone companies”. The second relationship is “the IP became more complex” and uses “product complexity as an alternative protection”. The third-degree relationship is with “too many companies in our market”. The fourth-degree relationship is with “(inbound licensing) other companies' technologies may reduce our innovation capacity”.

The government incentives in China are a high motivator factor for patenting. The literature shows that those incentives positively affect patent applications by reducing taxes; however, they harm patent quality (Prud'homme & Zhang, 2019). We saw that the companies patenting to use government incentives are more likely to consider collaborating with technology development zone companies. As a reminder, technology development zones are the science hubs that the Chinese government started to promote through S&T programs to improve innovation (Fu, 2015, p. 15; L. Li et al., 2019). IP amelioration make it more complicated and require detailed paperwork, which increases the application time and complicates the application process. Especially in emerging economies, the IPR complexity creates a significant barrier to patent applications (Mazzoleni & Nelson, 1998, p. 278). Meanwhile, companies consider also product complexity as alternative protection for IP and find that the competition in the market is significant (the number of companies in the market). Also, companies need to be more open to inbound licensing for fear of reducing the company's innovation capacity. The companies patenting to attract financial resources are more likely defensive- protective- seeking to increase internal R & D level and indigenous innovation capacity.

Patenting to measure Innovation performance

The companies patenting their invention "to measure innovation performance" are more likely to consider as a barrier: "We do not see any good technology offer in the market for inbound licensing". The second relationship is with the "technology level of the buyer company while outbound licensing". The third-degree relationship is with "R&D collaboration with universities". The fourth-degree relationship is with "*the reputation of the licensor company while inbound licensing.*"

Patenting to measure innovation performance is considered an internal motivation for patenting. The companies who are using this as a tool of a performance measure are more likely to consider no good technology in the market for inbound licensing (Bigliardi & Galati, 2016; Van De Vrande, de Jong, et al., 2009) or because of the uncertainty about the external knowledge creates a barrier for those companies (Lichtenthaler & Ernst, 2006, p. 380). Those companies use the company's technology level when out-licensing their IP. The level of absorptive capacity is an essential criterion for the seller company (Cesaroni, 2004; W. M. Cohen & Levinthal, 1989). Those companies are more likely to collaborate with universities to increase their indigenous innovation level and absorptive capacity (Fu et al., 2016). Besides

absorptive capacity level, the licensee's reputation is a significant criterion for those companies while outbound licensing (Barchi & Greco, 2018, p. 360). We can say that the barrier in the inbound licensing reputation of the licensee is a criterion, and R&D collaboration with universities can be considered defensive-protective behaviour

Patenting to motivate R&D department

The companies patenting their invention "to motivate R&D department" are more likely to consider "*using utility model as an alternative protection*". The second relationship is with "inbound licensing the already proved technology" and "inbound licensing to reduce time to market". The third-degree relationship is with "the risk that the licensor involves our R&D process". The fourth level is "*we prefer collaborating with universities while doing R&D collaboration*".

Those companies using patents to motivate R&D department workers are more likely to use the utility model to reduce the time for the obtention of protection and because of the cost advantage (Prud'homme, 2017) and also, the utility model protection applications are less complicated than patent application (Beneito, 2006; WIPO, 2023). Those companies also consider inbound licensing for reducing the time to market and uncertainty by using already proven technology when inbound licensing (Gassmann et al., 2018; Van De Vrande, de Jong et al., 2009). These variables show that those companies are interested in being in the market quickly, which can also motivate the R&D workers to see their invention take part in the market. However, those companies consider as a barrier to inbound licensing the rival involvement in their R&D process (Coras & Tantau, 2014; Oumlil & Juiz, 2016; Sulaymonov & Du, 2020). Considered a part of NIH's attitude, the fear of the involvement of an external party in their business show also a protective behaviour through external information when it comes from a company that they do not have previous knowledge, previous cooperation, or partnership. When there is uncertainty, the willingness to collaborate with universities for R&D shows that those companies seek to increase their internal knowledge and absorptive capacity (Fu et al., 2016). Using a utility model for alternative protection, inbound licensing to reduce time to market, and already proven technology to reduce uncertainty, the reluctance through inbound licensing by fear of an external party's involvement can be considered a defensive-protective attitude.

Patenting to improve image

The companies patenting their invention "to improve their image" are more likely to consider "inbound licensing to enter a foreign market". The second relationship is with "using patents as a protection tool". The third-degree relationship is with "inbound licensing to for cost reduction"

Those companies are more likely to use inbound licensing to enter a foreign market (Harhoff et al., 2014) to have access the foreign technology quickly and to be able to work in foreign markets without infringement risk. Also, those companies consider patenting the most critical IP protection choice besides secrecy or lead-time advantage (Mitkova & Ayerbe, 2004). Inbound licensing for cost reduction (Gassmann et al., 2018; Spithoven et al., 2013). The inbound licensing to access foreign markets and inbound licensing to reduce R & D cost show that those companies are more likely to adopt defensive-cost reducing behaviour.

9.3.2. IP modalities and IP exploitation decisions

The CART analysis in SPSS gave us the results of its algorithm which put in binary form the responses and show a behaviour tree. The results show different behaviours. The exploitation behaviour of the companies is shown as follows:

Table- 71 Patent strategy in open innovation processes

Use	First degree relationship	Second degree relationship	Third degree relationship	Fourth degree relationship	Exploitation behaviour
Internal use					
Stocking for str use	The companies in our market has a strong patent activity	Prefer to collaborate with public R&D institutions	Inbound patenting the complementary technology	Outbound licensing is not a part of our company strategy	Stocking patent to protect internal R&D- inbound patenting to increase internal R&D
Stocking for NPD	The reputation of the licensor company while inbound licensing	Technological development in the market pushes us for NPD	There is no adequate technology for us in the market		NPD- Reduce uncertainty by using information second hand (reputation) while inbound licensing
External use					
R&D contracts	Government promotions for working with universities and R&D institutes	Potential R&D collaboration with licensor company is important	Potential R&D collaboration with licensor company is important		Increase internal absorptive capacity by collaboration and increase R&D capability
Patent pool	Other technologies are too complicated for us while inbound licensing	Inbound licensing for cost reduction ----- We're inbound licensing from a patent pool			Lack of licensing experience. Uncertainty. Decrease cost and decrease infringement risk & uncertainty
Joint Venture-M&A	Reputation of licensee company is important while outbound licensing	Lead time advantage as an alternative protection ---- Use of utility model	R&D collaboration with Universities		Increase information about the partner (reputation), and absorptive capacity by collaborating with universities
Long term alliance with foreign comp	Government promote to work with universities or R&D institutes	Bad previous inbound licensing experience --- Lead time advantage as an alternative protection	Outbound licensing to work with a subcontractor		Increase internal R&D and absorptive capacity . Uncertainty about the local knowledge
Licensing	Took initiative to approach to the licensor company while they are inbound licensing	Inbound licensing from independent companies ---- Prefer R&D institutes for R&D collaboration	Using utility model as an alternative protection	Inbound licensing for cost reduction	Slightly open behaviour by approaching to he seller company, Looking for gain time and reduce cost for IP protection (Utility model)

Investigating the internal and external use of patents gave us different exploitation strategies and behavior of patent use. We've investigated two internal use cases, stocking inside the company for strategic use and stocking for new product development (NPD). We saw that both behaviour lay behind protective and defensive attitudes.

Internal IP exploitation decision**Stocking patents for strategic use**

The first results show that companies stocking their patents for strategic use are more likely to consider market turbulence, prefer R&D collaboration with public R&D institutes, and do not prefer outbound licensing. We can interpret this decision tree as the market's high R&D activity more likely influences the Chinese companies' IP stocking decision. This decision does not align with Lichtenthaler (2008), which suggests that the high R&D activity in the market increases the open innovation modalities and pushes companies to exploit their patents. However, the Chinese companies' IP stocking decision is more likely influenced third degree by the inbound patenting of the complementary technology to increase their internal R&D capacity and to produce internally (Gassmann et al., 2018, p. 91) and fourth degree by the outbound barrier, which is IP selling as “not our company strategy” which Lichtenthaler (2010) define in NSH attitude towards outbound licensing. The companies use IP stocking inside the company as a defensive-protective behaviour.

