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The place of enterprise social media platforms in today's enterprises : evaluation of usage and impact on workplace tools

Mayla Alimam

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Présentée par

< Mayla ALIMAM >

**Pour obtenir le grade de
DOCTEUR DE TELECOM SUDPARIS**

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N° NNT : <2017TELE0007>

**The Place of Enterprise Social Media
platforms in Today's Enterprises –
Evaluation of Usage and Impact on
Workplace Tools**

To
those for whom
I pray everyday

To
those who
left

To
the betrayed
memories

To
my beloved
Aleppo

فَكَّرُوا فِي الْأُمُورِ يُكشِفُ لَكُمْ بَعْضُ الَّذِي تَجْهَلُونَ بِالتَّفْكِيرِ
لَوْ دَرَى الطَّائِرُ الْمَوْكِرُ بِالْعُقْبَى أَبِي أَنْ يَهُمَّ بِالتَّوَكُّيرِ

أبو العلاء المعري

*Think about things! Thought clears away some part of ignorance
Were skilled the nesting bird to see the end, it ne'er would have begun to build*

Al-Ma'arri

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No words can express my gratitude and admiration for my parents and family. I thank them for their love, and I thank them for being who they are.

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Mayla Alimam
Caen, France
January, 2017

Résumé

De plus en plus, les entreprises incitent aujourd'hui leurs employés à adopter des modes de travail agiles et flexibles. Cette transformation est outillée par de nouvelles plateformes informatiques intitulées « plateformes de média sociaux d'entreprise » (de l'anglais « Enterprise Social Media platforms – ESM platforms »). Ces plateformes portent la promesse d'améliorer la communication des employés dans leur environnement de travail tout en outillant leurs liens sociaux. Néanmoins, le bénéfice de l'usage de ces plateformes par leurs employés demeure vague et peu mesurable pour les entreprises, dont les dirigeants ont pourtant besoin d'évaluer cet usage et de mesurer ainsi tangiblement le succès de leurs investissements. De plus, le fait d'introduire des plateformes ESM dans les environnements de travail impacte la façon dont les outils existants, tels que la messagerie électronique, sont considérées et utilisés. La question qui se pose est alors de savoir si ces nouvelles plateformes pourraient remplacer l'usage des outils existants.

Dans ce contexte, cette thèse adresse la problématique de la place des plateformes ESM dans les entreprises d'aujourd'hui. Elle examine l'usage réel de ces plateformes en offrant une analyse quantitative des réseaux sociaux, établie à partir de l'usage actuel de ces plateformes. En s'appuyant sur un modèle de recherche conçu pour caractériser l'activité, la thèse applique des tests d'hypothèse qui permettent de comparer l'usage prévu de ces plateformes à leur usage réel, et ainsi de mesurer le succès du déploiement de ces plateformes. De plus, cette thèse étudie, à travers une approche déductive et expérimentale, la capacité des plateformes ESM à remplacer l'usage des outils existants dans les environnements de travail. Ces plateformes fonctionnent aujourd'hui plutôt en tandem avec d'autres outils tels que la messagerie électronique. Cette thèse propose ainsi d'améliorer la messagerie par une fonctionnalité de tagging social afin que l'utilisateur puisse bénéficier de son réseau social sous-jacent. Ce service de tagging est ensuite testé et validé via un prototype. Pour conclure, cette thèse propose des scénarios pour les futurs systèmes sociaux, englobant la totalité des outils de l'environnement de travail au sein des entreprises.

Abstract

Today's organizations are increasingly promoting a shift of employees' ways of working towards more agility and flexibility. This shift is empowered by new IT tools commonly known as "Enterprise Social Media" (ESM). Taking mainly the form of integrated platforms, these tools are deployed with the promise of enhancing employees' communicative activities at the workplace while capitalizing on their social connections. Yet, it remains unclear for companies how their employees benefit from the use of these new tools (i.e., ESM platforms). Managers are unable to evaluate the use of these platforms and thus, tangibly measure the success of their investments. Moreover, introducing ESM platforms to the workplace impact the way the existing tools, such as email, are regarded and used. This leads to the question of whether these new platforms may be substitutes for the use of the existing tools. This thesis tackles the mentioned polemical questions about the place of ESM platforms in today's enterprises. Carried out jointly with Orange labs, the thesis assesses the role ESM platforms could play in supporting organizations in reaching their objectives and hence sustaining their businesses in an extreme competitive context. It explores the real use of these platforms by offering a quantitative social network analysis and data mining of an established ESM platform currently in use. While relying on a proposed research model that characterizes the activity, the applied hypothesis tests allow determining the correct use of ESM platforms, which in turn indicates the success of their deployments. Moreover, the thesis argues through a reasoning approach that the ESM platforms are not capable of substituting the use of existing workplace tools. Instead, they work in tandem with certain tools such as email. Based on the latter argument, the email tagging service is introduced as an example of how existing workplace tools may be enriched with social features to derive increased benefit for the workforce. The thesis finally validates the service through implementation and testing. To conclude, it proposes and discusses scenarios of future social systems that involve the overall set of workplace tools in enterprises.

Publications

This thesis relies on the following list of original research articles. The author's articles are either published in peer-reviewed conferences or submitted to peer-reviewed journals. They are referenced later in the manuscript using their numerical code.

Published

- [P1] **Alimam**, M., Bertin, E., Crespi, N. (2015, May). Social and Collaborative Services for Organizations: Back to Requirements. Proceedings of the Spring Servitization Conference (SSC) 2015: 26-32.
- [P2] **Alimam**, M., Bertin, E., Crespi, N. (2015, July). Enterprise Social Systems: The What, the Why and the How. In Business Informatics (CBI), 2015 IEEE 17th.
- [P3] **Alimam**, M., Bertin, E., & Crespi, N. (2016, June). Improving the Capabilities of Email for Businesses-The Case of Social Tagging. In Twenty-Fourth European Conference on Information Systems (ECIS).
- [P4] Bertin, E., & **Alimam**, M. (2016, May). Collaboration sociale d'entreprise: Le réveil du courrier électronique?. In La 21ème édition du Colloque annuel de l'AIM (AIM 2016).
- [P5] **Alimam**, M., Bertin, E., & Crespi, N. (2016, November). Enterprise 2.0– Literature Taxonomy and Usage Evaluation. In IFIP Working Conference on The Practice of Enterprise Modeling (pp. 26-40). Springer International Publishing.
- [P6] **Alimam**, M., Bertin, E., & Crespi, N. ITIL perspective on Enterprise Social Media. International Journal of Information Management. 37(4), 317-326.

Submitted

- [P7] **Alimam**, M., Bertin, E., & Crespi, N. Exploring the activity on an Enterprise Social Networking platform – A case study. Information Systems Frontiers. Submitted in January 2017.

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Chapter I: Introduction

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I.1 Background

Today's organizations are increasingly promoting a shift of employees' ways of working towards more agility and flexibility [Daft, 2012]. This shift is leading the companies' strategic planning as it enables to address the demanding competitive environment that is challenging the accomplishment of their business goals [Cross, 2002], [Denning, 2011]. Hence, today's management is becoming less about commanding and more about supporting employees' collaboration and collective work [Bernoff, 2010], [Kuettner, 2013]. A growing number of informal work processes are thus taking place at the workplaces of these organizations. These processes are mainly described as spontaneous and unstructured expressing activities related to communication, collaboration, information exchange, and knowledge management.

Today's organizations rely on specific IT services, aka *enterprise tools*, to enable the execution of their work processes. The purpose of these enterprise tools is to increase the company's performance and improve productivity [Kulkarni, 2013]. Enterprise Information Systems (EIS) are probably the most popular tools used for that purpose. They mainly allow streamlining the company's business processes [Bryant, 2013], [Bonner, 2013].

Besides that digitalization of business processes' execution, enterprises also rely on complementary tools to enable the unstructured informational flow that does not belong to the scope of EIS processes. Known as *workplace tools* [Balakrishnan, 2010], these tools are also IT services, however used at the workplace to allow the execution of the enterprise's informal work processes. They vary depending on the company's specific needs. For example, telecommunication services such as videoconferencing and soft-phones are used for interpersonal communication, whereas, knowledge management systems are used to store, organize and retrieve information resources at a company. Another example of such workplace tools is the electronic mail, commonly called email, which is offered nowadays as a default service in almost all enterprises. Although originally designed for communication purposes, the variation of uses allowed by email turned it into a ubiquitous enterprise tool and one of the most popular ones in every workplace.

Nevertheless, since 2006¹, the business world has witnessed a rise of new innovative enterprise tools known as Enterprise Social Media (ESM). ESM tools are defined as web-based platforms that allow workers to communicate and collaborate following a

¹ The use of social media services in organizational contexts was firstly described by Andrew McAfee and referred to as Enterprise 2.0. See Chapter II for more details.

publish/subscribe interaction model². These tools swept to the enterprises following the significant success of their siblings in the public world. Public social media revolutionized people's interactions over the Web platforms as they helped maintaining people's existing social networks and connecting between strangers based on shared interests or activities [Ellison, 2007]. The similarity between public social media platforms and the new ways of working that are being enacted in today's enterprises brought to light the potential benefits of such tools for the companies and hence, encouraged their adoption [Alfaro, 2013]. Thus, a large number of ESM products, such as Jive, Yammer, etc., are now deployed and used in enterprises. Most of these products have a facebook-like interface for a social networking platform allowing workers to perform micro-blogging activities for communication and knowledge management purposes.

The phenomenon of using social media platform in organizational contexts invited several actors to participate and contribute to the lifecycle of these tools: ESM designers and solution providers to deliver platforms adapted for a particular enterprise use; enterprise management to decide whether such services would correlate with the company's strategy and assist in accomplishing its objectives; IT administrators in the enterprises to supervise the selection and the correct deployment and use of this new enterprise tool; and finally, the employees of the company who will be empowered by the new tool, and based on their use, the implementation of such services would be considered as beneficial to the company.

In terms of research, contributions to the field of ESM have not been sufficiently numerous compared to the urgent need to explore this rapidly spreading phenomenon. At the early stage of these tools, the young research domain of ESM was emergent. Hence, like in any new innovation (e.g., the case of emerging ERP systems [Nazemi, 2012]), theories and their evidences were missed while researchers were focusing on analyzing this phenomenon. Now after one decade, although this domain seems to move towards more sustainability [Wehner, 2016], [Williams, 2013], a crucial need yet exists for additional studies that build evidences based on experimentations and empirical results.

I.2 Motivation and Research Questions

The promising potentials of ESM platforms have urged enterprise management to adopt their solutions [Curtis, 2010]. Market studies show a growing demand for products of

² Chapter II provides a precise description of ESM tools

ESM platforms. In 2012, McKinsey Global Institute reported that 70% of 4200 companies around the world are using social media [Chui, 2012]. Gartner also predicted in the same year that 50% of large companies would have a deployed ESM platform by the end of 2016 [Mann, 2012]. The adoption of ESM platforms is thus proliferating in today's enterprises while the research is not aligning its focus to cover critical aspects related to their initiatives [P5]. That is to say, the wide spread of deployed ESM platforms at workplaces has created a polemical situation related to the state of these newly deployed enterprise tools within the work environment. We describe this situation based on two perspectives complementary to each other. The first is an internal perspective that provides a focus on the ESM platforms themselves, whereas the second is an external perspective that concerns the environment of workplace tools within which ESM platforms are introduced. We elaborate on each of the perspectives as follows.

Firstly, it has become imperative to correlate between the real usage of ESM platforms and the business expectations. Companies deploying ESM solutions rely mostly on promises of market's leaders and surveys of market's analysts. However, these companies need to rely on what is beyond these anticipations. They need to be able to assess the use of their deployed solutions based on tangible benefits in order to determine whether these solutions are accomplishing the planned goals that initiated their deployments at the beginning. This leads to a first research question as follows:

RQ1: *How to determine the benefits of using ESM platforms in companies and assess the success of their deployments?*

Secondly, observing the introduction of ESM platforms to workplaces suggests offering a wider perspective of examination; one that involves the existing enterprise workplace tools. The purpose is to study how the use of these new tools impacts the presence of existing enterprise tools. Particularly, the promise of ESM platforms has been fostering the shift of workplace tools from traditional forms of communication tools represented mainly by email [Alfaro, 2013], [Silic, 2015]. ESM platforms seem to be supporting the emergent new ways of working in organizations. Indeed, these newer platforms rely at their core on the creation of relationships between users [Leonardi, 2013]. In the face of email overload, these platforms enable a new way of establishing employees' communicative and collaborative activities [McAfee, 2009]; a way that capitalizes more on the social aspect compared to the traditional user-centric tool of email [Treem, 2012]. Yet in practice, email continues to play a central role in enterprises. Its widespread use is even expected to continue growing according to recent market statistics and forecasts for 2019 [Radicati, 2015]. This context leads to crucial questions

related to the environment containing the workplace tools and the impact of the new tool.

RQ2: *Are ESM platforms supplements to, or substitutes for certain existing workplace tools?*

RQ3: *How would the introduction of ESM platforms impact the design of existing workplace tools?*

I.3 Contributions of the Thesis

This thesis aims at examining the impact of the deployed ESM platforms on the organizational environment of coexisting workplace tools. In order to address the research questions presented in Section I.2, it first starts by clarifying the concept of these tools and developing a deeper understanding of their presence in the companies based on a comprehensive review of their literature.

Next, while addressing the first research question, RQ1, it tackles the problem of assessing the success of introducing ESM platforms to enterprises from a perspective that focuses on their deployments. It argues that the new opportunities that these tools offer to the companies should be assessed based on the analysis of real usage rather than based on promises and theoretical expectations. It thus offers a quantitative analysis of an established ESM platform. While characterizing the activity, it infers the main usage, from which, ESM users benefit the most. It evaluates this usage with tangible values based on a proposed research model. The proposed evaluation is a step towards enabling companies to accurately measure the success of ESM deployments and thus the return of their investments on adopting such tools.

Furthermore, from an external perspective that involves the hosting environment, this thesis contributes to exploring the impact of ESM platforms on the workplace tools. To answer the second research question related to determining the place of these platforms among the workplace tools, RQ2, we first offer an explanatory identification of critical criteria that describe the overall set of enterprise workplace tools and categorize them into a typology. Apart from the characterization of the platforms, we also offer a comparison between the ESM platforms and the email as it is the most widely used enterprise tool. The purpose is to determine whether these two tools will work in tandem.

Drawing on our conclusion of the above contribution, we finally address the third question, RQ3, about how ESM platforms would impact the design of existing

workplace tools. We argue that the new social dimension that distinguishes these newly introduced tools suggests a new vision of the existing traditional ones. Providing a particular focus on email, we propose an enriched design of this tool that builds on its underlying social network in a similar way to social media while drawing attention to its latent knowledge. Hence, we propose, and validate through an experimented prototype, a new service that we name: email social tagging service.

To conclude our work, we argue that the future research should provide a systemic perspective of the workplace tools; one that considers these tools as parts of an ecosystem that may be seen as an Enterprise Social Systems (ESSs) [Kumar, 2016]. We thus discuss possible scenarios of future ESSs.

Based on the above, we summarize our contributions along this thesis through five main points as elaborated below. These contributions are either published in proceedings of peer-reviewed conferences, or submitted to peer-reviewed journals. Table I.1 provides more details about the research articles based on which we built our contributions.