Using patents for product development

The second result shows that companies stocking their patents for internal use of NPD are more likely to consider the seller company's reputation while inbound licensing; significant technological turbulence in our market pushes us to do more NPD; there is no adequate technology for us while inbound licensing. The reputation of the licensor company is significant for the buyer companies. Those companies are more likely to use their patents inside the company for NPD when the other companies in the market also do NPD, and the technological change speed is high. However, since reputation is the first-degree criterion for those companies while inbound licensing, it is acceptable that “there is no adequate technology for us” is a sufficient barrier. At the same time, the most important is the reputation of those companies.

This result aligns with the theory regarding reputation, while inbound licensing is essential for companies to reduce uncertainty (Lichtenthaler et al. (2007)). The environmental factors are also critical for inbound licensing decisions because the high speed of technological change pushes the companies to gain time to get in the market (Popa et al., 2017; Teece, 2007) and more specifically for NPD, the market dynamics are crucial (Mahdian & Shahin, 2020, pp. 418–419). On the other hand, companies can either find that the technical quality offered in the

market for inbound licensing is either complicated (Flor et al., 2021) or different from their current technology, and consequently, the knowledge capacity of the workers does not enough to comprehend (Bigliardi & Galati, 2016; Van De Vrande, de Jong, et al., 2009), or they use it as a pretext because of the insecurity feeling through external knowledge (Lichtenthaler & Ernst, 2006, p. 380). This behaviour can be considered an inbound defensive practice when questioning the “keeping IP inside the company for NPD” decision. The companies use IP stocking inside the company as a defensive–protective behaviour.

External IP exploitation decision

To understand external exploitation behaviour, we have investigated the use of patents for R&D contracts, patent pools, joint ventures or M&A, long-term alliances, and licensing agreements. We saw that companies using external exploitation are more likely to decrease R&D costs and increase internal R&D and indigenous innovation capacity. In other words, we noticed that all behaviour lay behind cost-reducing and protective attitudes.

Using patents for R&D contracts

The companies using their patents for “establishing R&D contracts” are more likely to consider the “government promotions for working with universities and R&D institutes” as important factors and have the highest relationship. The second relationship is with “potential R&D collaboration with licensor company is important,” and the third is with “inbound patenting the complementary technology.”

The government promotions to increase the indigenous innovation capacity of the companies (Galvao et al., 2019; Greco et al., 2016, 2017) are most generally done with the university and government R&D institutions collaboration. The companies’ behaviour shows that the patents are used to establish R&D collaboration and work with governmental institutions (Muzamil Naqshbandi & Kaur, 2014). Our research shows that companies that use patents for R&D collaboration (Mitkova, 2009) are more likely to use governmental entities to collaborate and use inbound licensing as a potential R&D collaboration starter (Y. Wang et al., 2013; Y. Wang & Li-ying, 2015). Also, inbound licensing allowed the companies to access complementary technology while collaborating with other companies (Caviggioli & Ughetto, 2013; Gassmann et al., 2018; Gassmann & Enkel, 2004; Lichtenthaler, 2010; Spithoven et al., 2013; Toma et al., 2016). This behaviour aligns with the theory and can be considered an offensive external use of patents to establish R&D collaboration with inbound licensing. However, inbound

licensing is used to increase the internal R&D and not to exploit the IP itself. Therefore, this can be considered offensive-protective behaviour.

Using patents in a patent pool

The companies using their patents “*in a patent pool*” are more likely to consider “*other technologies are too complicated for us while inbound licensing*” and have the highest relationship with this variable. The second relationship is with “*inbound licensing for cost reduction*” and “*we are inbound licensing from a patent pool.*”

Using a patent pool is a way to create collaboration and allows both parties to use the licenses of the counterpart without infringement risk (Ernst et al., 2016). In our research, we saw that companies using their patents in a patent pool are more likely to consider that the technologies offered in the market are complicated for them and are more likely to be conscient about their lack of knowledge, which limits their inbound licensing because of the “complexity of the external knowledge.” However, using a patent pool helps the companies to cover up their weakness and increase their tacit knowledge level (Oduro, 2020). In the Chinese context, the patent pool is more secure for those companies because the patent pool also gives the possibility of tacit knowledge transfer and the know-how of the counterpart through daily connections (Ayerbe & Mitkova, 2006). Also, companies are more likely to use inbound licensing to reduce R&D costs. This behaviour aligns with the theory and can also be considered offensive-protective use of patents.

Using patents for joint venture or M&A agreement

The companies using their patents for M&A are more likely to consider that the reputation of the “reputation of licensee company is important while outbound licensing”. The second relationship is with alternative protection use as “lead-time advantage” and the “use of utility model”. The third relationship is with “R&D collaboration with Universities”.

The joint venture and M&A are considered collaborative R&D (Holgersson & Granstrand, 2017, p. 1270) and positively correlated with the company’s size. In our study, we observe that the companies using outbound licensing for joint ventures or M&A agreements find the reputation of the partner company very important. Turbulent market conditions and uncertainty may push companies to be more careful. Reputation, considered secondhand information about the partner company, is the first variable companies generally take in hand (Barchi & Greco, 2018, p. 360). The lead-time advantage and the utility model are considered alternative

protection tools for IP. Hall et al. (2014) find that lead time advantage or secrecy is a strategic tool when the market is turbulent and the IP protection is not strong enough (B. Hall et al., 2014). However, the utility model is highly used in the Chinese context. Because of the low cost and speed obtention process of this protection for product innovation, companies use it to go rapidly in the market (Beneito, 2006; WIPO, 2023). R&D collaboration with governmental entities such as Universities is essential for the indigenous innovation promotion that the Chinese government promotes to collaborate with to increase the companies' knowledge and indigenous innovation capacity (Fu et al., 2016). We consider this attitude to improve absorptive capacity and learn about the partner company's offensive-protective use.

Using patents for long term alliances with foreign companies

The companies using their patents for long-term alliances with foreign companies are more likely to consider that the “government promote to work with universities or R&D institutes”. The second relationship is with “bad previous inbound licensing experience” and “lead-time advantage as an alternative protection”. The third relationship is “outbound licensing to work with a subcontractor”.

The long-term alliance is also considered an R&D collaboration, like a joint venture. Companies seek to retain long-term alliances when it benefits both parties, first because it reduces uncertainty, and second, it helps both parties use their IP effectively when their goals are parallel to each other (Roy & Sivakumar, 2011). Our research observed that companies using their patents for long-term alliances are more likely to consider the government R&D collaboration promotion with universities important. In emerging economies, the government promotions to increase indigenous innovation capacity and absorptive capacity if companies do government promotions (Galvao et al., 2019; Greco et al., 2016, 2017). On the other hand, those companies consider lead time advantage as alternative protection and do not have much inbound experience. Those choices put evidence that the companies are looking to gain time to get into the market by using lead-time advantage (Gallié & Legros, 2012), and stay reluctant for inbound licensing under the pretext of they have a previous negative inbound licensing experience (Dziurski & Sopińska, 2020, p. 318). However, those companies consider out-license their IP for working with the licensee company as their subcontractor for manufacturing. This behaviour shows that those companies prefer to work as licensors and reduce the risk of uncertainty and production costs (Gassmann & Enkel, 2004). We consider

this attitude offensive but protective of improving absorptive capacity and reducing uncertainty.

Using patents for licensing purposes

The companies using their patents for licensing are likelier to consider that they “took the initiative to approach the licensor company while inbound licensing”. The second relationship is with “inbound licensing from independent companies” and “prefer R&D institutes for R&D collaboration”. The third-degree relationship is with “using utility model as an alternative protection”, and the fourth is with “inbound licensing for cost reduction”.