Contribution 1: A comprehensive review of ESM literature that classifies it and contributes to identifying its gaps and future research areas. Our survey is provided from a tool-centric perspective inspecting the research contributions that concern every stage of the lifecycle of these tools. It encompasses the interdisciplinary perspectives formed about these tools in different research communities.

Contribution 2: A quantitative analysis and mining of real usage data generated from an established ESM platform. We infer reliable information about the platform's benefit that is valuable to the workforce in the organizational context. We also contribute to assisting managers who are questioning their investments by determining whether these platforms are being correctly used based on tangible measures. While the availability of this type of organizational data analysis is almost inexistent, we believe that, to our best knowledge, our analysis here is the first to provide tangible usage evaluation and success measurement.

Contribution 3: A reasoning approach that determines the place of ESM within the environment of existing workplace tools. We provide evidence of the reason why, contrary to prior assumptions, ESM platforms cannot be a substitute for the central enterprise tool of email.

Contribution 4: A prototype of “email tagging service”. An innovative service that enriches the design of email with a social tagging feature in order to capitalize on its latent knowledge. The utility of our prototype is demonstrated based on qualitative experimentation and interviews conducted in a real organizational context.

Contribution 5: A proposition of possible scenarios of future ESSs with a highlight of their main advantages and pitfalls.

Thesis contribution	Research article(s)	Bookmark	Research Question
Contribution 1	[P5], [P6]	Chapter II	-
Contribution 2	[P1], [P7]	Chapter III	RQ1
Contribution 3	[P2], [P3], [P4]	Chapter IV	RQ2
Contribution 4	[P3], [P4]	Chapter IV	RQ3
Contribution 5	[P2]	Chapter V	-

Table I.1 Author’s research articles and contributions

I.4 Context of the Thesis

This thesis is carried out at Orange labs and Telecom SudParis. Orange labs is a division at the operator Orange specialized in research and innovation, and forming a huge community of members, teams, and research projects. As part of a team responsible for delivering innovative services for enterprises, our work has contributed to a research project entitled “Work Environment for Employee Empowerment (WEfEE)”.

Apart from the research objectives of the project, the problem statement described in this thesis is also a contextual fact at the hosting company. As a large group, Orange has recently adopted a transformation strategy that allows it to remain at the head of competitors. This strategy relies mainly on employee’s empowerment and is supported by powerful technologies to deliver a boosted performance.

For that purpose, Orange announced in 2015 the official launch of an internal social network that has been put into practice since 2012 through two releases. The tool is intended to support the collaboration and a new promoted transparent information exchange between employees. Its first beta launch was subject to a certain user resistance and led to a usage related mainly to social activities. However, the second

release of this tool pushed its use towards the creation of business related communities which expressed employees' knowledge management and collaboration activities. The tool is now being used by more than 30,000 users.

Nevertheless, the newer release of this tool could not substitute the practice of older ways of communication expressed mainly through email exchanges. Thus, employees remained to be subject to email overload. This state arrived against some assumptions about the new tool and confused the perception of its utility at the early stage of its beta launch.

Being involved within such a context, as users as well as researchers, allowed us to observe and experience the situation very closely. It also provided us with a perfectly appropriate case to analyze concretely and to conduct, based on it, surveys and experiments related to this thesis.

I.5 Organization of the Thesis

This thesis is organized as follows (see also Table I.1). Chapter I presents the problem statement and highlights the main research questions addressed within the context presented.

Chapter II surveys and summarizes the literature on ESM. First, it contributes to clarifying the concept of these newer workplace tools. Then it provides a classification of the literature structured around the lifecycle stages of ESM. It thus outlines the literature's main research areas and highlights the remaining issues.

Chapter III evaluates the deployments of ESM platforms at the workplace based on usage analysis. It hypothesizes some measurements to determine the correct use of the platforms. It finally provides a quantitative social network analysis and mining of a case of an ESM platform put into practice to validate the hypotheses and obtain the measurements.

Chapter IV determines the impact of ESM platforms on their hosting environment of workplace tools. It is composed of two main sections. The first section offers a characterization of the platforms based on a developed explanatory typology. Further, it provides a focus on email and compares it to the platforms in terms of capabilities and usage. The second section proposes the email tagging service, which is an example of how existing workplace tools may be enriched with social features to increase their benefit to the workforce.

Chapter V provides conclusions and implications. It conceptually discusses scenarios of future social systems. It finally concludes with a discussion of the limitations and the future perspectives of this thesis.

Chapter II: Literature Review

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II.1 Introduction

At the time of their emergence, ESM platforms were considered as experimental [Bughin, 2008]. Early studies about these tools mainly focused on describing their functionalities and potentials risks. However now, as this research field is moving towards sustainability [Williams, 2013], recent scholars seem to give more attention to other aspects of ESM, such as their characterization, deployment, use, etc. Yet, many challenges in ESM research remain, and a misalignment exists between the research focus and business needs [El Ouiridi, 2015], [James Baxter, 2012], [Wehner, 2016], [Williams, 2013].

This state of ESM research echoes the state of Enterprise Resource Planning (ERP) systems when, like in any new innovation, theories and evidences were lacking at the early stage of their rise. Hence, ERP researchers of that era significantly contributed to ERP research by identifying and categorizing the research issues around product lifecycle processes [Esteves, 1999]. In fact, ESM platforms are software packages, just like any other IT service that need to be managed within an enterprise. As in ERP systems [Nazemi, 2012], ESM platforms also have a structured lifecycle that represents the phases through which an ESM project passes in the deploying organization. To our knowledge, their deployment processes have never been examined neither evaluated as other standard enterprise IT services. However, the need for such evaluation has become very important, as it allows identifying the stages of the lifecycle that need to be improved.

This Chapter addresses the lack of theoretical structure in the ESM research field. It investigates the ESM from an IT Service Management (ITSM) perspective that focuses on the overall management of ESM as part of an enterprise's IT services. We analyze and categorize the literature based on a globally recognized standard of ITSM known as ITIL framework. ITIL-based management covers the major stages of an IT service lifecycle, ensuring that the deployed services are fully aligned with business needs and meet customers' requirements. Hence, the following research question is addressed: *What are the gaps that could be identified in ESM literature if these services were evaluated in the same way as other established enterprise IT services?*

In this Chapter, Section II.2 discusses similar surveys and elaborates on the concepts of ESM and the ITIL. Section II.3 offers the methodology that we followed to build our survey. Section II.4 presents the distribution of literature based on the ITIL stages. Section II.5 discusses the remaining gaps. Finally, Section II.6 provides conclusions.

II.2 Theoretical Foundations

II.2.1 Related Work

Although the ESM research field is relatively young compared to other fields, yet we were able to identify a few research studies that reviewed the ESM literature within the context of using social media in enterprises for business purposes. We cite these articles here and explain how we build on their work.

On the one hand, the authors in [Williams, 2013] provide a survey of both academic research studies and industrial reports. Largely considered as a new innovation, the authors reveal how ESM research has been mainly focused on the adoption and the use of these services, while significantly overlooking a number of industrial interests related to ESM control and governance. The authors argue that the rising phenomenon of ESM has reached the point of sustainability and thus scholars must turn their focus away from its description and exploration to the empirical large-scale examination of established cases.

On the other hand, similar findings are also provided in other five literature reviews, however, within a narrower scope. The focus in [James Baxter, 2012] is maintained specifically on the area of ESM implementation, whereas the one in [El Ouiridi, 2015] is maintained on the literature related to the use of ESM.

Attention is drawn to the use of online social networks in organizational contexts in [Berger, 2014] and [Hanafizadeh, 2012]. However, [Berger, 2014] limits its scope to the Information Systems (IS) research studies, which is also the case in [Wehner, 2016]. Reference [Hanafizadeh, 2012] also maintains a specific focus on the business impacts of this use whether internally or externally.

Drawing upon our analysis of the mentioned literature reviews, we acknowledge their findings and support the claim in [Williams, 2013] that the ESM research field should no longer be considered as emergent. We also argue that the last five studies are performed within a specific focus; one that misses considering the overall lifecycle of ESM and the interdisciplinary perspectives of their studies. For this purpose, we provide, through the literature review of this Chapter, a broader perspective that involves each stage of the lifecycle of these IT tools.

II.2.2 ESM Concept in the Literature

II.2.2.1 What are ESM platforms

A broad definition of the social media used for communication and interaction within the workplace is provided in [Leonardi, 2013]:

ESM are “web-based platforms that allow workers to do the following:

- 1) Communicate messages with specific co-workers or broadcast messages to everyone in the organization.
- 2) Explicitly indicate or implicitly reveal particular co-workers as communication partners.
- 3) Post, edit, and sort text and files linked to themselves or others.
- 4) View the messages, connections, text, and files communicated, posted, edited and sorted by anyone else in the organization at any time of their choosing”.

Building knowledge is at the core of ESM [Gardner, 2013]. In terms of functionality, ESM services specifically promote the social networking enabled through their platforms [Ellison, 2007] and the role of established online social connections in organizational communicative activities [Turban, 2011].

II.2.2.2 Several terms – the same notion

Alongside with the ongoing evolution of the ESM research filed since its emergence, many terms were developed by different research communities referring to the notion of ESM. We mention, in the following, the most frequently used terms that we have identified during this thesis.

- *Enterprise Social Software* rose from the notion of groupware and computer-supported collaborative work (CSCW), emphasizing the action of interacting groups of people [Allen, 2004], [Bibikas, 2010], [Bruno, 2011], [Christidis, 2012], [Cook, 2008], [Erol, 2010], [Haefliger, 2011], [Shirky, 2005].
- *Enterprise 2.0* denotes the use of emergent social software platforms in corporations for business purposes [McAfee, 2006]. Employed alongside Enterprise Social Software [Herzog, 2013], the term Enterprise 2.0, aka *Emergent Social Software Platform* [McAfee, 2013], highlights the organizational strategic challenges and the managerial considerations related to

the corporate use of these Web 2.0 technologies [Bibikas, 2010], [Corso, 2008], [Kuettner, 2013], [McAfee, 2013].

- *Enterprise Social Systems* however, outline the systemic aspect, bringing together all types of a company’s operations in the same enterprise architecture, which is also known as a social enterprise [Bhatti, 2013], [Burégio, 2015], [Mettler, 2015], [P2]. It responds particularly to the need for emergent collaboration, shared knowledge and the development of personal relations.

Nevertheless, we find that ESM is the term corresponding best to this thesis’s scope that we detail in Section II.2.2.4.

II.2.2.3 Evolution of ESM tools

ESM usually take the form of features integrated into a single platform (e.g. social networking platforms). However, they can also exist as individual stand-alone tools. Technically, they constitute a combination of Web 2.0 technologies that reveal a strategic integration into the various organizational processes [Bughin, 2008].

Although no specific set of ESM tools has been explicitly provided in the literature, current research seems to have an implicit consensus about the key tools that are most used in enterprises. Table II.1 interprets this consensus, providing a chronological overview of the research articles that we identified mentioning ESM tools.

Contributions		E2.0 Tools												
		Web services	P2P networking	Collective intelligence	Social networking	Podcasts	Blogs	Micro-blogging	RSS feeds	Wikis	Mash-ups	Social bookmarking	Virtual worlds	Social customer relationship management
Early stage	[Bughin, 2008]	○	○	○	○	○	○		○	○	○			
Current	[Andriole, 2010]			●	●	●	●	●	●	●	●	●	●	
	[Treem, 2012]				●		●	●	●	●	●	●		
	[Gardner, 2013]				●		●	●	●	●	●	●		
	[McAfee, 2013]				●		●	●	●	●	●	●		
	[Burégio, 2015] [Schubert, 2015]				●		●	●	●	●	●	●		●
	Key tools				✓		✓	✓	✓	✓		✓		

Table II.1 Key ESM tools as found in the literature

Table II.2 offers an overview on each tool. As indicated in the Table II.1, between the early stage of ESM research [Bughin, 2008] and the current stage, a wide set of these tools are provided. The table also shows that not all of these tools were kept in enterprises under the umbrella of ESM. The last column states the tools most commonly mentioned in the current literature, as they appear in (at least) 50% of the cited contributions. These tools are: social networking, blogs, micro-blogging, RSS feeds, wikis, and social bookmarking [Andriole, 2010], [Bughin, 2008], [Burégio, 2015], [Gardner, 2013], [McAfee, 2013], [Schubert, 2015], [Treem, 2012]. Nevertheless, for the rest of this thesis, we do not distinguish between different tools. Instead, we use ESM platforms to refer to social networking platforms integrating the mentioned tools as features.

Tool	Description
Web services	Software facilitating the communication between systems
Peer-to-peer networking (P2P)	A technique for efficiently sharing files within a closed set of users
Collective intelligence	Any system attempting to reach a decision-making made by a group rather than an individual
Social networking	Any system allowing users to create profiles and learn about other members' profile information
Podcast	Multimedia form (audio or video recording) of a blog or other content
Blogs	Online journals or diaries hosted on a website
Micro-blogging	A service enabling its subscribers to broadcast messages to other subscribers
Really Simple Syndication (RSS)	A method allowing people to subscribe to online distribution of information (e.g. news, blogs, etc.)
Wikis	Systems for collaborative editing and publishing
Mash-ups	Creation of new services that aggregate contents from different online sources.
Social bookmarking	Sharing, editing and tagging web bookmarks with subscribers
Virtual worlds	Simulated environments wherein users participate in activities and communicate with others using created personal avatars

Getting Things Done software (GTDware)	A lightweight project management functionality
Social Customer Relationship Management (CRM):	Services engage with customers using social features

Table II.2 Description of ESM tools

II.2.2.4 Scope

The term ESM entails the use of publicly available platforms as well as private or enterprise-owned ones to accomplish business objectives [Leonardi, 2013], [Turban, 2011], [Wehner, 2016]. This implies using ESM to support employees' information exchange internally and streamline the business processes, as well as to allow external communication with stakeholders and customers [McAfee, 2013]. However in this thesis, we particularly bring into focus the internal use of ESM platforms at the workplace. Yet, the blend of social features with a company's predefined business flows, as in [Maamar, 2014], is not included in our scope.

II.2.3 ITIL: a Framework for Service Management

The Information Technology Infrastructure Library (ITIL) is a globally recognized standard that contains a series of best practices for IT Service Management (ITSM) in organizations. Often used in conjunction with other models, such as Control Objectives for Information and Related Technologies (COBIT) for IT governance and The Open Group Architecture Framework (TOGAF) for IT architecture, ITIL has grown to be the most popular and complete ITSM framework that aligns IT services with business needs [Arraj, 2010], [Marrone, 2011].

ITIL was first published in 1989. In its latest edition (2011) it provides a revolving flow of five core stages that cover and manage the lifecycle of IT services as shown in Figure II.1 [Meijer, 2013]. These stages are: service strategy, design, transition (for its deployment management), operation and continual service improvement. A specific description of each stage is provided in Section II.3.2.