Licensing is considered the pecuniary form of open innovation (Chesbrough & Brunswicker, 2013) and may provide different types of users to the company to use their IP externally. In our research, companies using their patents for licensing are more likely to approach the licensor company while inbound licensing. This attitude shows that those companies are open to inbound innovation. Then, we saw that those companies are more likely to consider inbound licensing from independent companies and prefer R&D institutes for collaboration. We understand that those companies, contrary to others, took the initiative and risk to approach the seller company, even if they do not have previous experience; however, for R&D collaboration, governmental entities such as universities are more secure and beneficial for those companies. As mentioned previously, the role of governmental entities is undeniable in emerging economies (Brunswicker & Vanhaverbeke, 2015; Fu et al., 2016). Utility model use is beneficial for Chinese companies. It reduces cost and time to market (Prud’homme, 2017). Inbound licensing is a cost-reduction way for those companies (Flor et al., 2021). We consider this attitude offensive and open by improving absorptive capacity, reducing time to market, and cost-saving.

Conclusion of Chapter 9

In this chapter, we introduced the synthesis of the results and discussed them vis à vis the existing literature.

For the first question of our research, we saw that Chinese companies use the same protection tools like patents and secrecy (W. M. Cohen et al., 2000), utility model (Prud'homme, 2017), but not patenting abroad (Archontakis & Varsakelis, 2017).

The external factors for patenting, such as competition level, trade freedom (Popa et al., 2017), and government incentives to promote R&D activities, are important, as the literature suggests (Fu, 2015; Savitskaya et al., 2010; Y. Wang, Zhou, et al., 2012). Specifically, the government's incentive to collaborate with other companies is important in the Chinese context.

All patenting motivations include entry into new markets (W. M. Cohen et al., 2002). Another motivation is to protect their business interests (Blind et al., 2006; Holgersson & Granstrand, 2017) and reduce the risk of imitation (W. M. Cohen et al., 2000; Gassmann et al., 2010; Lichtenthaler, 2009b). Patents also serve as a means to block competition (Ayerbe, 2016; Ayerbe & Mitkova, 2013) and enhance the company's image (James et al., 2013; Pénin & Neicu, 2018). Companies also use patents to measure their innovation performance and motivate their R&D departments internally (Blind et al., 2006; Holgersson & Granstrand, 2017). Additionally, patents are employed as a negotiation tool for cross-licensing (Blind et al., 2006; Holgersson & Granstrand, 2017), to establish a strong patent portfolio (Blind et al., 2006; Holgersson & Granstrand, 2017), and to set standards in the market (Blind et al., 2006; Holgersson & Granstrand, 2017) These actions give companies leverage in future negotiations. Lastly, companies also benefit from government incentive (Blind et al., 2006; Holgersson & Granstrand, 2017) align with the literature

The inbound motivations namely access to a new inventions (Gassmann et al., 2018), blocking rivals (Grimpe & Hussinger, 2008; Holgersson & Granstrand, 2017), or obtain access to complementary technologies (Gassmann et al., 2018; Gassmann & Enkel, 2004; Spithoven et al., 2013). search to expand their portfolio (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016), gain access to complementary technologies (Caviggioli & Ughetto, 2013; Lichtenthaler, 2010; Toma et al., 2016), making cross-licensing agreements (Davis, 2008), reduce R&D expenses (Gassmann et al., 2018; Gassmann & Enkel, 2004), to gain access to new technology (Gassmann & Enkel, 2004; Kapetanidou & Lee, 2019; Laursen & Salter, 2006;

Rothwell, 1994), acquire proved technology (Chesbrough & Crowther, 2006), expanding into foreign markets (Greul et al., 2018; Harhoff et al., 2014), and subcontracting licensor (Azzam et al., 2017; Gassmann & Enkel, 2004) also align with the literature.

However, for outbpuund motivations, as stopping related activities (Caviggioli & Ughetto, 2013; Monk, 2009; Zuniga & Guellec, 2009), selling of technology that is not part of the core technology (Caviggioli & Ughetto, 2013; Monk, 2009), or simply aligning with their overall business strategy (Caviggioli & Ughetto, 2013; Kutvonen, 2011), making money from patents (Gassmann & Enkel, 2004; Lichtenthaler, 2007; Zuniga & Guellec, 2009), to increase reputation (Lichtenthaler, 2007; Lichtenthaler & Ernst, 2007; Van De Vrande, de Jong, et al., 2009), cross-licensing (Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009), creating alliances (Kutvonen, 2011), standard setting (Caviggioli & Ughetto, 2013; Koruna, 2004; Lichtenthaler, 2007; Van De Vrande, de Jong, et al., 2009), subcontracting other companies (Gassmann & Enkel, 2004), blocking rivals (Bianchi et al., 2014; Caviggioli & Ughetto, 2013), access to a new market (Caviggioli & Ughetto, 2013; Lichtenthaler, 2007), company strategy (Kutvonen, 2011) all motivations are confirmed except outbound licensing for blocking rivals (Bianchi et al., 2014; Caviggioli & Ughetto, 2013).

The partner type of the companies aligns with the literature for patent pool companies (SaiSruthi, 2018; Shapiro, 2001), R&D institutes (Brunswicker & Vanhaverbeke, 2015; W. M. Cohen et al., 2002; Fu et al., 2016), independent companies (Laursen & Salter, 2006), Spin-off (Brunswicker & Chesbrough, 2018; Chesbrough, 2003b; Fu et al., 2016; Gentile-Lüdecke et al., 2020; Lichtenthaler, 2005). However, no confirmed collaboration with universities (Brunswicker & Vanhaverbeke, 2015; W. M. Cohen et al., 2002; Fu et al., 2016) and consulting companies (Bianchi, 2016; Lamberti et al., 2017; Martinez et al., 2014; Tether & Tajar, 2008).

In the same vein, the choice of R&D collaboration partner results aligns with the theory except for collaboration with universities (Brunswicker & Vanhaverbeke, 2015; W. M. Cohen et al., 2002; Fu et al., 2016) and consulting companies (Lamberti et al., 2017; Martinez et al., 2014; Tether & Tajar, 2008).

Partner selection criteria are confirmed namely relevance of the technology (Cassiman & Veugelers, 2006; Y. Wang & Li-ying, 2015), reputation (Barchi & Greco, 2018; Lichtenthaler & Ernst, 2007; Van De Vrande, de Jong, et al., 2009), Potential R&D collaboration (Sampson, 2005; Y. Wang et al., 2013; Y. Wang & Li-ying, 2015), Price (Arora, 2003; Arora &

Gambardella, 2010; Cassiman & Valentini, 2016; Fosfuri, 2006), patent citation (Blind et al., 2009; Jaffe & De Rassenfosse, 2017), company affiliation (Giuri et al., 2007; Gulati, 1998), Market size (Kester et al., 2011; Koruna, 2004; Pitkethly, 2001), technology level (Cassiman & Veugelers, 2006; Cesaroni, 2004; Chesbrough & Crowther, 2006; W. M. Cohen & Levinthal, 1989).

However, in partner contact activities, only hiring new R&D staff is confirmed (Arora et al., 2016; Cassiman & Veugelers, 2006).

The inbound barriers are partly confirmed by long negotiations (2018, p. 354; Prud'homme, 2019) and high prices (Dziurski & Sopińska, 2020; Galia & Legros, 2004). The remaining reasons are not confirmed as inbound barriers for Chinese companies, namely, the lack of government promotions (Greco et al., 2017; L. A. Hall & Bagchi-Sen, 2002), do not feel secure (NIH) (Lichtenthaler & Ernst, 2006), negative previous experience (Dziurski & Sopińska, 2020, p. 318), reduce internal R&D (Lichtenthaler & Ernst, 2006, p. 376), no good technology offer for us (Bigliardi & Galati, 2016; Lichtenthaler & Ernst, 2006; Oduro, 2020; Van De Vrande, de Jong, et al., 2009).

The outbound barriers are confirmed namely IPR complexity (Chesbrough et al., 2006; Savitskaya et al., 2010; Zuniga & Guellec, 2009), NSH (Bianchi et al., 2014; Lichtenthaler, 2009b; Rivette & Kline, 2000), contract complexity (Hoffmann & Schlosser, 2001), not our strategy (Lichtenthaler et al., 2010), our technology is not developed yet (Amann et al., 2022; Peeters & van Pottelsberghe de la Potterie, 2006), and lack of experience (Lichtenthaler et al., 2010). The difficulty in finding a buyer (Enkel et al., 2009; Savitskaya et al., 2010) is not confirmed.