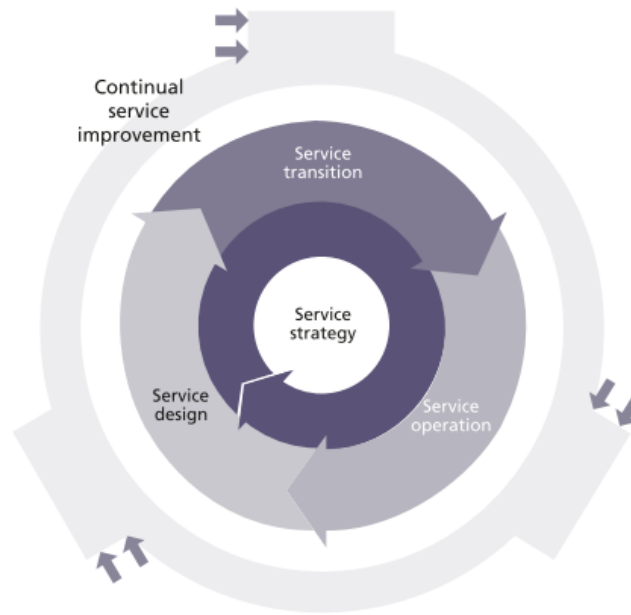


Figure II.1 service lifecycle (source: [Meijer, 2013])

Implementation of ITIL can be applied to all businesses and environments. It plays a critical role in the deployment of enterprise systems such as ERP systems [Parvizi, 2013] and hence, in improving the organizational performance [Iden, 2013] and bringing value to organizations [Vicente, 2013].

ITIL resolves the issue of IT miscommunications within enterprises. Traditionally, the setup of an IT organization comprises two enterprise parties communicating with the client (the application user): application developers (responsible for developing or providing IT products) and production personnel (responsible for issues concerning IT operations). Communication is established with the client through two separate channels: One allows the application management to establish agreements on new applications; and the other is used by production personnel to ensure an error-free functioning of the IT applications. This setup creates serious issues due to miscommunication between the two IT organization entities. For example, an application must be sufficiently considered during the development phase in order for it to operate smoothly while conforming to the operational requirements.

ITIL implementation therefore places a central IT service management (ITSM) channel to mediate between the IT organization side and the business side. It coordinates the application development and the IT operations and directs the communication with the client (see Figure II.1).

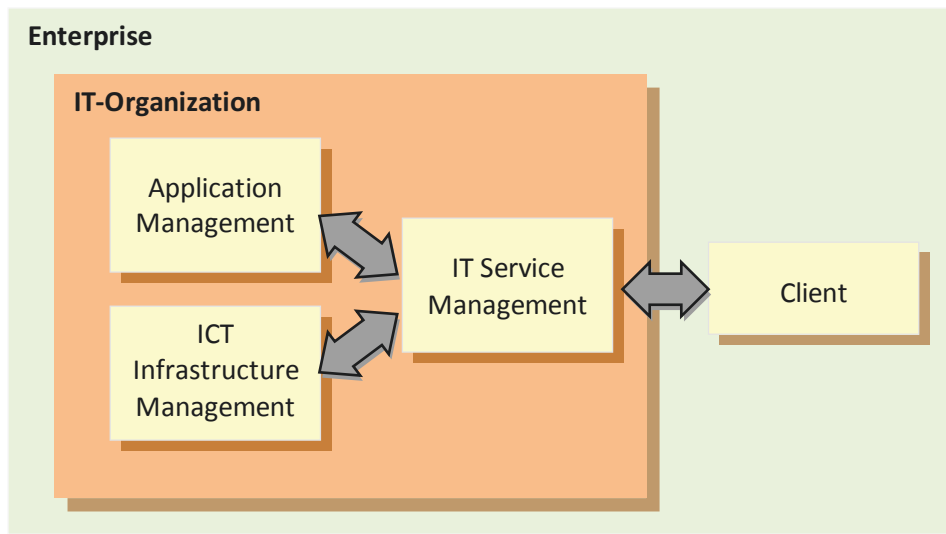


Figure II.2 An IT organization setup according to the ITIL

II.3 Survey Methodology

Our survey examines the current state of ESM literature. It addresses the following research question: Considering that ESM research has become a stable field ten years after its emergence [Williams, 2013], does the research within this field completely cover all aspects of the entire lifecycle of ESM?

To answer this question we evaluate the literature within a holistic context of organizational IT services lifecycles. We argue that, as with other enterprise IT services, ESM are newly introduced services that should also follow a strategic management approach. Hence, we rely on the ITIL framework for delivering valuable IT services to businesses. Our methodology encompasses two main phases as elaborated in the next paragraphs.

II.3.1 Identifying the Relevant Literature

We follow a structured and iterative process built on Webster and Waston's approach [Webster, 2002] and Okoli and Schabram's guidelines [Okoli, 2010] to search, identify, and analyze the relevant literature. As this field only emerged in 2006, we deliberately excluded from our scope all scholar works that appeared in the three years following its introduction to avoid the bias of exploratory and descriptive literature [Williams, 2013].

We searched among peer-reviewed articles published in major scholarly journals and conference proceedings between 2010 and 2016. In addition, since publications on ESM

belong to various disciplines, instead of directly mining specific journals, we followed Webster and Waston's guidance and searched for articles in online access databases. The following four libraries were selected based on their impact evaluation and wide coverage: Wiley Online Library, SpringerLink, IEEE Xplore, and Science Direct.

To obtain our dataset, we, firstly, performed a keyword-based search using the following query: "enterprise" AND "social media" OR "enterprise 2.0". This step returned 298 articles. Secondly, based on a comprehensive lecture of the abstracts, we manually selected the relevant articles which returned 35 articles. Citations of each article were then reviewed which added 8 articles.

Finally, a second search was performed to review the citations of the added articles, yet, no relevant articles were detected. The resulted dataset of 45 articles was then analyzed and mapped to the ITIL framework.

II.3.2 ESM Implementation According to the ITIL Framework

The ITIL framework is able to accompany the implementation of any new IT service within an enterprise. However, its generic terminologies and processes should be adapted to the particular case of implementing ESM at the workplace.

Regarding the enterprise parties, client here refers to the *company's* employees who are becoming users of the ESM platform to be deployed; whereas the term *enterprise management* indicates the IT organization. For simplicity reasons, we use the same term to refer to the ITSM, application management and ICT infrastructure management. The enterprise management is responsible for selecting an appropriate ESM solution from the market's service provider offerings or, developing a private solution. The enterprise management also deploys and manages the ESM solution and coordinates with the company's top management to establish a strategic planning and vision.

During the implementation, some practices should be ensured at each of the five lifecycle stages of the service as follows:

- (1) During the *service strategy* stage, the enterprise management decides on a strategy that aligns its employees' needs to the company's strategic objectives. The organizational requirements should be well-defined at this stage, taking into account the capabilities of the offering of ESM service provider's in the market.
- (2) The *service design* includes all actions related to the design of the ESM. The enterprise management decides whether to develop a new private ESM platform

or to select and customize a market offering. The requirements, having been defined and recorded in the service strategy, are analyzed and agreed upon in order to produce an ESM architectural design that conforms to the strategy’s constraints. The design should also ensure compliance with the company’s IT infrastructure as well as its corporate and IT policies.

- (3) Deploying ESM platforms is achieved at the *service transition* stage. The enterprise validates the deployment and the utility of the platform as it has been designed and documented at the design stage. It ensures the employees’ acceptance and the realization of the desired outcome while controlling the risks of failure.
- (4) The *service operation* stage is responsible for technical, application and operation management. The enterprise management ensures all the activities and processes that should be applied and coordinated to deliver service support at agreed-upon levels.
- (5) *Continual service improvement* is an ongoing process in which the enterprise focuses on the value returned to its employees while ensuring that the service is continually updated to address future needs. This stage combines methods of quality management and capability improvement.

We use these implementation guidelines as a reference to evaluate the literature on ESM by mapping it onto the service’s lifecycle stages. The five obtained categories of contributions, corresponding to each stage, were then grouped by theme into sub categories as elaborated below.

II.4 Literature Categories Based on the ITIL Lifecycle Stages

Figure II.3 shows the distribution graph of the selected articles on the five lifecycle stages of the ITIL. A summary of these findings is provided in Table II.3.

Themes at ESM lifecycle stages		Nb	Contributions
Strategy	Guidelines for deployment	4	[Burégio, 2015], [Louw, 2013], [Shirish, 2016], [Turban, 2011]
	Identifying opportunities	15	[Androile, 2010], [Burégio, 2015], [Cleveland, 2016], [Evans, 2015], [Fulk, 2013], [Gardner, 2013], [Holtzblatt, 2013], [Louw, 2013], [Mäntymäki, 2016], [Ooms, 2015], [Richter, 2013b], [Riemer, 2012], [Treem, 2012], [Turban, 2011], [Williams, 2011]

	Identifying enterprise requirements	2	[Schubert, 2015], [Williams, 2011]
Design	Design and limitations	3	[Komarov, 2014], [Leonardi, 2013], [Mathiesen, 2013]
	Architectural considerations	5	[Burégio, 2013], [Burégio, 2015], [Cross, 2010], [Dhara, 2010], [Maamar, 2015a]
Transition	Adoption approaches	7	[Guinan, 2014], [Louw, 2013], [Mathiesen, 2013], [Meske, 2013], [Richter, 2013a], [Riemer, 2012], [Turban, 2011]
	Challenges facing the deployment	13	[Almeida, 2012], [Androile, 2010], [bin Husin, 2010], [Braun, 2013], [Haeffliger, 2011], [Hanley, 2013], [Krogh, 2012], [Louw, 2013], [Oostervink, 2016], [Poba-Nzaou, 2016], [Riedl, 2012], [Trimi, 2014], [Turban, 2011]
Operation	Promoting users' participation	5	[Hanley, 2013], [Kuettner, 2013], [Louw, 2013], [Meske, 2013], [Schubert, 2015]
	Roles and responsibilities	6	[Bhatti, 2013], [Burégio, 2015], [De Hertogh, 2011], [Louw, 2013], [Maamar, 2015b], [Mathiesen, 2013]
Continual improvement	Identifying performance indicators	3	[Androile, 2010], [Burégio, 2015], [Turban, 2011]
	Evaluating user's perception and feedback	5	[Holtzblatt, 2013], [Mettler, 2015], [Richter, 2013a], [Shirish, 2016], [Treem, 2015]
	Analyzing data generated from usage	3	[Cao, 2013], [Lin, 2012], [Riemer, 2012]

Table II.3 Identified themes and contributions at each ESM lifecycle stage

II.4.1 Strategy

17 studies are investigating this stage of the ESM lifecycle. Three main themes are identified as described in the following paragraphs.

II.4.1.1 Guidelines for a successful ESM deployment

The literature provides best practices to succeed the deployment of ESM platforms. A market analysis is required to establish the awareness of the service's benefits and possible risks [Burégio, 2015]. The clear enterprise strategic vision should be translated into functional and non-functional requirements that assist in selecting the appropriate solution [Burégio, 2015], [Louw, 2013], [Turban, 2011]. The financial benefits and costs associated with the use of the chosen service should be calculated [Turban, 2011].

Also, the necessary IT infrastructure must be identified, including the company's current security systems, in order to determine the feasible level of mixed infrastructure for this deployment. The organizational culture and the readiness of its top management to support the deployment should be examined. An organization should then indicate how, according to its policy and regulations, it allows its employees to manipulate the service while defining the nature of content to be exchanged. Finally, a promotion, maintenance, and risk management plans should be defined [Burégio, 2015], [Turban, 2011]. The training programs should be aligned with younger employees' goals and interests, the use should be kept professional, and the privacy should be maintained in a transformational leadership style [Shirish, 2016].

II.4.1.2 Identifying the opportunities of ESM

Being aware of the capabilities of ESM platforms and the opportunities³ they offer is a key factor behind a company's decision to select and adopt the new service [Turban, 2011], [Louw, 2013], [Burégio, 2015]. The opportunities ESM platforms provide are thus explored on two levels: collective and individual.

At the collective level, several studies have explored ESM and characterized their platforms from aspects including the communicative, the collaborative, and so on. We therefore analyze these studies and aggregate their outlined opportunities into one list aiming to provide an overall guide of potentials and benefits of ESM platforms. More specifically:

- (1) ESM services provide an information-sharing channel that motivates information dissemination and transfer;
- (2) they capitalize on the social relations and enable users to communicate informally and expand their relationships;
- (3) they increase the awareness and transparency as their behaviors and knowledge are made visible to others;
- (4) they are editable as they enable users to craft and re-craft a communication act before it is viewed by others;
- (5) their communicative activities remain accessible after the end of the communication which makes them persistent;

³ Apart from the term "opportunity", the literature is also using, according to its perspective, other terms such as: benefit, functionality, feature, and capability

- (6) they promote users' participation and collaboration and provide a space for collective intelligence, crowd-sourcing ideas and innovation;
- (7) they support the orchestration of workflows and coordinate activities;
- (8) their ease of use facilitate learning and training such as in wikis and blogs;
- (9) they enable a knowledge management where digital contents can be collectively created, organized, and monitored by users;
- (10) finally, they can be a place for finding expertise and solving problems.

Table II.4 offers an overview of this list indicating the studies revealing each opportunity.

Opportunity	Contribution(s)
(1) Information dissemination	[Fulk, 2013], [Richter, 2013b], [Riemer, 2012], [Turban, 2011]
(2) Communication and social networking	[Androile, 2010], [Fulk, 2013], [Gardner, 2013], [Mäntymäki, 2016], [Ooms, 2015], [Richter, 2013b], [Riemer, 2012], [Treem, 2012], [Turban, 2011], [Williams, 2011]
(3) Visibility	[Richter, 2013b], [Treem, 2012]
(4) Editability	[Treem, 2012]
(5) Persistence	[Treem, 2012]
(6) Collaboration and innovation	[Androile, 2010], [Evans, 2015], [Holtzblatt, 2013], [Mäntymäki, 2016], [Richter, 2013b], [Riemer, 2012], [Turban, 2011], [Williams, 2011]
(7) Coordination	[Mäntymäki, 2016], [Ooms, 2015], [Williams, 2011]
(8) Training and learning	[Androile, 2010], [Turban, 2011]
(9) Knowledge management	[Androile, 2010], [Gardner, 2013], [Turban, 2011], [Williams, 2011]
(10) Expertise finding and problem solving	[Fulk, 2013], [Mäntymäki, 2016], [Richter, 2013b], [Riemer, 2012], [Turban, 2011]

Table II.4 Opportunities offered by ESM services

At the individual level, as different types of ESM are observed, some scholars are further investigating the variance of capability support between different types of ESM. Both [Turban, 2011] and [Treem, 2012] highlight the degree to which one ESM is supporting a number of capabilities provided in each one of their works. For example, wikis support a high degree of collaboration, innovation, and communication, but a low

degree of management activities and problem solving. From the same lens, [Burégio, 2015] describes the key capability supported by each type while highlighting its possible risks. Also, [Cleveland, 2016] explores features of micro-blogging and demonstrates its positive impact on knowledge processes which enables, thus, knowledge creation.

We synthesize the above findings as follows:

- a) Wikis co-create knowledge through shared content, but require strong commitment to keep the content updated;
- b) Online social networks support access for expertise, resources, and leaders with the provided social profiles, however, their advantages are only useful when they are accessed by a large number of users;
- c) Micro-blogging encourages interactive discussions and allows informal information communication, but its unstructured content might cause information overload; social bookmarking promotes a useful information resources assessment, but raises confidentiality concerns when the access to resources is (too) open. Features of micro-blogs impact upon the knowledge processes as follows:
 - The knowledge seeking process is impacted by the pervasiveness of micro-blogging (i.e. accessibility from any location or device); the ability to repost; and the created user profiles which are sources of knowledge.
 - The knowledge contribution process is impacted by the brevity of micro-blogging interactions.
 - Both knowledge seeking and contribution processes are impacted by the features representing the ability to subscribe to experts, exchange direct communication and tagging.