The second subsection (subsection 9.2) discusses the cluster analysis, giving us two cluster groups. All the clusters are adopting a protective patenting. However, the first group of companies use patents externally for M&A and long-term alliance establishment, besides selling licenses to increase their revenue.

The second cluster group, contrary to the first one, uses the patents externally only for licensing revenue. Therefore, we consider this group closer than the first group aligning with the theory (Chesbrough, 2003a)

Finally, the third subsection (subsection 9.3) is dedicated to discussing the results of the decision tree analysis. The decision tree shows the companies' behaviour and that the patenting

decision is closely related to inbound open innovation and market influence. The internal exploitation of the patents is related to market conditions. External exploitation of the patents is related to reputation of the partner, government promotions to work with R&D institutes and universities.

Chapter 10 Conclusion

The last chapter of our study is dedicated to the general conclusion, theoretical and managerial contributions of our study, with the determination of our limits and further research areas are given.

10.1. General conclusion

In this study, we try to see Chinese companies' patent strategies and exploitation practices in the open innovation process. We try to respond to three research questions:

- RQ1 “What patenting strategies do Chinese companies employ in open innovation processes?”

- RQ2

“Which forms of patent exploitation do Chinese companies use during this process, and how do various factors influence them?”

- RQ3 “What types of companies adopt the open innovation model and engage in patent exploitation? Are there any specificities that influence their choice of patent exploitation methods?”

As a response to the first question, we saw that Chinese companies use formal and informal IPR protections reciprocally. They prefer secrecy, lead time advantage, and product complexity as informal tools. Besides, they use patents and utility model protection as formal IPR protection tools. Nevertheless, the use of patents and utility models is also very common. We saw that the high competition and market dynamics push companies to continue to use informal protections, mostly secrecy and lead-time advantage. These findings align with the theory specifically when the market has a high competition level; the companies prefer lead time advantage and product complexity instead of patenting (Gallié & Legros, 2012; Veugelers, 2018)

We also saw that the government fosters partnerships with other companies and consulting companies, but the Chinese companies stay reluctant to this latter option. The government also strengthened the IPR. However, it creates a barrier for some companies, the complexity of IPR.

Regarding the motivations behind patenting, our study findings indicate that companies apply for patents to achieve several objectives. These include gaining access to new markets,

protecting their inventions from being copied, blocking competition, and establishing market standards. Furthermore, having a strong patent portfolio allows for better negotiation in terms of cross-licensing agreements. Additionally, obtaining patents can enhance a company's image and serve as a measure of internal performance. Lastly, it can also attract government incentives.

Regarding patenting strategies employed by Chinese companies based on our observations, we found that they predominantly utilize defensive approaches. This includes employing inbound open innovation methods such as engaging in research and development collaborations with other entities, entering into cross-licensing agreements with other organizations and purchasing licenses when necessary. These findings are consistent with existing theories (Xi & Mitkova, 2013).

We also saw that they prefer to use inside their patents. Not all companies, but some are more open and seek use for bargaining or long-term alliances.

Concerning open innovation modalities, we saw that inbound modalities align with the theory. Outbound modalities also align with the theory. However, public companies generally do not sell licenses for subcontracting and do not use outbound open innovation to stop competition by creating an entry barrier in the market.

The partner typology exhibits a slight difference compared to what is found in the existing literature. Our research reveals that contrary to the findings of (Verbano et al., 2015), which state that universities and R&D centres are preferred as collaboration partners by companies engaged in inbound open innovation, independent companies and R&D institutes are the first choice in our study. Following them are patent pool companies, consulting firms, and universities. Chen et al. (2007) attribute this preference to the geographical location of these companies. Those situated near major cities like Beijing have access to prominent universities, while other cities have R&D institutes instead. Chinese companies seek to enhance their absorptive capacity regardless of the company's location through collaborations with governmental institutions.

The criteria for selecting partners based on capabilities align with established theories. In particular, companies consider factors such as reputation, partner's market size, technological level, patent citations, company affiliation, potential for R&D collaboration, previous

experience in R&D collaboration, and the cost of patents or licenses when entering a partnership.

Following the theory, Partner contact activities also align. We have explored options such as recruiting additional R&D personnel, directly contacting partners, attending seminars, and utilizing product advertisements – all consistent with the theory.

The barriers to open innovation align with the theory, with a few exceptions. We observed that certain elements of NIH syndrome, such as the apprehension of licensors interfering in their own business, licensors potentially licensing companies abroad, lack of trust in external knowledge, fear of diminishing internal R&D capacity through the use of external knowledge, and perceiving external knowledge as complex for the company.

However, the data indicates that Chinese companies in our study seldom encounter negative experiences during inbound open innovation processes. Thus, negative experiences are deemed the least significant barrier for these companies. All companies are well-informed about government incentives for research and development activities. Nonetheless, the most crucial barrier is long negotiation periods. Most firms do not claim dissatisfaction with technology offerings available on the market. Consequently, most companies consistently find suitable technology offers to meet their needs.

The outbound barriers also align with the theory, precisely the IPR complexity, contract complexity, difficulty finding a buyer, lack of experience, and NSH syndrome effects, such as our technology is not for sharing and losing control of their patents. Nevertheless, the companies state that outbound open innovation is not their strategy, but the data show that they are doing outbound open innovation. The latter is a very protective attitude towards external parties, in this case, to our research.

-RQ 2 “Which forms of patent exploitation do Chinese companies use during this process, and how do various factors influence them?”

In response to the second question, our analysis of patenting motivations, patent exploitation choice, open innovation modalities, and external factors gave us two clusters.

Our analysis shows that both groups of companies use defensive patenting strategies by using patents for protection and to access new markets.

When analyzing patent exploitation, we saw that both companies use internal and external exploitation modalities. However, we saw that the first group of companies also use non-pecuniary outbound modalities such as joint ventures and M&A establishment with patents and pecuniary modality, license selling. In contrast, the second group of companies use patents differently by solely focusing on selling licenses to generate extra income.

Both groups of companies chose patent pool companies as inbound open innovation partners. However, the first group of companies also chose universities and R&D institutes as partners. Regarding R&D collaboration, group 1 companies prefer collaborating with universities, R&D institutions, regional transfer offices, and technology development zone companies. They also directly communicate with potential partners and consult with partner consulting companies. On the other hand, group 2 companies primarily reach out to R&D institutions, regional technology transfer offices and technology development zone companies for collaborations. Occasionally, they may also establish direct contact with partners. Both companies are actively looking for ways to generate more revenue. One strategy they have implemented is the sale of licenses, which serves as an additional source of income for both groups. Both groups consider companies' technology level and reputation important for selecting partners. However, only companies in Group 1 actively seek partner contact opportunities through seminars, agents, or direct contact with potential partners.

Table- 72 Patent application and exploitation in Open Innovation process forms

Criteria	Group 1		Group 2	
Patenting	Motivation		Motivation	
	Protection Access new market		Protection Access new market	
Patent Use	Internal	External	Internal	External
	NPD R&D Contracts		NPD R&D Contracts	
Open Innovation	Inbound	Outbound	Inbound	Outbound
	Motives		Motives	
	Protection Big portfolio	Make money	Protection Big portfolio Cross-licensing	Make money
	Mode		Mode	
	Cross-licensing	Licensing Joint venture M&A Alliance with foreign comp.	Cross-licensing	Licensing
	Partner Type	Partner Criteria	Partner Type	Partner Criteria
	Patent Pool University R&D institute	Technology level Reputation	Patent Pool	Technology level Reputation
	R&D collaboration partner type	Partner contact	R&D collaboration partner type	Partner contact
	R&D institute Reg.Tech.Tr.Off. Tech.Devp.Zone Comp Direct contact Consulting comp University	Seminars Direct contact Agent	R&D institute Reg.Tech.Tr.Off. Tech.Devp.Zone Comp Direct contact	

Our finding suggests that the clusters share a common motivation for protection. Despite the first group of companies being more open than the second group, they still prioritize increasing their absorptive capacity through collaborations with universities. Both groups of companies are focused on generating revenue solely from outbound open innovation, and Chinese companies remain not totally open in the open innovation process.