II.4.1.3 Identifying enterprise requirements for ESM

The correlation between the organizational requirements and the capabilities of the researched ESM is a key success factor in the ESM implementation process. Reference [Schubert, 2015] provides a guiding framework based on an established overview of activities (business processes and use cases). While arguing that business activities that have a non-sequenced ad-hoc structure cannot be modeled, the authors propose describing these types of activities through use cases, which is more flexible. The framework uses the activities' descriptions to identify candidate areas for collaboration

scenarios. These scenarios are then matched with features of the tools. The authors finally propose to establish a generic catalogue of predefined collaboration scenarios that frequently occur in companies.

The authors in [Williams, 2011] empirically examine the companies' main motivation to deploy the new service. In addition to the collaboration aspect, companies are also requiring mechanisms to manage their collective knowledge in order to improve the benefit diffusion of their own expertise and better manage its innovation. The key required functionality in these solutions is therefore identified as managing content creation.

II.4.2 Design

The eight contributions at this stage are grouped into two themes.

II.4.2.1 Design and limitations of current ESM products

The range of features and functionalities of ESM platforms can be distinguished by the underlying business models that are deployed by the service providers. Several components of these models are explored in the literature.

In [Leonardi, 2013], the authors provide a historical description of the delivery of ESM platforms. Since their emergence, ESM platforms have been delivered to organizations following one of three forms.

- The first form exists in enterprises as public services, yet not particularly specific to the enterprise, such as publicly available micro-blogs and online social networking sites (e.g. Facebook). This form enables the employees' interactions with external customers.
- The second form exists as private services exclusively for internal audiences, implemented and hosted either by the company itself or as cloud-based services. A wide variety of such products exists in the market and provided by leading IT service providers such as Salesforce's Chatter, Microsoft's Sharepoint, and Jive from Jive Software.
- The third form is implemented in enterprises as in-house developed proprietary solutions, often built as research prototypes. Lessons learned from such prototypes are then incorporated into new commercial products. For example, Beehive system which was launched in 2007 as a Facebook-like social network

for the internal use of IBM employees. Beehive was then discontinued in 2011 and had many of its features incorporated into a new product called SocialBlue.

In addition to the delivery of ESM, a wide perspective of analysis is also provided in [Mathiesen, 2013] based on the several elements of their business models. ESM products are here grouped into three distinct archetypes as follows:

- (1) Consumer model which is community driven (e.g. Facebook) providing access to either open or private networks and integrated into a wider set of consumer applications (e.g. sign in with a Facebook identity);
- (2) Corporate model, tightly integrated with organizational processes and technologies (e.g. Microsoft SharePoint). This model is primarily focused on the employee and is funded by service licensing;
- (3) Hybrid model, which blends the corporately focused models with the packaging of a consumer model making use of the community driven benefits (e.g. Jive).

Looking into these models from the perspective of [Leonardi, 2013], we infer that the consumer model exists in enterprise in the form of public services, whereas both the corporate and the hybrid models are implemented as private services customized for the enterprise's objectives.

Nevertheless, challenges are facing the design of today's products. ESM users are reporting the following features as crucial in the design of ESM: Security, ease of use, price, design and interface, and finally, user support and file management [Komarov, 2014]. The authors in [Mathiesen, 2013] raise the question about the ability of corporate providers to shift towards more consumer based approaches and the consumer providers to serve the corporate market.

II.4.2.2 ESM ecosystem architectural considerations

Beyond their specification and business models, literature on ESM contains guidance and technical discussions related to their architectural design. The integration of ESM platforms within the company's activities and operations is critical to the success of their initiatives [Cross, 2010]. Regarding their communicative activities, [Dhara, 2010] reconsiders the architecture of the company's communication service to integrate views from several online social network platforms. The authors' proposed architecture builds on application views that use APIs from the desired social networking platforms and combine them in a SIP communication process. Based on this, they build a prototype of an enterprise service that they call "rendezvous" which provides the person who is placing a call, with information about the availability and current context of the

respondent from his/her social platform. Although their prototype is only tested using Twitter and Facebook, yet their proposed architecture builds on application views that use APIs from the desired social networking platforms.

As for their operational activities, [Burégio, 2015] conceptualizes an architecture that bridges between the business and the social worlds through a “meet-in-the-middle platform”. The platform consists of connectable building blocks named as social machines [Burégio, 2013]. An example of implementing the functionalities of these social machines is illustrated in [Maamar, 2015a], through message-based interactions. “Link” functionality mediates the authentication process of a stakeholder on his/her social network account and establishes a pre-authorized communication channel in order to let business processes (e.g. launching a marketing campaign) create posts on the social network.

II.4.3 Transition

At this stage, 18 contributions are classified into two themes.

II.4.3.1 Different ESM adoption approaches

Achieving a successful ESM implementation at the enterprise requires the management of this enterprise to adopt a well-defined adoption strategy that takes into account the specific enterprise conditions [Turban, 2011]. It must be aligned with the organization’s mission, work processes, culture and industry [Guinan, 2014], [Louw, 2013]. Several adoption approaches are explored in the literature as follows:

- A bottom-up approach that relies on the personal preferences of employees and avoids the management’s excessive regulation (e.g. the case of the Deloitte company adopting Yammer for social networking after one year of use initiated by a group of Deloitte consultants [Riemer, 2012]). This approach is best applicable in growing organizations with a critical mass of younger employees or in flatter organizations where younger employees have better visibility to senior management [Guinan, 2014], [Richter, 2013a].
- A top-down approach is, however, optimal in situations where a rapid adoption is needed to meet competitive challenges management [Guinan, 2014], [Richter, 2013a] especially in small to medium enterprises [Meske, 2013].
- A middle-out approach is optimal in larger, globally dispersed organizations where entrepreneurs and middle managers have enough technical knowledge to

master these tools and enough influence over the projects and work processes to propagate usage [Guinan, 2014].

- A hybrid approach is possibly the most suitable to ESM platforms [Louw, 2013], [Mathiesen, 2013]. It combines top-down elements with bottom-up elements to provide guidance and managerial support while allowing a degree of autonomy in usage and content creation by the end-users.

II.4.3.2 Challenges facing ESM deployment

As attention is given to concerns associated with the adoption and promotion of ESM platforms, we provide here the results of our analysis of published guidelines and various frameworks that describe and characterize these challenges. Our results combine overlapping challenges into five categories related to the organization, technology, information and usage. They can be used as a reference that summarizes the challenges to be considered at the deployment stage. The categories are as follows:

- *Enterprise Structure:* The relationship between the enterprise and the platform users (i.e. employees and clients) can influence the deployment [Haefliger, 2011]. In large organizations, ESM users appreciate the benefits of the deployed services better than their managers [Trimi, 2014].
- *Enterprise culture:* Employees' mindset can reject changing established routines and resist using the new platform. Thus, the adoption of such technology requires a culture that supports the innovation [bin Husin, 2010], [Louw, 2013], [Poba-Nzaou, 2016], [Riedl, 2012], [Turban, 2011].
- *Service complexity:* The complex design or use of the new platform (e.g. a poor design or a lack of the graphical user interface consistency) and its rapid evolution can result in cognitive constraints and influence user adoption [Hanley, 2013], [Louw, 2013], [Poba-Nzaou, 2016].
- *Information security and control:* ESM platforms allow little control over published content, whereas corporations usually aim to control and protect their information to avoid sensitive data leakage [Almeida, 2012], [Androile, 2010], [Braun, 2013], [Haefliger, 2011]. This loss of control can also influence the company's reputation in case of negative interactions through public communication channels [Braun, 2013], [Poba-Nzaou, 2016]. The use of the new platform can result in some legal issues related to the intellectual property of the generated knowledge [Poba-Nzaou, 2016], [Turban, 2011]. The control of user rights and permissions while maintaining the leadership and empowerment

of users' communities has a direct influence on the user interaction and contribution [bin Husin, 2010], [Louw, 2013]. The confidentiality of the enterprise information can also be exposed to malicious attacks in case of service vulnerability. [Braun, 2013], [Turban, 2011]. The transferred knowledge over platforms allowing a mixed content (internal and external) risk passing to competitors [Krogh, 2012].

- *Interest*: Employees' mindset can refuse the change of its established routine and resist using the new platform. The adoption of such technology requires, thus, a culture that supports innovation. Employees are also confronted with an ambiguity of use as ESM offer an openness that is not specifically limited to the company's boundaries [Braun, 2013], [bin Husin, 2010], [Louw, 2013], [Oostervink, 2016], [Poba-Nzaou, 2016], [Riedl, 2012].
- *Resources*: The extensive engagement in the new platform is a potential threat as it raises the question of resource management including the waste of productive time, internet consumption, etc. The lack of guiding policies and internal resources also represents a potential threat [Poba-Nzaou, 2016], [Turban, 2011].

II.4.4 Operation

Formulating and maintaining a governance plan is critical at this stage [Burégio, 2015], [De Hertogh, 2011], [Hanley, 2013], [Louw, 2013]. In relation to the governance and control of ESM platforms, two themes are identified in the 11 contributions.

II.4.4.1 Promoting users' participation

Deployed ESM platforms require a specific approach, relying mainly on promotion, in order to manage the evolutionary socio-technical change that they cause within the companies [Kuettner, 2013]. Hence, guiding framework at this stage require formulating, by a decision making authority, a practical technology roadmap. The roadmap should involve training, communication and promotion program supported by online training content and live interactive workshops and training sessions to gain end-user awareness and participation [Hanley, 2013], [Louw, 2013]. Users have to be convinced of the benefits of the selected tool as the act of using it is often voluntary [Schubert, 2015]. This is why considering the employees' mindset is a key factor of a successful implementation, especially in the case of small to medium enterprises [Meske, 2013].

II.4.4.2 Roles and responsibilities

Researchers suggest empowering end-user and giving users sufficient autonomy to exploit, contribute and distribute content [De Hertogh, 2011], [Mathiesen, 2013]. However, use rights should be defined [Burégio, 2015], [Louw, 2013]. The authors in [Bhatti, 2013] prove the stability of integrating a role-based access control framework with a system of group communication that allows message exchange in ESM. The approach in [Maamar, 2015b], however, categorizes the applications' social operations in order to define the proper restrictions of each category's actions.

II.4.5 Continual Improvement

At this stage, 11 contributions are divided into three themes.

II.4.5.1 Identifying performance indicators

Identifying relevant metrics is critical for the enterprise to determine the tangible benefits of ESM [Burégio, 2015]. However, few of the surveyed studies offer key performance indicators. The derived metrics currently remain at a general level [Turban, 2011], as they are not derived from each tool's technical specification (e.g. In [Androile, 2010], the ability to share knowledge is derived from the functionality of knowledge management).

II.4.5.2 Evaluating user's perception and feedback

User's perception, and hence, the usage itself varies between users. According to [Richter, 2013a], ESM platforms are used as a social tool for task coordination in teams; as a social tool for organizing within projects; or as a networking and crowd-sourcing space at enterprise-wide levels. The intensity of usage also impacts this perception: Only active contributors experience the benefits consistently [Holtzblatt, 2013]. Also, studies reveal that, contrary to expectations, younger employees resist the use of ESM platforms as they have concerns about their potential distraction or risks [Shirish, 2016], [Treem, 2015]. Similarly, [Mettler, 2015] argues that, in regards to sharing information, users are more self-interested and less social in corporate environments than in private contexts.

II.4.5.3 Analyzing data generated from ESM usage

The relationship between users' interactions on their social network and their attributes derived from the company's graph of hierarchy is explored in [Cao, 2013]: Peered

employees are more interactive with each other or with their direct manager; they interact more when employed in the same country. Reference [Riemer, 2012] analyzes the messages exchanged over a Yammer social platform, and proposes new criteria for collaboration systems' classification: Capturing and storing data, and building relationships and conversation. The authors in [Lin, 2012] gather data not only from the company's social networking platform, but also from other sources, including e-mails and instant message communications. Their findings reveal that mixing genders in teams produce a better financial performance, and that projects with too many managers seem to be less successful financially.

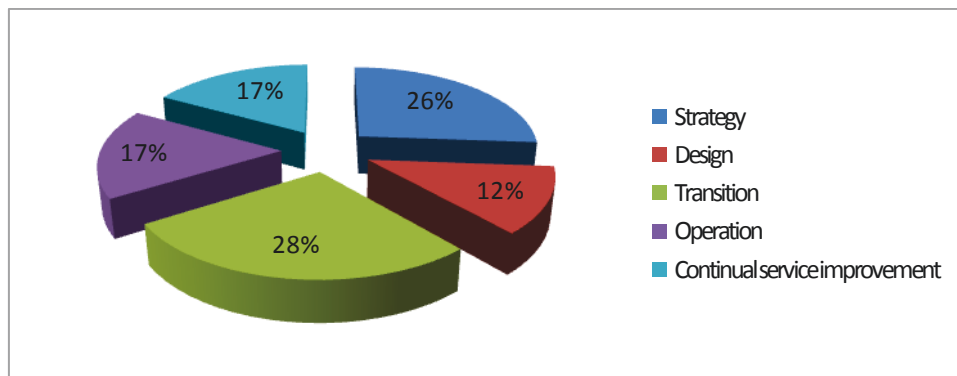


Figure II.3 Distribution of ESM literature on the ITIL lifecycle stages

II.5 Discussion and Remaining Issues

The global overview, shown in Figure II.3, suggests that the current ESM literature is indeed covering all five stages. However, we highlight, according to Table II.3, a particular focus maintained mainly on two themes. The majority of current ESM studies are concentrating on identifying the opportunities and challenges of ESM platforms. The reason for this is probably because that the majority of organizations are currently at the phase of testing a new deployed ESM platform or planning to do so.

Our findings suggest maintaining a vision of the complete lifecycle stages while studying the tools; starting from the enterprise's strategic objectives. For example, ESM developers should ensure the correlation between their provided design and the organizational needs expressed by corporate implementers. The defined KPI should be able to evaluate the achievement of the company's objectives. These objectives should be specific and measurable, not vague terms, such as "bringing agility" or "transforming ways of working".

From the same overall perspective, we support the call for additional empirical methods that is highlighted in previous literature reviews. We argue further that empirical case studies are now more available for exploration; researchers are thus prompted to rely on the analysis of such case studies besides their standard currently applied methods of survey data collection. Issues and pitfalls detected in current deployments should be hence used as inputs of a new iteration of the lifecycle.

The overall observation of the lifecycle also suggests going beyond the current focus on the ESM platforms themselves. It suggests a systemic consideration of the platforms; one that contributes to exploring the impacts of introducing such platforms to an environment containing exiting similar tools that are already in practice.

Apart from the mentioned general observations, we also bring to light several remaining gaps at each of the five stages. We draw on our identified themes while comparing the findings with the ITIL's key processes that should be executed at each stage. We thus highlight the following issues:

- **Strategy:** According to the ITIL, the process of considering the right fit between companies' expressed needs and the market's offerings is still missing. Evaluating the variation of company sizes between small and large, which influences a company's requirements and financial capacity, needs to be considered within strategic planning to initiate an optimal ESM implementation. Research also needs to consider the trade-off between safe practices with strict control and risky reliance on employees' discretion that achieves greater innovation.
- **Design:** Several issues remain here starting from linking between the strategic planning achieved in the first stage and the proposed design. The architectural design needs to be more developed to cover technical details related to its consistency and compliance with a company's processes, infrastructure, policies, etc. The influence of the corporate context on the design of these ESM platforms should also be considered. Typically, for private or in-house services, enterprise services reach much fewer users than in the public world, which leads to the creation of much smaller social graphs. From that perspective, the social networks design analyses, such as identifying advantages and challenges of their interaction patterns or developing their content clustering mechanisms, etc. should be reconsidered for ESM platforms.
- **Transition:** The impact of this deployment on existing enterprise services having similar functionalities is not addressed. The question of whether ESM

platforms should substitute existing tools such as email remains problematic (e.g. the case of adopting a zero email approach based on the use of a social networking platform [Silic, 2015]). Also, none of the risk analysis frameworks is comparing the identified challenges with the risk of not implementing ESM platforms.

- **Operation:** The literature's focus on promotion is systematic, as newly introduced IT tools can always be met with users' resistance to change. However, research also needs to bring into focus the risk mitigation techniques in addition to other aspects of ESM control. For example, the issue of controlling and protecting the privacy of the generated knowledge while empowering users' participation and initiatives remains problematic.
- **Continual service improvement:** Measuring the returned value of ESM platforms and providing a proof of their Return On Investment remain ambiguous. Also, the definition of appropriate Key Performance Indicators (KPIs), able to evaluate employees' participation and engagement, is still needed. Furthermore, as the usage of ESM platforms is gradually moving towards sustainability in enterprises, more focus on their usage and the analysis of their generated big data becomes indispensable especially to predict risk breaches [Wahi, 2015].

II.6 Conclusion

This Chapter evaluated the literature on ESM within the holistic context of any IT service lifecycle. Given the lack of taxonomies and structures in current ESM literature, we contributed to this growing research field by summarizing and tabulating the literature findings for easy reference while relying on the ITIL framework for delivering valuable IT guidance to businesses.

Our findings act as a foundation for researchers as they provide an overview of the current research streams. We discussed the main remaining issues at each lifecycle stage and highlighted the promising research areas for future research.

Apart from that, we provided essential general observations related to the overall vision of the ESM lifecycle. Based on these findings, we conclude with the following two points:

- Firstly, given that the majority of current research has focused on defining the opportunities and challenges of ESM platforms, it seems imperative now to

bring to light the validation of what has been identified so far. That is, to provide evidences about whether or not ESM platforms are attaining their promising potentials after they became in practice. Thus, this validation has to be based on real usage data especially that, several years after deployment, a steadily growing number of empirical case studies have now become available for exploration.

- Secondly, besides the current focus on topics related to ESM platforms, a broader focus on the impact of these platforms on their hosting environment is remaining. It has been discussed in the literature how the introduction of an ESM platform to the workplace influences the organizational culture and mindset of employees at the company (e.g. [P1], [Turban, 2011]). However, apart from such socio-organizational concerns, the technical aspects related to this introduction remain unexplored. Yet until now very little is known about if or how ESM platforms impact the way existing workplace tools operate and are used; whether these platforms are technically capable of substituting the use of existing tools; and further, whether the advantages of the platform's social features may not be used to enhance the operations of existing tools. We thus highlight the need for the research to investigate and develop the understanding of such aspects.

The above mentioned conclusions reveal two critical challenges that this thesis will be addressing further in this manuscript. We devote a complete chapter for each challenge. Our contributions are hence presented in Chapter III and Chapter IV respectively.

Chapter III: An Internal Perspective on ESM Platforms: Quantitative Usage Analysis

Given the main remaining challenges highlighted in Section II.6, this chapter is devoted to addressing the issue related to evaluating the potentials and the deployment of ESM platforms based on real usage data. This issue has been outlined through the first research question as presented in Section I.2.

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III.1 Introduction

The use of ESM platforms has been increasing rapidly in businesses during the recent years [Chui, 2013]. The enormous success of this type of platform in the mass-market triggered their diffusion into the enterprise world. Some distinguished solutions such as Jive⁴ and Yammer⁵ are now leading today's market providing Facebook-like platforms for private enterprise use. The informality of their use seems to support the organizational shift towards agility [Majumdar, 2013], [Richter, 2016]; a shift that has been leading the strategic planning of today's companies [Daft, 2012], [Resca, 2013].

The wide spread of public and professional social networking platforms has made them the target for comprehensive data mining and analysis of their underlying networks. These sorts of investigations aim to quantitatively discover patterns and interesting knowledge from the data sets generated from the use of these platforms. Although intensively applied in the public world (e.g. [Han, 2015], [Külcü, 2014], [Wilson, 2009]), especially for advertising (e.g. [Podobnik, 2013]), these analysis approaches are still new in the business world. The use of these platforms is recent compared to the use of public social networking sites, and data generated from their usage is less accessible than data of mass-market products. Hence, apart from relying on the promises of market's leaders or on surveys from analysts and feedback from users, companies that are deploying ESM solutions are lacking quantitative studies on the real usage of these platforms at the workplace. Indicators to measure the success of their deployment with tangible values are remarkably unavailable. Monitoring and evaluating the usage of an ESM platform are thus becoming an essential need [P5].

Within the context of evaluating the place of ESM platforms in today's workplaces, this Chapter offers a focus that is specifically related to the ESM as platforms put into practice in enterprises. We explore how these platforms are being used at the workplace. The purpose is to determine, based on real usage data, which of ESM goals is attained when these platforms enter into practice. Further, we argue that assessing the way activities are performed on these platforms allows determining the success of ESM deployments with tangible values. Hence, we offer a research model that allows exploring the activities performed on ESM platforms. Our model aims to address the following research question: *How to determine the benefits of using ESM platforms in companies and assess the success of their deployments?*

⁴ www.jivesoftware.com (accessed January, 8, 2017)

⁵ www.yammer.com (accessed January, 8, 2017)

Using the case of a well-established ESM platform, quantitative analysis and mining mechanisms are applied to test our formulated hypotheses. We exploit a data set extracted from the ESM's records with the support of its administrators. Profiles of 6250 members of the platform are mined and the activity of these members is analyzed during a time period of three months. We characterize the activity and outline how to determine the correct usage of the platform.

We argue that the definition of success is relative and depends on factors related to the organizational context and purposes of this deployment. Apart from the organization size that heavily impacts the perceived benefit of the deployment, the organizational form and the goals sought from this deployment also contribute to define the success. For further reading about this latter factor, see the highlighted box on page 39. However here, we consider as successful when the deployment of the ESM platform is succeeding in empowering the informal communicative activities of the company's workforce. The hypotheses that we develop thus concern the deployments wherein the company is seeking to shift towards the agility by supporting the empowerment of its workforce.

The remainder of the Chapter is organized as follows: Section III.2 highlights the related work. Section III.3 details our methodology and presents our research model. Section III.4 provides contextual information about the ESM on which our study was based. Section III.5 presents methods for setting up the data. Section III.6 provides insights into the technical aspects related to our calculations. Section III.7 analyzes and discusses each hypothesis, and Section III.8 provides conclusions.

III.2 Related Work

III.2.1 Deployment and Usage Assessment

Assessing the use of an ESM platform is a step that systematically follows its deployment. A well-done assessment evaluates whether a tool is being used in a way that corresponds to the managers' initial vision and anticipated purposes [P5].

Numerous studies have performed this type of assessment, relying on surveys, interviews, and feedback collected either from company's managers (e.g. [Androile, 2010]) or employees themselves (e.g. [Holtzblatt, 2013]). These studies highlight the core benefits perceived from the use of the newly deployed tool. A set of opportunities offered by ESM platforms is thus resulting (see Section II.4.1.2 for more details). These opportunities can be devised based on two distinguished dimensions: social and

informational. Two fundamental opportunities are thereby revealed as being most beneficial for the professional use of an ESM platform [Kline, 2013]:

- 1) using this tool to communicate and grow social capital, and
- 2) using it to exchange information and manage personal knowledge.

However, few studies evaluate this use based on empirical evidence. Both [Ellison, 2015] and [Mäntymäki, 2016] explore the multiple uses of ESM platforms with a focus on knowledge management practices. According to these authors, the use of an ESM platform can improve knowledge sharing when it builds on users' social capital. The authors in [Riemer, 2015] differentiate between forms of social capital and find that the use of ESM platforms favors collective and collaborative actions.

Nevertheless, and despite the above-mentioned highlights of how ESM usage has been explored, we argue that prior research overlooked assessing the examined ESM usage in terms of activity in order to describe what constitutes correct usage and thus a healthy activity and a successful deployment.

III.2.2 Social Network Analysis

Social network analysis is a research focus that involves a wide range of analysis and mining techniques from statistics and network science [Cross, 2002]. Applied to data sets generated from the use of a social networking platform, it allows researchers to quantitatively evaluate this usage and offers insights into behaviors, relationships, and activity of users and communities [Lin, 2012].

Social network analysis builds on the underlying networks in users' relations (i.e. social ties [Granovetter, 1973]) or users' interactions over the platform [Smith, 2009]. Although it is becoming prevalent in various areas among public social networking platforms (e.g. studying communities' behavior for political purposes [Bond, 2012]), this type of analysis remains very limited in the world of corporations for business purposes.

For example, [Cao, 2013] explore the relationship between users' interactions on their social network and their attributes derived from the company's graph of hierarchy. They outline how shorter hierarchical distance positively impacts the frequency of interactions. Reference [Lin, 2012] reveals that mixing genders in teams produces a better financial performance, and that projects with too many managers seem to be less successful financially. In [P5], we qualitatively compare two networks, generated independently, from Email and from ESM usage. We argue that employees use ESM

platforms to extent their professional relations beyond the circle of persons that they daily connect with at work.

Each for a different purpose, the above studies provide very useful information mined from the networks of ESM usage. However, these studies remain extremely few compared to the scale of enterprises' daily-generated big data and the huge amount of knowledge that underlies their networks [Chelmis, 2015]. Like in the public world, interesting information may be derived from the enterprise data about the employee behavior or even the business outcome. From this perspective we propose this Chapter's contribution.

Highlight

The relationship between the organizational forms and the deployment of ESM platforms

As different types of enterprises (i.e. organizational forms) involve different ways of working, deploying ESM platforms will, in its turn, differ in accordance with the organizational forms. These organizational forms stand as a mean to accomplish the organization's overall goals, however, they vary in accordance with the organization's management and strategy.

Theoretically, the organizational forms balance between two edges: the mechanistic edge and the organic edge [Burns, 1972], [Daft, 2012]. On the one hand, the mechanistic model represents the rigidity and the verticality. It implies a high formalization and respect of standard procedure, as for example in Fordist or bureaucratic organizations. In a pre-defined manner, information flows vertically up the organization's hierarchy and business processes get broken down into strict tasks.

On the other hand, the organic model represents the fluidity and the horizontality [Ylinen, 2014]. The informal new ways of working occurring in these forms cause the information to flow cross-departmentally and in all directions, which leads to a complexity of communication. This model is increasingly becoming a goal for companies searching to face sustainable challenges such as the organization's growing size and the competitive changeable environment outside its boundaries [Daft, 2012].

However in practice, the organizations are a hybridization of characteristics of each of the two edges only with different degrees. Looking into the opportunities that ESM platforms are capable of offering to the company, we highlight the close fit between the

ESM power and the organic forms. Although the communication is vital in both models, the vertical information flow in a broadcast style, which characterizes the mechanistic forms, does not specifically require the advanced functionalities of ESM platforms, which in turn also support teams' collaboration. Hence, while some enterprises with more mechanistic characteristics may not have interest in adopting this type of tool, the journey of those seeking for a transformation may be successfully supported through the deployment of ESM platforms (e.g. the case of the French Ministry of Foreign Affairs⁶).

III.3 Research Model and Hypotheses

As mentioned earlier, this Chapter addresses the question of evaluating the opportunities offered by ESM platforms and tangibly determining the success of their deployments. We argue that a platform's activity reflects the exploitation of its offered opportunities. To that end, we develop a research model that enables to characterize the activity of an established ESM platform (see Figure III.1). It examines how the platform is being used based on the evaluation of activities performed on the platform. Our objective is to determine how ESM platforms are benefiting their users. Also, we aim to determine whether an ESM platform is being correctly used which indicates its successful deployment.

ESM platforms essentially offer two opportunities to their users as follows (see Section III.2.1 for details):

- 1) To build social capital based on the creation of a personal network of relations.
- 2) To exchange information and practice activities related to the knowledge management.

The use of EMS platforms is thus derived from the use of features allowing benefiting from these two opportunities. Respectively with the two opportunities, these features represent the following two behaviors [Cao, 2013]:

- 1) The organizing behavior (i.e. the creation of social profiles, relations, and containers), which reflects benefiting from the first opportunity.
- 2) The interacting behavior (i.e. interacting within containers), which reflects benefiting from the second opportunity.

⁶ In July 2015, the French Ministry of Foreign Affairs officially launched its own ESM solution named "Diplomatie" [Chapuis, 2013] after six months of beta-use <http://www.diplomatie.gouv.fr/en/french-foreign-policy/digital-diplomacy/digital-diplomacy-and-knowledge/>

We use the term “container” here to refer to a space within which information can be published or exchanged (i.e. blog and/or group). We highlight that, after a period of initial usage, the steady activity of an ESM platform mainly shows in interacting rather than in organizing behavior⁷, as transactions relating to the latter occur infrequently after the initial period. The activity of an ESM is thus interpreted by users’ participation within containers.

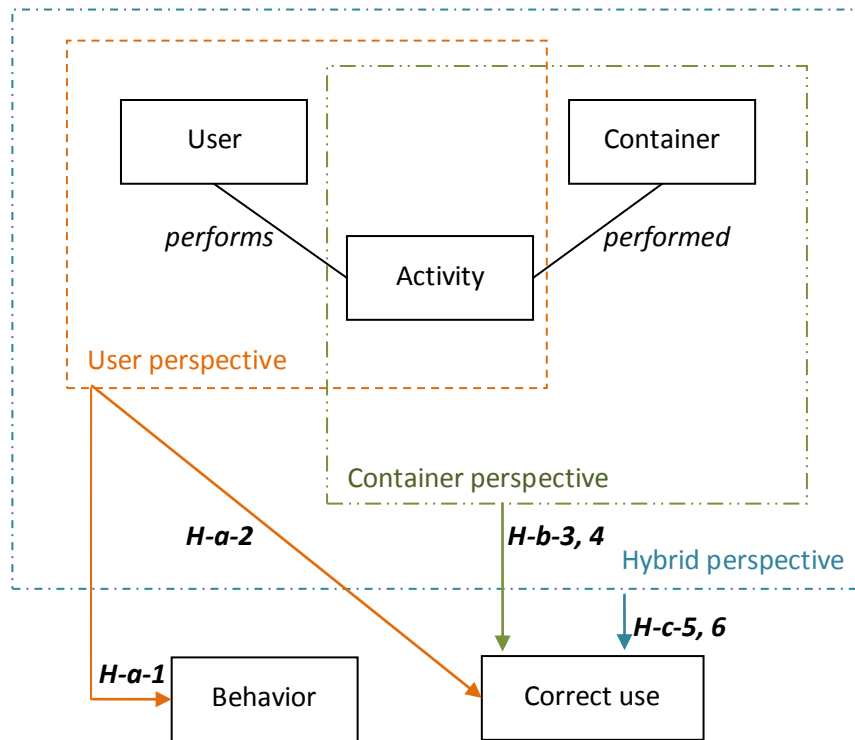


Figure III.1 Research model - activity is users’ participation within containers

In this context, we define three perspectives to analyze the activity of an ESM platform (i.e. users’ participation within containers): user perspective, container perspective, and activity perspective (i.e. user-container). In the following sub-sections, we elaborate on each of these three perspectives and formulate our hypotheses. Consequently, we apply a hypothesis testing methodology [Snijders, 2001] using the case study described in Section III.4.