- RQ 3- “What types of companies adopt the open innovation model and engage in patent exploitation? Are there any specificities that influence their choice of patent exploitation methods?”

Our research aims to highlight the correlation between patenting choices and the selection of patent exploitation, considering both internal and external factors that may impact this decision. Through our analysis, we have developed a decision tree that illustrates the degree of relationship between these criteria. The findings reveal a tendency for companies to adopt a defensive approach towards patenting. Specifically, we observed a strong association between patenting decisions and their corresponding criteria as below:

- 1- Access in new markets & inbound patenting for having easy access to a new invention
- 2- Block rivals & negative previous inbound licensing experience
- 3- Protecting the business & don't trust other companies' technological competencies for inbound licensing
- 4- Reduce the imitation risk & and outbound licensing to access foreign markets
- 5- Standard setting in the market & and inbound licensing for cost reduction
- 6- Using as a negotiation tool for cross-licensing & and inbound licensing from R&D institutes
- 7- To build a strong patent portfolio & The government promotion for working consulting companies
- 8- Improve image & and inbound licensing to enter a foreign market
- 9- Measuring our innovation performance & no good offer in the market for inbound licensing
- 10-It motivates our R&D department - rewarding & inbound licensing already proved technology and reduce time to market.
- 11-Use government incentives for R&D collaboration & collaborate with technology development zone companies

The patenting behaviour of the companies relies on protective and defensive behaviour, mainly inbound licensing, collaborating with R&D institutes or technology development zone companies.

In the same vein, the patent exploitation strategies gave us the relationship between patent exploitation decisions and their corresponding criteria as below:

- a. Stocking for strategic use & Inbound patenting complementary technology
- b. Stocking for NPD & The reputation of the licensor company is important
- c. R&D contracts & Potential R&D collaboration with licensor company while inbound licensing
- d. Using in a patent pool & inbound licensing for cost reduction
- e. Using in joint venture or M&A agreement & reputation of the partner is important while outbound licensing
- f. Long-term alliances with foreign companies & R&D collaboration with R&D institutes
- g. License selling & contacting directly license seller company directly while inbound licensing

When considering internal exploitation, the decision-making process is influenced by market conditions, competition levels, and technological turbulence. On the other hand, external exploitation involves companies seeking security through government endorsements or partnering with reputable companies to minimize market uncertainty. In turbulent markets, companies aim to protect their position against competitors and often opt for protective exploitation strategies even when utilizing patents for outbound open innovation **activities**. Additionally, licensing is pursued solely to increase revenue, and companies are open enough to contact license sellers during inbound licensing agreements.

10.2. Theoretical contributions

Our major contribution is introducing a new behaviour path of patent use through open innovation processes. Our study proves that Chinese companies' patent application is mostly used in inbound open innovation processes and predominantly adopt a defensive approach regarding patenting strategies (Xi & Mitkova, 2013). This defensive strategy serves as a means for these companies to protect themselves against potential competitors in the market (Azzam et al., 2017, p. 13).

We also show that only a few limited Chinese companies opt for an offensive patenting strategy (Xi & Mitkova, 2013). These companies are driven by their willingness to expand their reach into foreign markets, which they achieve through outbound licensing. These companies leverage inbound open innovation by actively seeking partnerships and licensing agreements with foreign companies. Through this collaborative process, they can incorporate external knowledge and expertise into their operations, enhancing product development and market penetration and increasing their internal R&D capacity.

Most Chinese companies prioritize protecting their intellectual property rights domestically through defensive patenting strategies. This conservative approach reflects their cautious attitude towards sharing internal knowledge with potential competitors.

In this behaviour path, inbound open innovation is a significant aspect of Chinese companies' approach to open innovation. These companies focus on internal patent usage, stocking for strategic use (Xi & Mitkova, 2013), and utilizing them for new product development. This strategy is closely tied to inbound patenting.

Moreover, Chinese companies place great importance on their partner's reputation (Lichtenthaler & Ernst, 2007; Van De Vrande, de Jong, et al., 2009) during the inbound licensing process. By adopting inbound open innovation, these companies can thump into external expertise and resources, enhance their capabilities, and foster collaboration within the industry. The emphasis on inbound approaches highlights the value placed on acquiring knowledge and technology from external sources rather than solely relying on internal R&D efforts.

Chinese companies are employing various strategies to reduce their R&D expenses. One such strategy is patent pools (SaiSruthi, 2018; Shapiro, 2001) for inbound licensing. These Chinese firms can establish new collaborative relationships by collaborating with licensor companies through R&D collaborations (Ayerbe & Mitkova, 2008; Hagedoorn & Zobel, 2015). It is important to note that outbound licensing is not solely pursued to increase revenue; it also serves as a means to increase the level of inbound licensing and subsequently reduce internal R&D costs (Gassmann et al., 2018; Gassmann & Enkel, 2004).

Outbound licensing is not solely pursued to increase revenue. Some companies also leverage outbound licensing to reduce their internal R&D costs (Gassmann et al., 2018; Gassmann & Enkel, 2004) further by increasing the level of inbound licensing.

Only a few companies actively seek collaboration opportunities through joint ventures or M&A agreements (Mitkova, 2009). Moreover, these companies are very discerning about the reputation and credibility of their potential partners. This cautious approach ensures they align themselves with organizations that uphold similar values and possess the necessary expertise to contribute meaningfully to their open innovation endeavours.

Our study reveals that inbound open innovation is also prevalent among companies. Furthermore, our research highlights that while many Chinese companies may not fully embrace outbound open innovation activities, they still actively collaborate with foreign entities. This finding challenges previous studies suggesting Chinese companies lagging in adopting open innovation. Our study provides a nuanced understanding of the different approaches taken by companies, categorizing them into two distinct clusters based on their preferred modalities of open innovation.

One cluster (cluster 2) primarily focuses on licensing out for additional revenue. In contrast, the other cluster (cluster 1) utilizes joint venturing, creating M&A alliances, and forming partnerships with foreign companies as their main strategies for open innovation. This typology provides a deeper understanding of how companies approach and leverage open innovation to drive growth and success. Additionally, our study sheds light on adopting open innovation in Chinese companies. Despite being known as a global economic powerhouse, most Chinese companies still have room for improvement in fully embracing outbound open innovation activities. The outbound open innovation allows these companies to tap into the global knowledge and resources through collaboration and partnerships. In conclusion, our research underscores the importance of inbound and outbound open innovation strategies for companies looking to thrive in today's interconnected and dynamic business environment.

Our research provides further evidence of specificities in the adoption of Open Innovation. Unlike previous studies, we discovered that the motives for adopting Open Innovation are similar in China. However, there is a slight difference in partner choice between Chinese and Western companies. While Western companies prefer to partner with universities (Verbano et al. 2015), Chinese companies strongly prefer partnering with R&D institutes. This distinction highlights the unique approach Chinese companies take to Open innovation. Our study contributes valuable empirical evidence that expands the existing literature and provides a deeper understanding of the nuances associated with open innovation adoption motives.

Contrary to previous literature (Savitskaya et al., 2010), they no longer view negative past experiences with inbound open innovation as the primary obstacle. Instead, they now identify long negotiation periods as the most significant barrier to implementing inbound open innovation strategies. This finding suggests that Chinese companies have recognized the importance of collaboration and knowledge exchange in driving innovation. However, they face challenges regarding the time and financial resources-consuming nature of negotiations, which can delay the implementation of new ideas and hinder progress. As a result, organizations must find ways to streamline these negotiations and create more efficient processes for collaborating with external partners.

10.3. Managerial contributions

Our research, which involved surveying 129 companies, has provided valuable managerial insights into the practice of open innovation among Chinese companies. Since the Chinese market opened up, it has become inevitable for Eastern companies to establish relationships with their Chinese counterparts at some point. However, there is a noticeable difference in openness between Chinese companies and their Western collaborators, which can create a gap in understanding. With this in mind, we hope our insights will assist companies eager to collaborate with their Eastern alter egos.

Our study reveals some interesting findings.

Firstly, Chinese companies are actively embracing the concept of openness in their business practices. This is evident through their efforts to collaborate and partner with external entities. Government incentives are important in a planned economy such as the Chinese economic environment. Therefore, government incentives have played a significant role in fostering this culture of openness by creating an environment that encourages and supports such collaborations.