⁷ Yet, we do not ignore the organizing behavior. This behavior is interpreted directly in users’ profiles. Thus, we explore it as part of the user’s perspective (see Section III.3.1 for details).

III.3.1 Activity from User Perspective

This perspective aims to explore the overall activity of each user individually. In this perspective we focus on user's activity. Thus, we study the total amount of a user's participation and omit the fact that a user may participate less in one container and more in another container. "Active participants" are considered as users who participate very frequently in the containers of the platform [Cao, 2013]. They can be identified based on the total amount of their participation compared to other less active or inactive users.

Active participants tend to be popular (i.e. the target of many interactions made by people in their network) [Mislove, 2007]. We are interested in studying the social power of these users as argued in [Wilson, 2009]. This power is owned from the social graph (i.e. users' location in the graph of their social relations). A participant with a strategic location in the social graph acts like a hub and can thus play a mediating role, transferring information to other users and thereby diffusing knowledge [Kang, 2015]. Users' social power corresponds to their organizing behavior that is interpreted directly in their profiles. For example, the result of a transaction corresponding to sending a membership request to a private social group is interpreted as a social relation appearing in the user's profile. Comparing users' organizing and interacting behaviors [Smith, 2009] reflects how an ESM platform is benefiting the company's employees as each behavior is related to a specific opportunity. Hence, the following hypothesis may be formulated for the organizational context.

H-a-1: Active participants are popular; they are connected to a great number of users and thus have significant social capital (i.e. power).

Users' activity (i.e. participation in containers), depends on factors such as age, involvement in the technology field, etc. [Treem, 2015]. This suggests that the potential effects of certain factors on user interaction behavior need to be explored. Although user age might have a direct effect on interactions, we deliberately choose to ignore this factor in consideration of profile information confidentiality. Hence, we focus on users' involvement in technologies which is reflected in their job or work domain. A correct use shows when users are involved equally in the use of their platform, no matter what their technological background is. Consequently, we formulate the following hypothesis to test the influence of this mentioned factor.

H-a-2: Users' activity does not depend on their involvement with technology at work. Participants are active independently of their type of job or work domain, such as developers.

III.3.2 Activity from Container Perspective

The second perspective provides a focus on containers' activity (i.e. what happens in containers). Containers are the places within which users perform their interactions. This perspective deliberately omits that fact that the container's interactions may be performed by specific users only.

Containers' activity reflects the liveliness of a platform [Brown, 2007]. Thus, a correct use of the ESM platform implies maintaining its containers active. To that end, container factors that affect / get affected by container's activity need to be explored. We focus on two factors: the number of members / followers of a container [Backstrom, 2006] and the audience of a container (i.e. to how many users their contents reach) [Lipsman, 2012]. The following two hypotheses may be thus formulated while arguing that they reflect a correct use:

H-b-3: Active containers contain a greater number of members.

H-b-4: Active containers have a greater audience.

III.3.3 Activity from User-Container Perspective

The third perspective is a hybrid of the first two. It provides a focus on the activity at a granular level. The activity is thus examined while taking into account every user's participation within every container. The goal is to study the distribution of users' participation within containers. This distribution may be biased if container's participation is made only by a specific group of users. According to the 1% rule, only 1% of users of a community actively create the majority of this community's content [Horowitz, 2006]. This rule is an observed phenomenon in cyber culture that segments the usage within Internet communities and collaborative websites [McConnell, 2006]. However in practice, the more users are involved in participating, the more correct the use of the platform becomes. This leads to the following hypothesis:

H-c-5: The significant participation in containers is made by more than 1% of the platform's users.

Finally, we argue that user's significant participation reflects user's key skills. Thus, participants cannot actively contribute to all or to a large number of containers. We thus formulate the last hypothesis that describes the correct use.

H-c-6: The significant participation of users is limited to specific containers. Participants cannot actively contribute to all or to a large number of containers.

III.4 Case Study

III.4.1 Context

Our empirical study is performed based on the use of a private ESM platform at CONNECT. We collect and analyze data generated from this use. CONNECT is a large multinational company from the IT/telecom industry containing 6250 employees. It encompasses a wide range of job types varying from research and development to marketing and sales. The knowledge work is prominent at CONNECT. Thus, the company uses a solution to support the knowledge activities between its employees. This ESM solution relies on Jive Software for internal employees' communication and collaboration. We refer to this ESM as the “JS” in the rest of the Chapter.

JS has a Facebook-like interface that transforms the two mentioned ESM opportunities into practice. It expresses the organizing and the interacting behaviors through six main features. The first four are derived from the first opportunity whereas the last two are derived from the second opportunity as follows:

- (1a): creating a personal profile;
- (1b): building asymmetric relations with other users, as a user can follow and receive notification from other users;
- (1c): joining or only subscribing to news feed of groups;
- (1d): creating containers (i.e. a personal blog and/or a group);
- (2a): creating pieces of content (e.g. texts, documents, polls, etc.) in a container;
- (2b): acting on an existing piece of content through a comment, a like or a vote, etc.

A container on the JS refers to a space within which information can be published or exchanged. It can be either a group or a blog belonging to a specific user. Groups on the JS belong to various types, including projects and community spaces. These in turn are associated with one of four possible levels of content privacy: “open”, in which membership is open and content is visible company-wide, “members only”, which is the same as open except that participation is limited to members of that group, “private”, where the content visibility is exclusive to approved members, and “secret”, which we deliberately excluded from our data set for privacy constraints.

After two years of beta testing, the JS was officially deployed in the targeted company in 2015. Its use has now become popular and well-established as it is being supported by the management of CONNECT.

III.4.2 Data Set

Our data set is extracted from the use of the JS by the 6250 employees of CONNECT. It has the advantage of capturing all employees' data while involving each of their activities even those performed within private groups. It contains data about employees' profiles. These profiles are of different types and backgrounds (e.g. project managers, team leaders, research and development engineers, academic researchers). However for privacy reasons, we anonymize users' identities and deliberately hide some of their profile data (i.e. age, gender), as well as the content of interactions. Hence, for each user u identified by an identifier (uID), we extract the work domain as an attribute ($uDomain$), and the job type ($uJob$), in addition to a list of records representing the user's relations with other users (e.g. u_1 has a relationship with u_2 (u_1ID, u_2ID) and with u_3 (u_1ID, u_3ID)). Information about containers is also extracted. Recall that a "container" refers to a group or a personal blog. 1103 containers are involved in our data set. For each container c with the identifier (cID), we extract its type ($cType$) (e.g. "project", "social group", "blog", etc.), title ($cName$), creation date ($cDate$), and total number of users ($nbUsers$), whether members or followers.

The data set also contains data generated from employees' interactions over the JS. We refer to every transaction related to the content performed by a user in a JS container as an "interaction". This corresponds to functionalities 2a and 2b. For example, a blog post being created by a user is considered as an interaction. A user's action of viewing, commenting, or voting on another user's content is also performing interactions. The following interaction types are thus captured: bookmarking, commenting, completing, creating, liking, modifying, moving, rating, viewing, and voting. We considered a time period of 3 months, starting in May 2016, as reliably indicative of employees' usual internal social networking activity, while providing a comprehensive level of complexity in terms of visualizing the generated graphs as explained later in this document. Therefore, for each interaction in identified by the identifier ($inID$), we extract the following record: ($inID, inType, objID, objType, uID, cID, inDate$), where $inType$ refers to the type of interaction, $objID$ and $objType$ represent the identifier and type of object on which an interaction was performed (e.g. "document", "even", "blogpost", etc.) in a specific container cID . Another critical attribute is also captured in our data set: the reach attribute of objects posted in containers ($objReach$). This attribute

indicates the number of times an object has been seen by users even without interacting with it. Table 1 provides general information about the data set.

General information							
Nb of members	6250	Nb of participants	4479	Nb of containers	1124	Nb of interactions	269140

Table III.1 General information about the JS data set

III.5 Method and Data Setup

Our study applies a hypothesis testing methodology while relying on analysis and mining mechanisms of the data set that we presented in the previous Section. To that end, we devote this Section to organize our data set and build the necessary networks in a way that addresses the purposes of the hypotheses that we defined in Section 0. The following sub-sections provide more details on how we set the data up.

III.5.1 User Perspective

The purpose here is to explore users' participation on the JS. The participation during the study period is thus examined independently of the container type where a user performs activities.

Giving each recorded interaction a weight value $w = 1$, we calculate the participation of an arbitrary user u as the sum of the weights of this user's activities in all containers.

$$user_participation(u) = \sum_{i=1}^n w_i \quad \text{where } n \text{ is the total number of records containing } uID$$

Based on their interactions with the JS, "active participants" are users who have a higher participation score compared to the average level of user participation in containers.

$$user_participation(u) > mean(p_i) \quad \text{where } i = 1..number \text{ of users}$$

H-a-1 suggests comparing between the organizing and the interacting behavior of users. The interacting behavior is represented by the calculated *user_participation* values. As for the organizing behavior, it may be represented by the social power of a user. To identify and utilize the social power of active participants, we build the users' social graph with users as nodes in the network and their relations as directed edges. Each user's social power is measured based on their betweenness centrality [White, 1994].

The betweenness measure of a given node u takes into account the node's location and its role as a hub. Based on this calculation, we study the correlation between users' power (i.e. coefficients of betweenness centrality) and their interactions (participation score) to determine if and how strongly these pairs of variables are related to each other.

H-a-2 suggests examining whether the *user_participation* values are influenced by the factors of user's job and work domain. We use the one-way analysis of variance (ANOVA) to determine whether there are any statistically significant differences between the means of participation scores grouped by each of these factors (i.e. job and work domain) individually.

III.5.2 Container Perspective

The purpose here is to explore the overall activity within containers in the search for factors affecting this activity. We consider that the activity of an arbitrary container is represented by the number of interactions that are taking place in it. For simplicity reasons, we give each interaction a weight value of $w=1$, and thus we can calculate the global activity of a container independently of users or objects as follows.

$$\text{container_participation}(c) = \sum_{i=1}^n w_i, \text{ where } n \text{ is the total number of records containing } cID$$

Based on the count of the interactions within containers, we consider "active containers" as containers that have a higher participation score compared to the average level of participation within containers.

$$\text{container_participation}(c) > \text{mean}(cp_i) \text{ where } i = 1 \dots \text{number of containers}$$

For the purposes of H-b-3 and H-b-4, we study the effect of two container factors on the interactions within containers. These factors are: the number of members / followers of a container and the reach score of a container. Pearson's product-moment correlation is then calculated to determine this relationship.

III.5.3 User-Container Perspective

This hybrid perspective examines the participation of users within containers. The purpose is to test whether a user's activity varies depending on the container. We thus calculate the interactions of each user within each container. Let u be an arbitrary user, the participation score of u in the container c is:

$$upc(u, c) = \sum_{i=1}^n w_i \quad \text{where } n \text{ is the total number of records} \\ \text{containing } u \text{ as } uID \text{ and } c \text{ as } cID$$

The same user thus may have a different score value in each container within which he/she participates. For example, let $upc(u10, c1)$ be 15 and $upc(u10, c4)$ be 400; this means that the participation score of $u10$ in $c4$ is much more significant than the same user's participation score in $c1$.

H-c-5 and H-c-6 focus on the significant participation (i.e. on high upc values). Thus, we define a threshold based on which we consider a upc value to be significant and therefore u as active.

To apply our tests, we build a network containing ucp values edges. An edge's source node is thus the uID value whereas its target node is the cID value. We analyze the generated network and study the distribution of user's participation within containers. More details are provided in the sub-section III.7.5.

III.6 Technical Considerations

This Chapter's graphics and statistical computing have been made using R⁸. R is a programming language freely available under the GNU General Public License. It allows users to statistically explore data sets and make graphical displays of data.

While R has a command line interface, several graphical user interfaces also exist for it. The one we chose for our calculations is called RStudio⁹. This latter is an integrated development environment that offers a set of integrated tools including a console, syntax-highlighting editor, plotting area, debugger, and file management. While available in both open source and commercial editions, we relied on the free edition of this software.

Using R environment contributed to add value to this thesis. It facilitated and accelerated the data manipulation, calculation, and graphical display while allowing benefiting from the following advantages:

- It is freely available contrary to other products of the same level of advance such as Matlab¹⁰.
- Its programming language is relatively simple and effective.

⁸ www.r-project.org (accessed January, 8, 2017)

⁹ www.rstudio.com (accessed January, 8, 2017)

¹⁰ www.mathworks.com (accessed January, 8, 2017)

- It complies and run on a multiple platforms including UNIX and Windows.
- It can be extended very easily with 9782 packages available on CRAN (as of January, 8, 2017). As it is open for developer, additional number of user-created packages can be thus found for use or for development on other websites. This allows us to avoid wasting time on rewriting available codes.
- It provides a wide variety of statistical tests that can be simply applied by including their corresponding libraries. This facilitates the testing process as there was no need to manually implement complex algorithms such as calculating the correlation or the betweenness centrality coefficients.
- Apart from its data mining capabilities, it offers, via its *igraph* package, many techniques for manipulating network data, visualizing network graphs, and calculating graph metrics.
- In terms of network graphical displays, its performance is a lot more powerful compared to the graphical performance of products that manipulate network graphs such as Gephi¹¹ and NodeXL¹².

III.6.1 Main Used Packages

As mentioned above, many packages are available to extend R apart from the eight packages supplied with its distribution. Installing a package is simple and quick. It is made via the following function calls (the example installs *igraph* package):

```
## Download and install the package
install.packages("igraph")

## Load the package
library(igraph)
```

The following includes, but not limited to, examples of functions and packages we used to get our results.

¹¹ Gephi is free, open source software offering advantageous network visualization and a calculation of the most common metrics for social network analysis. www.gephi.org (accessed January, 8, 2017)

¹² NodeXL is a free, open source template for Microsoft Excel used for network visualization and graph metric calculations [Smith, 2010]. This latter is only partly available for a free use. www.nodexl.codeplex.com (accessed January, 8, 2017)

Keyword	Description
<code>summary()</code>	Returns descriptive statistics of a data set including the minimum, mean, etc.
<code>cor()</code>	Calculated correlation between variables
<code>aov()</code>	Conduct ANOVA and returns an analysis of variance table
<code>data.table</code>	A package providing an enhanced version of <i>data.frame</i> allowing a fast manipulation of data
<code>fread()</code>	Imports data from large data files
<code>Igraph</code>	A package for network analysis and visualization
<code>graph_from_data_frame()</code>	Creates and returns a network from a data table
<code>betweenness()</code>	A built-in routine that calculates betweenness coefficients

Table III.2 Examples of functions and packages of R used in our analysis

Figure III.2 offers a preview of a code that we wrote in R to build a network of significant participation. We first import the data, calculate the *ucp* values, and generate the array of significant participation. Then, we create the corresponding arrays of source and target nodes (vertices). Finally we build the network and manipulate its properties before we plot the resulting graph.

```

code.r x
Source on Save
1 #####
2 ▾ #### Plotting the graph of very significant participation ####
3 #####
4 library(data.table)
5 ac <- fread("Activity.csv")
6 library(plyr)
7 scores<-count(ac,c("userid","containerid","containertype"))
8 ## Graph of >100
9 scores.sig <- scores[scores$freq>100,]
10 colnames(scores.sig)[4]<-"weight"
11 ## Creating a table of corresponding nodes (vertices)
12 temp <- count(scores.sig, c("userid"))
13 activeusers <- data.table(temp$userid,rep("user",
14   length(temp$userid)),rep(1,length(temp$userid)))
15 temp <- count(scores.sig, c("containerid"))
16 groupsofactiveusers<-data.table(temp$containerid,rep("group",|
17   length(temp$containerid)),rep(2,length(temp$containerid)))
18 nodes <- rbind(activeusers,groupsofactiveusers)
19 ## Building the network
20 net.sig <- graph_from_data_frame(d=scores.sig,
21   vertices=nodes, directed=T)
22 ## Modifying a node's color according to its type
23 colrs <- c("gray50", "tomato")
24 V(net.sig)$color <- colrs[V(net.sig)$V3]
25 V(net.sig)$shape <- c("circle", "square")[V(net.sig)$V3]
26 E(net.sig)$width <- E(net.sig)$weight/600
27 plot(net.sig, edge.arrow.size=.4,vertex.size=5,
28   vertex.label.dist=.5,vertex.label.color=V(net.sig)$color)
29 legend(x=-1.5, y=-1.1, c("user","group"), pch=21,col="#777777",
30   pt.bg=colrs, pt.cex=2, cex=.8, bty="n", ncol=1)
31 #####

```

Figure III.2 Excerpt from R code: building and plotting the network of significant participation

III.7 Analysis and Mining of JS

Before detailing the analysis of each of the three perspectives, we provide in Table III.3 a summary of the JS data set. The following interesting facts are observed from Table III.1 and Table III.3. 72 % of the company's employees who are members of the JS are actually participating over this platform and have records of interactions. This high percentage of involved users indicates their interest in JS, especially since their participation occurs during the stability period of the tool (i.e. not only right after its launch).

User's social relations		Participation score per user		Participation score per container		Participation score per user, container	
Min	1	Min	1	Min	1	Min	1
1 st quartile	1	1 st quartile	12	1 st quartile	4	1 st quartile	1
Median	4	Median	25	Median	16	Median	2
Mean	11	Mean	60	Mean	55	Mean	6
3 rd quartile	12	3 rd quartile	98	3 rd quartile	51	3 rd quartile	4
Max	429	Max	9099	Max	1266	Max	7997

Table III.3 High level statistics of the JS data set

However, the density of user participation within containers varies. Although the average participation score per user is 60 during the study period, this value seems influenced by the participation of active users who represent less than 25% of participants. 75% of participants have no more than 98 recorded interactions. The same observation can also be made regarding social relations and the two other participation types. For example, 75% of users have less than 12 relations.

We elaborate, next, on the analysis based on each of the formulated hypotheses. Table III.4 summarizes our results.

III.7.1 Hypothesis H-a-1

Our analysis here consists in determining the social significance of active participants. We investigate the relationship between participants' *betweenness centrality* values and their *user_participation* values. The *Pearson's product-moment correlation* coefficient is 0.22, which is closer to 0 than to 1. This means that the pairs of variables are weakly related to each other.

The above result conflicts with *H-a-1*, which suggested that users who are active participants should have a significant number of established social relations compared to other less active users. Nevertheless, this contradictory finding clearly shows how this social networking tool is being used in this company. Active participants are this portion of the company's employees who are showing a real interest in the tool and are benefiting from its usage. However, these interested users seem to privilege the use of the JS as a tool for information dissemination over its other uses. This leads us to

deduce what ESM functionalities are more valuable to users and best fit their needs and expectations.

Contrary to public platforms, users in the enterprise world are less interested in building social capital and in extending their social relations through such a tool. Functionalities 1a to 1d are thus less vital for the structure of an ESM as long as this tool is enabling its users to communicate and interact directly within containers without the need for established relations between each other. Enterprise users are more interested in the content than in the identities of users generating this content. The assumption that ESMs increase information transparency with benefits for knowledge management thus seems valid [McAfee, 2009].

	Name / attribute	Result
Hypothesis	H-a-1	Not-supported
Test	Pearson's correlation	
	Coefficient	0.217335
Hypothesis	H-a-2	Supported
Test	One-way ANOVA	Factors
		Work domain Job
	Degrees of Freedom	6 37
	F-value	1.774 0.876
	p-value	0.101 0.683
Hypothesis	H-b-3	Not-supported
Test	Pearson's correlation	
	Coefficient	0.3729743
	One-way ANOVA	Factor
		Container Type
	Degrees of Freedom	2
	F-value	1.455
	p-value	0.234
Hypothesis	H-b-4	Supported
Tests	Pearson correlation	
	Coefficient	0.8215556
	Simple linear regression	
	p-value	< 2.2e-16
Hypothesis	H-b-5	Supported
Test	1% rule	See Table III.5
Hypothesis	H-b-6	Supported

Test	Qualitative network analysis	See Table III.5
------	------------------------------	-----------------

Table III.4 – Overview of the formulated hypotheses and results

III.7.2 Hypothesis H-a-2

Our second hypothesis suggests that users' activity is not influenced by their involvement in the technology. We examine the variability of *user_participation* values in response to, firstly, the work domain factor (*uDomain*), which contains seven different domains, and secondly, the job type (*uJob*), which is more precise and contains 38 distinct jobs. For each of the two factors, our findings indicate no impact on the activity of participants.

The *one-way ANOVA* test determines no statistically significant difference between the means, as the level of significance (*p-value*) is greater than 0.05 (see Table III.4 for details about the calculation results). These findings support *H-a-2*. They suggest, therefore, that the company's employees are involved equally in the usage of their ESM, independently of their backgrounds and skills.

III.7.3 Hypothesis H-b-3

The third hypothesis suggests that a relation exists between the sizes of containers (*cSize*) and the participation scores within these containers. The *Pearson's product-moment correlation* coefficient for the pairs of variables (*cSize*, *container_participation*) returns a value of 0.37, which does not support the hypothesis as it does not indicate a tight relationship between the pairs.

We also examine the variances and find no statistically significant difference between the three types of containers (open, member-only, and private). We explain these findings with the fact that users who are inactive in certain containers are still members or followers of these containers. Users subscribe to containers that could potentially interest them; however, they do not seem to do the opposite action (i.e. unsubscribe) when they no longer have an interest in these containers. We relate this behavior to the tool's subscription mechanism, which allows completely inactive members to maintain their membership in containers. This behavior can be explained further based on our previous findings (see *H-a-1*). Users seem not rely on their news feed page which contains content generated based on established relations (with persons or groups). Instead, they seem to directly browse their preferred containers, given that they can adapt their notification settings to stay updated from their chosen containers

III.7.4 Hypothesis H-b-4

This hypothesis suggests that the participation within containers impacts the audience of these containers. The audience is an insight data value that indicates the reach of a container's posts (i.e. the number of times this container's posts were viewed by users during the chosen period). Indeed, the *Pearson's product-moment correlation* test result is close to 1 (coefficient = 0.82), which reveals strongly related pairs of variables (*container_participation*, *container_reach*).

We follow up with a regression analysis to build a model that describes this significant relationship. We build on *container_participation* as the independent variable (predictor) to predict the dependent variable *container_reach* (outcome). Our outcome has continuous values; the *linear regression* is thus applied to calculate the outcome's fitted values. The estimated simple linear regression equation is then expressed as follows:

$$\text{container_reach} = 7.28 (\text{container_participation}) - 16.89$$

Based on this model, if a container gets a new, higher participation score (e.g. 1000), we expect this container to obtain a greater audience (*container_reach* = 7297). Figure III.3 shows the scatter plot of our pairs taking different forms according to the type of container. Both public and private containers seem to have high participation/reach scores, although their points tend to be outlying, which explains the error's sum of squares value (see Table III.4). However, based on their participation scores, open containers seem to have larger audiences than private ones. The above findings can be useful for container administrators who strive for a larger audience for their containers. Users could thus be encouraged to increase their interactions on a container's posts. For example, interested users could be tagged within a post's comment that would invite them to interact by adding other comments or likes to that post.

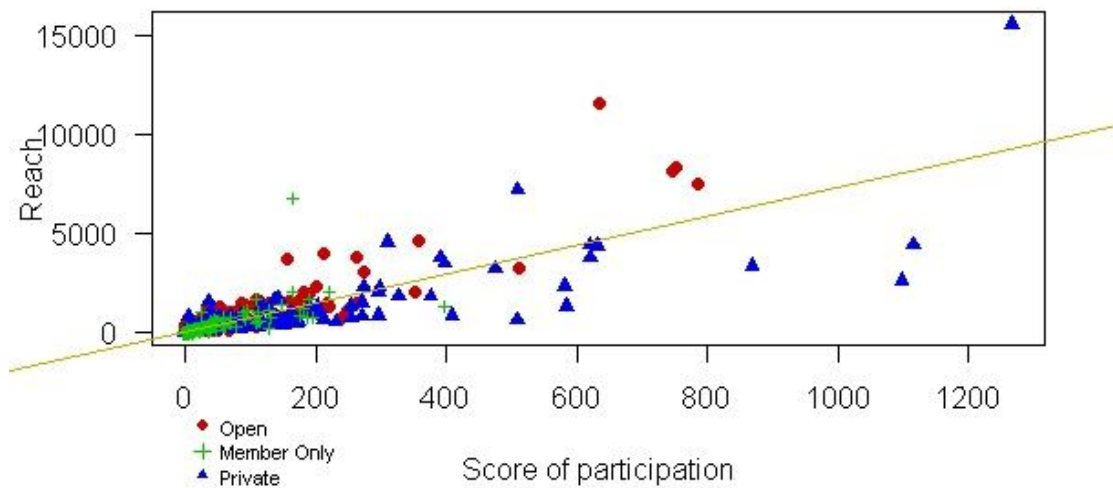


Figure III.3 The relationship between containers' participation score values and containers' reach values modeled with a yellow linear regression line

III.7.5 Hypothesis H-c-5 and H-c-6

The purpose of our analysis here is to describe how users contribute to containers; which means examining the relationship between users and containers as expressed by the participation. The same user may have a high participation score in a container and a low score in another. Recall that the participation score upc that we are interested in here equals a user's total number of interactions within a specific container. Based on the last two hypotheses, we perform our analysis on the participation scores having high values. We explain, next, how these scores have been chosen.

III.7.5.1 Defining a threshold value

We refer to the high participation score values as “significant participation” and choose them based on a threshold. As discussed earlier, the mean of these values cannot be accurately representative of the threshold (see the quartiles in Table III.3).

Therefore, we examine the frequency distribution pattern. The distribution pattern, shown in Figure III.4, follows a power law distribution. The y-axis depicts the count of occurrences of the participation score values upc (x-axis). For example, the participation score $x=15$ has a high frequency ($y=200$). This frequency counts the occurrences of upc values which are equal to 15; this includes $upc(u10,c1)$, $upc(u10,c6)$, $upc(u3,c6)$, etc.

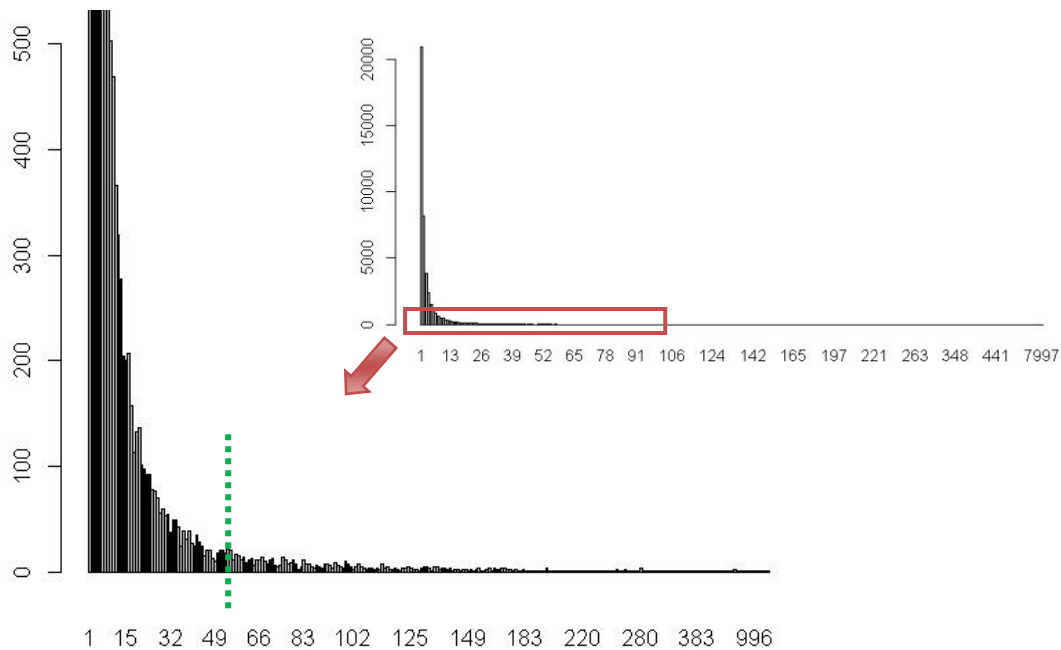


Figure III.4 Frequency distribution pattern of participation

In terms of form, the pattern recalls the concept of the *long tail* introduced by Chris Anderson to illustrate the consumption rates of retailers' products such as books and songs [Anderson, 2006]. This concept highlights the tail of such distribution patterns (to the right of the green separator) which depicts the portion that is far from the head or the central part (to the left of the green separator). A zoom on this portion is offered on the same Figure. In business economics, this tail separates the vital few from the trivial many at the head and the center of the curve. These least frequently occurring items in the pattern are the most important as they represent the majority of occurrences (i.e. more than a half). However, the portions in our pattern do not follow the expected 80/20 principle¹³. When transformed to the cyber culture, this segmentation seems to follow the 1% rule [van Mierlo, 2014] presented earlier in Section III.3.3.

Thus, we draw an analogy with the calculation method used in the WikiStats project¹⁴ within which performing more than 50 edits per month is considered as “significant”, whereas “very significant” participation refers to making more than 100 edits¹⁵ per

¹³ The Pareto principle, also known as the 80/20 rule states that 80% of the effects come from the 20% of the causes [Bunkley, 2008]

¹⁴ The WikiStats project is a space dedicated to providing statistics about the Wikipedia community <https://en.wikipedia.org/wiki/Wikipedia:Statistics> (accessed January, 8, 2017)

¹⁵ Wikipedians are evaluated based on the number of edits they make on Wikipedia articles per month. In the case of an enterprise usage, we extend the measurement to a scale of three months

month. Hence, we define two threshold values to explore separately the “very significant” ($upc > 100$) and “moderately significant” participation ($100 > upc > 50$).

III.7.5.2 Analyzing the generated networks

Based on the two threshold values defined in the previous Section (50 and 100), we create a network of each portion’s items, visualize its graph and compare it to the network of the remaining and of the entire population (i.e. the total amount of participation). Recall that, each item is a participation score value upc made by a user (source node) within a container (target node). It is thus transformed into a directed edge in a network containing users and groups as nodes of two types.

Figure III.5 and Figure III.6 show the generated graphs of significant participation. Table III.5 summarizes the performance measures based on which we describe and compare the networks. Table III.6 offers a description of each measure.