Furthermore, the competitive market conditions in China have also influenced these companies' approach towards open innovation. As they face intense competition and reduced trust levels, Chinese firms increasingly turn to external partners to mitigate risks and uncertainty. This insight highlights the importance of building strong relationships with trusted partners to ensure successful open innovation initiatives.

Moreover, due to the prevalence of imitation in China, protecting intellectual property becomes challenging for these companies. As a result, they rely on lead time advantage as an alternative means of protecting their innovations. By effectively leveraging their ability to bring products to market quickly, Chinese firms can stay ahead of imitators and maintain a competitive edge.

Open innovation is a key strategy that many firms are embracing, especially in the face of turbulent market conditions. These firms recognize the importance of fostering openness and collaboration to drive innovation and gain a competitive edge.

Patenting plays a significant role in this process, as these companies have a high propensity for protecting their intellectual property. They protect their innovations by seeking patents and signalling their commitment to open innovation.

Furthermore, Chinese companies are actively working to enhance their absorptive capacity. They understand that successful open innovation requires not only the ability to generate new ideas internally but also the capability to absorb and integrate external knowledge effectively.

However, Western companies must recognize that open innovation may not be as straightforward in China as in other countries. Despite efforts towards openness, Chinese companies often operate with a certain level of defensiveness and protectiveness when it comes to collaboration and outbound activities.

This defensive approach can be attributed to various factors, such as intellectual property concerns and the competitive nature of the Chinese business landscape. Therefore, Western companies looking to engage in open innovation with Chinese counterparts must be prepared to navigate these complexities. They should approach collaborations clearly, understand the potential challenges and take necessary precautions to protect their intellectual property rights. Additionally, Western companies must foster trust and establish strong relationships with their Chinese partners to overcome any barriers that may arise due to cultural differences or differing business practices. By doing so, they can create a conducive environment for successful open innovation initiatives.

10.4. Limits and research directions

Despite several contributions of our study, it also has some limits in terms of the literature and methodology of our research.

First, we have several theoretical limits. In this research, we have limited our approach to the open innovation process with the inbound and outbound open innovation process, and we excluded the coupled process to simplify our research which already has a heavy data load. We have also limited the patenting strategies to offensive and defensive strategies to clarify the difference in the behaviour and the analysis. The R&D collaboration is a reciprocal process. In our research, we considered the R&D collaboration as an inbound open innovation modality; further investigation into the inbound & R&D collaboration activities will be necessary for understanding the interaction.

Then, we have several methodological limits. Our sample consists of 129 companies from big cities, and they are big companies. Therefore, we could not precisely clarify the reason for the Chinese companies' university and R&D institute benchmark difference. Our sample also limits us to the big companies' open innovation behaviour, and we cannot compare if there is a difference between SMEs and large companies. We also asked too many questions in our questionnaire with the fear that we would not reach the same person or have the opportunity to do a second interview for missing questions because of the difficulty of the field. We also had a limited time to collect as much information as possible.

We also could not collect any information about the internal factors of the company's R&D management. We can collect only the companies' age, turnover, and headquarters region. Besides that, it is considered confidential information. Therefore, for fear of interfering with our interview, we had to limit our questions to general questions.

For the same reason, we could not collect information about the questions of protection in different countries.

Nevertheless, this research may open further research opportunities in the future. Firstly, we saw that the partner's reputation is one of the essential factors necessary for outbound licensing. Concerning the competitive market conditions of the Chinese market, the companies need a tool to disperse this uncertainty. Therefore, the reputation and the communication of the reputation may be exciting areas for further research.

The reciprocity of the R&D collaboration proves that coupled open innovation is an important area that can be developed in the Chinese technology transfer field. Further investigation on coupled processes can give insights to managers and also to academic research.

Finally, the results of our research remain specific to the large companies active in R&D and patenting but in different industries. In our study, we could not compare the industry differences in the patent and open innovation strategies. A further investigation into this domain can give fruitful insights into the management of R&D.

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Appendices

Appendice 1 Questionnaire

Participant	
<i>Participant info</i>	
1. Name of the respondent	<input type="text"/>
2. Title of the respondent	<input type="text"/>
3. Company Name	<input type="text"/>
4. Phone number	<input type="text"/>
5. Email	<input type="text"/>
6. Industry of the company	<input type="text"/>
7. Establishment year of the company	<input type="text"/>
8. Location of the main board	<input type="text"/>

I-According to your opinion	
<i>PI-I</i>	
9. There are too many companies in our market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
10. The companies in our market has a strong patent activity	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
11. There is a big technological development in our market and it is pushing us for NPD	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
12. It is difficult to forecast where will be the major technology in 3 years	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
13. We've got a trade freedom in our market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
14. Our market has a high growth potential	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
15. In our market, international companies are seeking to collaborate for production	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
16. Exportation is very important in our market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree

17. Gov.Fiscal Policy support us for our technological innovation activities	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
18. Gov.Tax Policy support us to reduce our R&D costs ...	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
19. Gov.financial policy create advantage to your company .	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
20. The government offers guidelines and support on our Science&Technology activities	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
21. The government offers education programs for our Science&Technology activity	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
22. The government strengthening the IPR protection	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
23. With the new changes, IPR protection become more complex to us recently	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
24. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

II-Does government promoting you to work with one of these entities during your patent activity?

P1-2

25. University, R&D institutes	<input type="radio"/> 1. No, Not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
26. Other companies	<input type="radio"/> 1. No, Not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
27. Consulting companies	<input type="radio"/> 1. No, Not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically

III-Which protection are you using for your innovation?

P1-3

28. Secrecy	<input type="radio"/> 1. No, not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
29. Complexity of product/process design	<input type="radio"/> 1. No, not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
30. Lead time advantage	<input type="radio"/> 1. No, not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
31. Patents	<input type="radio"/> 1. No, not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
32. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

IV-Alternative protection

P1-4

33. Do you prefer to protect your invention by Utility model before applying for invention patent?	<input type="radio"/> 1. No, not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
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34. When you apply for patent, do you patent abroad also? .	<input type="radio"/> 1. No, not systematically <input type="radio"/> 2. Sometimes <input type="radio"/> 3. Most of the times <input type="radio"/> 4. Systematically
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V-1-What is the reason for patenting in China?

PI-5

35. Access in new markets	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
36. Protect our business	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
37. Block our rivals to compete	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
38. It reduce the imitation risk	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
39. Improve our image	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
40. Measuring our innovation performance	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
41. It motivates our R&D department and our researchers	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
42. We are using as a negotiation tool for cross licensing .	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
43. To build a strong patent portfolio	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
44. Setting standards in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
45. To enjoy government incentives	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
46. Other	

V-2-What is the reason for patenting in Abroad?

PI-5

47. Access in new markets	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
48. Protect our business	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
49. Block our rivals to compete	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
50. It reduce the imitation risk	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
51. Improve our image	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree

52. Measuring our innovation performance	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
53. It motivates our R&D department and our researchers	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
54. We are using as a negotiation tool for cross licensing .	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
55. To build a strong patent portfolio	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
56. Setting standards in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
57. To enjoy government incentives	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
58. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

VI-1-Once you maintain a patent, which way would you prefer to use? (In China)

P1-6

59. Stocking our patent for strategic use	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
60. Using of product development	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
61. Using for R&D contracts with companies, universities or R&D centers	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
62. Using in a patent pool	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
63. Using in a joint venture or M&A.....	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
64. Using to establish long term alliances with foreign companies	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
65. Using for licence activities	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
66. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

VI-2-Once you maintain a patent, which way would you prefer to use?(Abroad)

P1-6

67. Stocking our patent for strategic use	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
68. Using of product development	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
69. Using for R&D contracts with companies, universities or R&D centers	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively

70. Using in a patent pool	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
71. Using in a joint venture or M&A	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
72. Using to establish long term alliances with foreign companis	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
73. Using for licence activities	<input type="radio"/> 1. Don't use <input type="radio"/> 2. Use often <input type="radio"/> 3. Use very often <input type="radio"/> 4. Use intensively
74. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

VII- What is the reason of your country choice while patenting abroad?

P1-7

75. Market size	<input type="radio"/> 1. No, Not important <input type="radio"/> 2. Somewhat important <input type="radio"/> 3. Important <input type="radio"/> 4. Very important
76. High IPR protection in the foreign country	<input type="radio"/> 1. No, Not important <input type="radio"/> 2. Somewhat important <input type="radio"/> 3. Important <input type="radio"/> 4. Very important
77. Low entry barriers in the foreign country	<input type="radio"/> 1. No, Not important <input type="radio"/> 2. Somewhat important <input type="radio"/> 3. Important <input type="radio"/> 4. Very important
78. Our previous IP transfer experience at this country ...	<input type="radio"/> 1. No, Not important <input type="radio"/> 2. Somewhat important <input type="radio"/> 3. Important <input type="radio"/> 4. Very important
79. High number of competitors in the country	<input type="radio"/> 1. No, Not important <input type="radio"/> 2. Somewhat important <input type="radio"/> 3. Important <input type="radio"/> 4. Very important
80. We are exploring this country	<input type="radio"/> 1. No, Not important <input type="radio"/> 2. Somewhat important <input type="radio"/> 3. Important <input type="radio"/> 4. Very important
81. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

VIII- Would you please order these countries (1to6) according to your patent application size ?

P1-8

82. Put in order according your patent application size	1. USA 2. Japan 3. Germany 4. South Korea 5. France 6. Other <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <i>Ordonnez 6 réponses.</i>
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IX-1- Beside your own patents, do you have below experiences in China? (Yes-No)

P1-9

83. Buying patents in China	<input type="radio"/> 1. Y <input type="radio"/> 2. N
84. Selling patents in China	<input type="radio"/> 1. Y <input type="radio"/> 2. N
85. Acquiring Licences in China	<input type="radio"/> 1. Y <input type="radio"/> 2. N
86. Selling Licences in China	<input type="radio"/> 1. Y <input type="radio"/> 2. N
87. R&D collaboration in China	<input type="radio"/> 1. Y <input type="radio"/> 2. N

IX-2- Beside your own patents, do you have below experiences Abroad? (Yes-No)

P1-9

88. Buying patents Abroad.....	<input type="radio"/> 1. Y <input type="radio"/> 2. N
89. Selling patents Abroad.....	<input type="radio"/> 1. Y <input type="radio"/> 2. N
90. Acquiring Licences Abroad.....	<input type="radio"/> 1. Y <input type="radio"/> 2. N
91. Selling Licences Abroad.....	<input type="radio"/> 1. Y <input type="radio"/> 2. N

X-1-You are buying patent because (In China):

P2-10-Concession

92. We want to have an access to a new invention.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
93. For blocking the rivals.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
94. We are patenting the complementary technology.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
95. Other.....	<div style="border: 1px solid black; height: 20px;"></div>

X-2-You are buying patent because (Abroad):

P2-10-Concession

96. We want to have an access to a new invention.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
97. For blocking the rivals.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
98. We are patenting the complementary technology.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
99. Other.....	<div style="border: 1px solid black; height: 20px;"></div>

XI-1-You are selling patent because (In China):

P2-11-Concession

100. We stop related technological activity.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
101. We bought a company and sell out their patents which are not related to our core technology.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
102. Patent selling is our business strategy.....	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
103. Other.....	<div style="border: 1px solid black; height: 20px;"></div>

XI-2-You are selling patent because (Abroad):

P2-11-Concession

104. We stop related technological activity	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
105. We bought a company and sell out their patents which are not related to our core technology	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
106. Patent selling is our business strategy	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
107. Other	

XII-1-You are buying licence because (In China):

P2-12-Concession

108. Have a big licence portfolio	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
109. Access complementary technology	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
110. Cross license with other companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
111. Reduce our R&D expenses	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
112. Gain access to the new tech. rapidly	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
113. Use technology already proved its success in the industry	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
114. Enter in a foreign market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
115. Working as a manufacturer for the licensor company	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
116. Other	

XII-2-You are buying licence because (Abroad):

P2-12-Concession

117. Have a big licence portfolio	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
118. Access complementary technology	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
119. Cross license with other companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
120. Reduce our R&D expenses	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree

121. Gain access to the new tech. rapidly	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
122. Use technology already proved its success in the industry	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
123. Enter in a foreign market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
124. Working as a manufacturer for the licensor company	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
125. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XIII-1-You are licensing your patents because (In China):

P2-13-Concession

126. We want to make money from our patents	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
127. Increase our reputation in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
128. Enter in a cross licensing with companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
129. Create alliances	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
130. Set our standards in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
131. Subcontract a production to another company	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
132. Stop any competing new research in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
133. Access in a foreign market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
134. sustain our company strategy	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
135. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XIII-2-You are licensing your patents because (Abroad):

P2-13-Concession

136. We want to make money from our patents	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
137. Increase our reputation in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
138. Enter in a cross licensing with companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree

139. Create alliances	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
140. Set our standards in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
141. Subcontract a production to another company	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
142. Stop any competing new research in the market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
143. Access in a foreign market	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
144. Sustain our company strategy	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
145. Other	<div style="border: 1px solid black; height: 20px;"></div>

XIV-1-You are buying licences from (In China):

P2-14-Concession

146. The companies of a patent pool	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
147. Universities	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
148. R&D institutes	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
149. Independent companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
150. Using consulting companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
151. Other	<div style="border: 1px solid black; height: 20px;"></div>

XIV-2-You are buying licences from (Abroad):

P2-14-Concession

152. The companies of a patent pool	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
153. Universities	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
154. R&D institutes	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
155. Independent companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
156. Using consulting companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
157. Other	<div style="border: 1px solid black; height: 20px;"></div>

XV-1-What is the importance of the below criteria of the licensor company or institution while you are buying license (In China):

P2-15-Concession

158. Spinn/off-Subsidiary (filière)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
159. Relevant technology	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always

160. Technology level of the firms	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
161. Reputation of the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
162. Potential R&D collaboration	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
163. Price	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
164. Patent citation in the patent database	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
165. Other	<div style="border: 1px solid black; height: 20px;"></div>

XV-2-What is the importance of the below criteria of the licensor company or institution while you are buying license (Abroad):

P2-15-Concession

166. Spinn/off-Subsidiary (filière)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
167. Relevant technology	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
168. Technology level of the firms	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
169. Reputation of the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
170. Potential R&D collaboration	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
171. Price	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
172. Patent citation in the patent database	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
173. Other	<div style="border: 1px solid black; height: 20px;"></div>

XVI-1-What is the importance of the below criteria of your licensing-out partner while you are licensing-out (In China):

P2-16-Concession

174. Company affiliation	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
175. Market size of the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
176. Technology level of the countries/ Companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
177. Reputation of the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
178. Potential R&D collaboration with the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
179. Other	<div style="border: 1px solid black; height: 20px;"></div>

XVI-2-What is the importance of the below criteria of your licensing-out partner while you are licensing-out (Abroad):

P2-16-Concession

180. Company affiliation	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
181. Market size of the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
182. Technology level of the countries/ Companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always

183. Reputation of the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
184. Potential R&D collaboration with the company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
185. Other	<div style="border: 1px solid black; height: 20px;"></div>

XVII-1-How do you attract the potential buyer for licenses while you're licensing-out? (In China):

P2-17-Concession

186. Product publicity (commercials)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
187. Presentation of technical papers in seminar	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
188. Seeking new R&D staff which are active and well known in the market	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
189. Direct contact with potential companies (direct marketing)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
190. Intermediate / Agent	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
191. Other	<div style="border: 1px solid black; height: 20px;"></div>

XVII-2-How do you attract the potential buyer for licenses while you're licensing-out? (Abroad):

P2-17-Concession

192. Product publicity (commercials)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
193. Presentation of technical papers in seminar	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
194. Seeking new R&D staff which are active and well known in the market	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
195. Direct contact with potential companies (direct marketing)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
196. Intermediate / Agent	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
197. Other	<div style="border: 1px solid black; height: 20px;"></div>

XVIII-1-Do you take initiative to approach (In China):

P2-18-Concession

198. To the license seller company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
199. To the licensee company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always

XVIII-2-Do you take initiative to approach (Abroad):

P2-18-Concession

200. To the license seller company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
201. To the licensee company	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always

XIX-1-Which institutions do you prefer while you are doing R&D collaboration? (In China)

P3-19-R&D collaboration

202. Universities	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
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203. R&D institutions (Public)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
204. Regional technology transfer office	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
205. Direct contact with potential companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
206. Consulting companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
207. Companies in the technology development zone	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
208. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XIX-2-Which institutions do you prefer while you are doing R&D collaboration? (Abroad)

P3-19-R&D collaboration

209. Universities	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
210. R&D institutions (Public)	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
211. Regional technology transfer office	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
212. Direct contact with potential companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
213. Consulting companies	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
214. Companies in the technology development zone	<input type="radio"/> 1. Never <input type="radio"/> 2. Rarely <input type="radio"/> 3. Often <input type="radio"/> 4. Always
215. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XX-1-Invention Patent

P3-20- %of patents

216. Own domestic patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
217. Buy-in patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
218. Sell-out patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
219. Buy-in licenses	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
220. Sell-out licenses	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%

XX-2-Utility Model

P3-20- %of patents

221. Own domestic patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
222. Buy-in patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
223. Sell-out patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
224. Buy-in licenses	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
225. Sell-out licenses	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%

XX-3-Design Patent

P3-20- %of patents

226. Own domestic patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
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227. Buy-in patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
228. Sell-out patents	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
229. Buy-in licenses	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%
230. Sell-out licenses	<input type="radio"/> 1. Less than 50% <input type="radio"/> 2. More than 50%

XXI-Age & Number

P4-21-Age & Number

231. How many patents do you maintain in your portfolio? .	<input type="radio"/> 1. 1 to 20 <input type="radio"/> 2. 21 to 50 <input type="radio"/> 3. 51 to 100 <input type="radio"/> 4. 101 to 300 <input type="radio"/> 5. More than 300
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XXII-What is the average number of your (per year) in China:

P4-22-Age & Number

232. Buy-in patents	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50
233. Sell-out patents	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50
234. Buy-in licenses	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50
235. Sell-out licenses	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50

XXII-What is the average number of your (per year) abroad:

P4-22-Age & Number

236. Buy-in patents	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50
237. Sell-out patents	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50
238. Buy-in licenses	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50
239. Sell-out licenses	<input type="radio"/> 1. 1 to 5 <input type="radio"/> 2. 6 to 20 <input type="radio"/> 3. 21 to 50 <input type="radio"/> 4. More than 50

XXIII-What is the average age of your patents that you are holding (since the publication of the patent) in China:

P4-23-Age & Number

240. Own domestic patents	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
241. Buy-in patent	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
242. Sell-out patents	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
243. Buy-in license	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
244. Sell-out License	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years

XXIII-What is the average age of your patents that you are holding (since the publication of the patent) Abroad:

P4-23-Age & Number

245. Own domestic patents	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
246. Buy-in patent	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
247. Sell-out patents	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
248. Buy-in license	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years
249. Sell-out License	<input type="radio"/> 1. 1 to 5 years old <input type="radio"/> 2. 6 to 10 years <input type="radio"/> 3. More than 10 years

XXIV-1- You are not selling or licensing your patents in order to (in China):

P5-24-Barrier

250. The IPR is very complex in the country for selling ...	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
251. Our patent portfolio is not for sharing	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
252. We don't want to lose the control on our own technology	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
253. The license contracts are too complex	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
254. It's not a part of company strategy	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
255. Our patented technology is not sufficiently developed yet	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
256. It is difficult to find buyer for our technology	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
257. We don't have a prior experience on selling license or patent	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
258. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XXIV-2- You are not selling or licensing your patents in order to (Abroad):

P5-24-Barrier

259. The IPR is very complex in the country for selling ...	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
260. Our patent portfolio is not for sharing	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree

261. We don't want to lose the control on our own technology	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
262. The license contracts are too complex	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
263. It's not a part of company strategy	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
264. Our patented technology is not sufficiently developed yet	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
265. It is difficult to find buyer for our technology	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
266. We don't have a prior experience on selling license or patent	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
267. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XXV-1- You are not licensing-in or buying patents in order to (China):

P5-25-Barrier

268. There is a risk that the licensor involve in our R&D process	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
269. There is a risk that foreign licensor may license to our competitors oversea	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
270. We don't trust to other companies technological competence	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
271. We have a bad experience of external technology acquisition	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
272. We don't feel secure if we use external knowledge	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
273. The government doesn't give incentives for the external technology acquisition	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
274. The negotiation process is too long for a license agreement	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
275. We don't see any adequate technology offer in the market for us	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
276. Licenses / Patents from other companies may reduce our innovation capability	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
277. Other technologies are very complex to use in our company	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
278. Transaction cost is too high	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
279. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XXV-2- You are not licensing-in or buying patents in order to (Abroad):

P5-25-Barrier

280. There is a risk that the licensor involve in our R&D process	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
281. There is a risk that foreign licensor may license to our competitors oversea	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
282. We don't trust to other companies technological competence	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
283. We have a bad experience of external technology acquisition	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
284. We don't feel secure if we use external knowledge	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
285. The government doesn't give incentives for the external technology acquisition	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
286. The negotiation process is too long foir a license agreement	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
287. We don't see any adequate technology offer in the market for us	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
288. Licenses / Patents from other companies may reduce our innovation capability	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
289. Other technologies are very complex to use in our company	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
290. Transaction cost is too high	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
291. Other	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

XXVI-1-You are planning to (In China)

P6-26-Future plans

292. Increase your patent selling activities in the following years	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
293. Increase your license selling activities in the following years	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
294. Increase our R&D collaboration with foreign companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
295. Increase ourR&D collaboration with Chinese companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
296. Increase our R&D collaboration with universities ...	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
297. Increase our own R&D investments	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree

XXVI-2-You are planning to (Abroad)

P6-26-Future plans

298. Increase your patent selling activities in the following years	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
299. Increase your license selling activities in the following years	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
300. Increase our R&D collaboration with foreign companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
301. Increase our R&D collaboration with Chinese companies	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
302. Increase our R&D collaboration with universities ...	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree
303. Increase our own R&D investments	<input type="radio"/> 1. Strongly disagree <input type="radio"/> 2. Disagree <input type="radio"/> 3. Agree <input type="radio"/> 4. Strongly agree

XXVII-Company Profile

P7-27-Company Profile

304. Main activity of your company	<input type="radio"/> 1. Manufacturing <input type="radio"/> 2. Service Provider <input type="radio"/> 3. R&D company
305. Which one is suitable to describe your company government?	<input type="radio"/> 1. Public <input type="radio"/> 2. Private <input type="radio"/> 3. Public/Private
306. What is the structure of your company?	<input type="radio"/> 1. Subsidiary of a Chinese gr <input type="radio"/> 2. Subsidiary of a foreign gr <input type="radio"/> 3. Familia structure <input type="radio"/> 4. Corporate comp
307. What is the % of your exportation in your total sales?	<input type="radio"/> 1. Less than 10% <input type="radio"/> 2. 10 to 50% <input type="radio"/> 3. More than 50%
308. What is the number of your total staff?	<input type="radio"/> 1. Less than 10 <input type="radio"/> 2. 10 to 50 <input type="radio"/> 3. 50 to 100 <input type="radio"/> 4. 100 to 300 <input type="radio"/> 5. More than 300
309. Do you have a	<input type="checkbox"/> 1. R&D department <input type="checkbox"/> 2. Patent department <input type="checkbox"/> 3. License department <input type="checkbox"/> 4. Patent law department <i>Vous pouvez cocher plusieurs cases.</i>
310. What is the range of your company turnover? (RMB)	<input type="radio"/> 1. Less than 1 million <input type="radio"/> 2. 1 to 5 million <input type="radio"/> 3. 5 to 20 million <input type="radio"/> 4. 20 to 50 million <input type="radio"/> 5. 50 to 200 million <input type="radio"/> 6. More than 200 million