Measures \ Network	“Very significant” participation scores	“Moderately significant” participation scores	The rest of participation scores	All participation scores
Undirected edges				
Percentage of users	4%	7%	100%	100%
Nb of user nodes	190	331	4479	4479
Nb of container nodes	165	273	5588	5603
Ratio user/container	1.2	1.2	0.8	0.8
Nb of edges	284	491	43883	44658
Connected components	90	144	44	40
Percentage of connected components	55%	53%	1%	1%
Diameter	10	15	11	11
Average geodesic distance	3.451938	6.960024	4.17521	4.165968
Directed edges				
Density	0.002259887	0.001348116	0.0004330513	0.0004393888
Maximum out-degree	17	15	346	378
Average out-degree	0.8	0.8129139	4.359094	4.429478

Table III.5 Summary of generated participation networks

As indicated in Table III.5, both of the significant participation networks are generated by more than 1% of users (4% and 7% for the network of very significant and moderately significant participation respectively). This supports H-c-5 as the number of active contributors within the JS community is greater than the informally expected number in cyber culture that follows the 1% rule. It indicates a growing involvement of JS users as they become active contributors.

Measure	Description
Connected components	Separate sub-graphs that have no connection with the super graph
Diameter	The longest Geodesic distances between any two of the graph's nodes
Geodesic distance	The shortest path between two nodes
Density	The proportion of present edges from all possible edges in the network
Out-degree	The number of edges directed out of a given node

Table III.6 Description of the network measures

Table III.5 also indicates that the generated networks form sparse graphs having very low density values. We highlight how the significant participation scores are not exclusive to specific containers or users, which is expressed through the ratio of user to container and the average number of out-degree. This result can be used to evaluate the healthiness of an ESM; a healthy network forms a sparse sub-network of significant participation containing a ratio user-container close to 1 and a low number of out-degree. The correct use thus appears in approximately equal distribution of significant participation scores across users-containers pairs. This distribution is shown in Figure III.5 and Figure III.6.

We can use the above results to describe the relationship between users and containers, as our networks do not contain user-to-user edges. The majority of significant participation scores represents one user contributing to only one container (average out-degree = 1). These findings support H-c-6 that users actively contribute to only a limited number of containers, as they have a specific (limited) number of skills. The containers thus represent the domains of these users' skills.

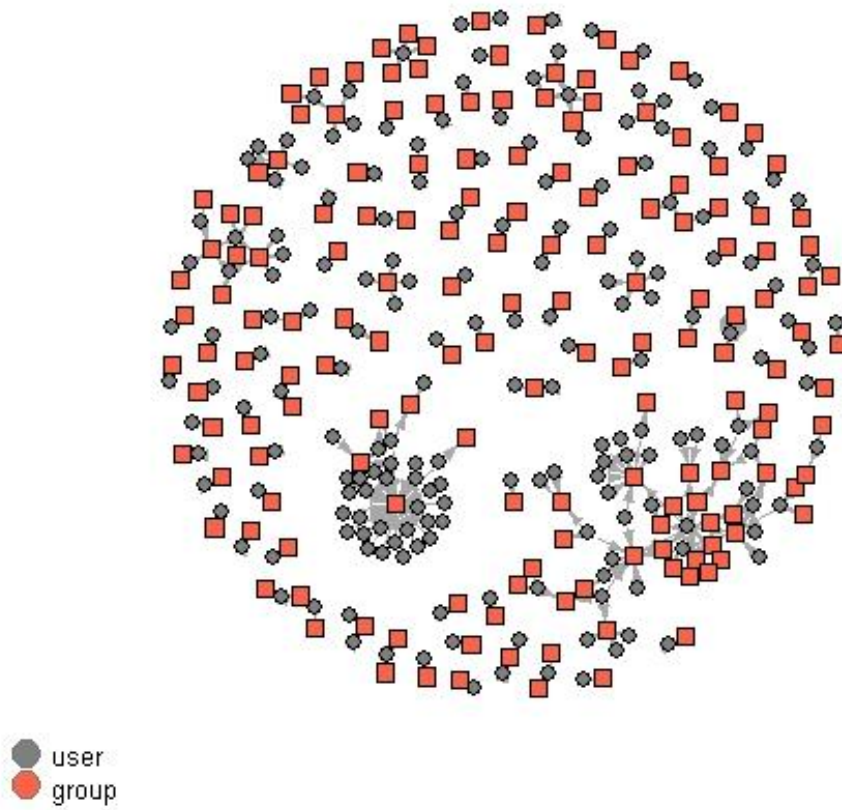


Figure III.5 Illustration of the generated network of "very significant participation"

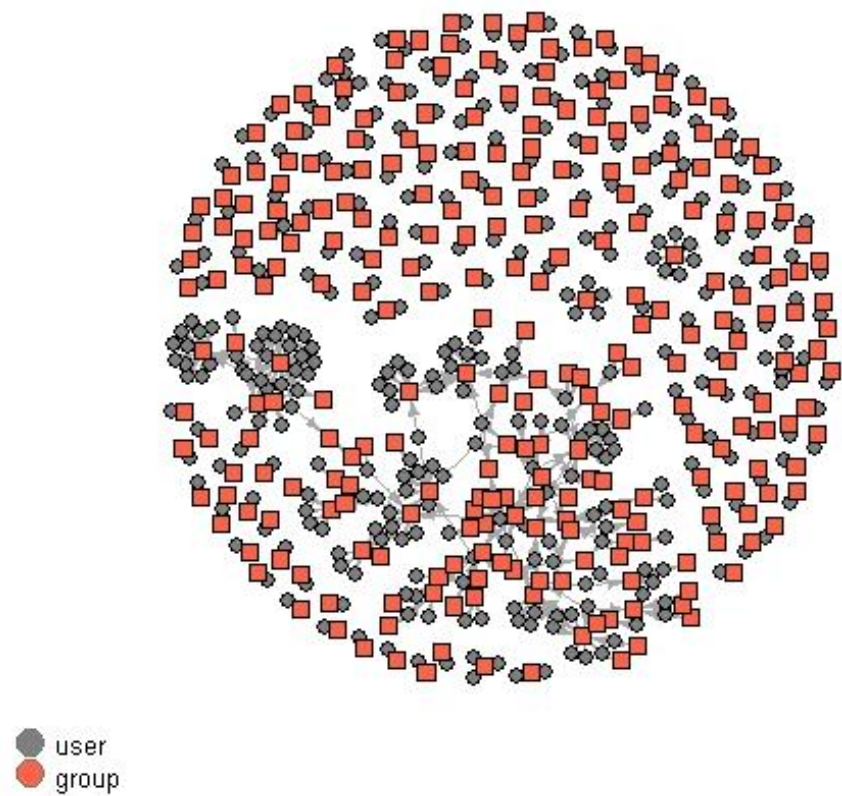


Figure III.6 Illustration of the generated network of "moderately significant participation"

Lastly, we draw attention to the significant number of connected components in both networks compared to the number of containers or users. These connected components are easily spotted in many user-container pairs (see Figure III.5 and Figure III.6). We highlight how connected components with a diameter (i.e. the distance between user-container-user) greater than two form communities of users/containers. The average size of these communities is represented by the average geodesic distance. The largest community is the one whose size equals the diameter of the network. These communities reveal a potential collaboration that could be recommended to the community's users.

III.8 Summary

This Chapter explored the use of an ESM platform and examined the healthiness of its activity. A correct use and a healthy activity of the platform suggest a successful deployment. Thus, we empirically studied the activity of a well-established platform at the workplace aiming at evaluating the success of such deployment based on tangible values rather than on subjective surveys and feedback.

Six theoretical hypotheses were formulated within a research model for the purpose of determining the main ESM benefit and evaluating its use. The hypotheses were tested on a data set collected from the use of the Jive software within CONNECT, a large company from the IT/telecom industry.

The research model characterized the activity from three perspectives. Firstly, the user perspective investigated the activity of users only to detect their predominant usage. ESM users seemed to give less attention to building social capital than to exchanging information and building knowledge. A transparent information transfer seems to take place on the ESM.

Secondly, the container perspective investigated the activity within the platform's dedicated spaces (i.e. containers) only. A linear regression model was introduced demonstrating how the high level of activity within a container led to a greater audience.

The third perspective provided a hybrid viewpoint that examined the activity at a level that involved the total participation score of each user within each container. Based on the generated network of participation, we showed how a healthy activity can be translated into values using certain graph performance measures.

Chapter IV: An External Perspective on ESM Platforms: The Impact on Existing Workplace Tools

Through its two main Sections, this Chapter contributes to addressing the second and the third research questions of this thesis, which are also highlighted among the main remaining issues in Section II.6. The Chapter offers a broader perspective that assesses ESM platforms while taking into consideration their hosting environment.

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IV.1 Evaluation of ESM Platforms within the Environment of Existing Workplace Tools

IV.1.1 Introduction

Introducing ESM platforms to workplaces allows employees to benefit from various opportunities related to the work activities at the company (see paragraph II.4.1.2). While some of these opportunities, such as allowing the social networking, are distinct from those offered via existing tools at the workplace, others are not. In fact, ESM platforms rely on a new interaction model, known as the publish/subscribe model [Eugster, 2003]. The design of the latter model leads to a new way of performing the activities; a way that capitalizes on the social dimension resulting in more openness and transparency in performing tasks. Hence in terms of capability, ESM platforms offer the ability to substitute the use of certain existing workplace tools [McAfee, 2009]. For example, they allow a new way of communication and information sharing via the micro-blogging while these activities at the workplace are taking place using tools such as email, instant messaging, etc.; the platforms thus may be a substitute for email or instant messenger, especially given that several ESM solutions in the market contain these tools as integrated functionalities. This assumption has been the main discursive argument for promoting certain transformation strategies such as the “zero mail” program that was launched at Atos in 2011 to replace the use of email by a deployed platform¹⁶. However in practice, this assumption has not been totally supported [Silic, 2015]. Regarding email specifically, this tool continues to play a central role in enterprises. Its widespread use is even expected to continue growing according to market statistics and forecasts for 2019 [Radicati, 2015].

This context suggests that the place of ESM platforms within the environment of existing workplace tools can yet be seen as undetermined. While the majority of ESM research is developing the understanding of these platforms in a way that encourages their adoption (as concluded in Chapter II), few are the studies investigating the wider perspective of these tools, i.e. having their functionalities and use examined and compared to the enterprise’s existing set of workplace tools.

Therefore, this Section offers an exploration of ESM platforms from that wider perspective. It aims to evaluate these newer workplace tools while addressing the

¹⁶ Atos is an international Information Technology services company headquartered in France. Its initiated Zero email program aims to completely eliminate the internal email exchanges through the use of alternative communications across its collaborative platform “Bluekiwi”

following research question: *Are ESM platforms a supplement to, or a substitute for certain existing workplace tools?*

IV.1.2 Approach

To address the research question of this Section, we firstly develop a typology of workplace tools. The typology offers a scope that involves not only tools residing in the ESM platforms as integrated features (e.g. micro-blogs), but also existing tools (e.g. instant messengers). Thus, it allows us to classify the overall set of workplace tools by descriptive types. Our typology employs explanatory typological techniques so it can be used to define types of tools and also to classify the tools [Elman, 2005].

Next, based on the developed typology, we assess a sample of leading ESM products in the market. This assessment gives insights into what types of tools are lacking in the design of current ESM platforms with regards to the ecosystem of workplace tools.

Further, based on our typology's perspective on the platforms, this Section specifically draws attention to email. Thus, it gives a sharper focus on this tool and has it compared to ESM platforms in terms of capability and usage.

A conclusion of this Section's evaluation is finally offered at the end of the Section.

IV.1.3 An Explanatory Typology of Workplace Tools

IV.1.3.1 Related work

The classification approaches of tools used in the workplaces or their features appear in two research communities as follows.

From the perspective of Computer-Supported Cooperative Work (CSCW), Johansen introduces the earliest and the most common base for categorizing CSCW and groupware systems [Johansen, 1988]. The author provides a time-space matrix comprising the following: the location dimension, differentiating whether the interaction takes place in the same physical space or is geographically distributed, and the temporal dimension, differentiating whether an interaction takes place in real time or asynchronously. This classification is extended in various frameworks such as in this book [Andriessen, 2012], where a process perspective is added, differentiating person interchange processes, task-oriented processes and group oriented processes.

Within the same community, Grudin and Poltrock propose, in their latest framework, a complementary approach to the classification by crossing time and process dimensions

[Grudin, 2013]. While retaining the temporal dimension, they evaluate the second dimension based on three variables describing behavior contributions in CSCW technologies: communication, information sharing and coordination. They suggest a distribution of the tools according to the six derived categories.

As for the ESM community, [Kaplan, 2010] focuses on six groups of social media applications and provides a classification among them. The derived categories are characterized by two dimensions: social presence / media richness and self-presentation / self-disclosure. However, [Williams, 2011] proposes a framework classifying and comparing ESM projects themselves, taking into account their business context. The two zones composing the framework represent the specific project goals and the key aspects of the wider enterprise context.

The above presented approaches contribute to characterize and classify sub-sets of workplace tools corresponding to the scope of their research field. A wider scope is yet missing; one that involves the range of the two separate scopes and looks into the overall set of tools based on the same criteria, which is the goal of our typology.

IV.1.3.2 List of considered tools

Enterprise's workplace tools¹⁷ are the ones empowering the enterprise's informal work processes [Balakrishnan, 2010] such as the communication, collaboration, information exchange, and knowledge management. They are used at the work-unit level as standalone applications, or otherwise as integrated services. Workplace tools are divergent. They have different nature and structure. Some rely on telecommunication systems such as phones, voicemail, etc. Some implement Web 2.0 technologies. Some are services specifically designed to be integrated in broader tools (e.g., location trackers, Rich Site Summary - RSS feed, etc.). Some others are implemented as standalone applications (e.g. chatting tools, web-conferencing, etc.).

Due to this diversity, we propose combining all the workplace tools in one list in order to classify them, next, in a typology, taking into account a set of diverse criteria. Our list combines essential telecommunication tools, collaboration tools such as groupware and CSCW, as well as social tools i.e. ESM tools, as appears in academic researches [Balakrishnan, 2010], [Grudin, 2013], [Kaplan, 2010] and key market analyses [Chan, 2011], [Forrester, 2009], [O'reilly, 2007] (see also findings in paragraph II.2.2.3 for a

¹⁷ Recall that tools involving external stakeholders (such as Customers Relationship Management) or aimed to monitor and manage the business activity (such as Business Intelligence) are out of our scope

summary of ESM tools considered in recent literature). Table IV.1 presents the resulted list and offers brief details about each one.

Workplace tools	Details
Phones	Desktop phones, soft-phones and mobile phones
Voicemail	Exchanging offline voice messages
Chatting	Instant messengers and online chatting such as chatting websites or services
Text messaging	Via telecom operators as in mobile phones
Email systems	Client applications to exchange electronic messages
Search tools	Interfaces to access to research engines
Social search	Involving a user's social graph in the search process
Activity streams and RSS	Displaying updated web content or user activity in a timely order, alternatively called news feed
Podcasts and streaming	Delivering audio and video content progressively to end-users
Wikis, blogs and micro-blogs	A web service provided by a social website to enable its subscribers to broadcast messages to other subscribers
Online whiteboards	Drawing sketches collaboratively with other users
Forums, communities and group discussions	Spaces to exchange messages seen by other members
Social bookmarks	Sharing, editing and tagging web bookmarks with subscribers
Conferencing (data and video conferences)	Online meetings
File sharing	Sending files electronically
Collaborative planning	Planning projects and activities collaboratively between users
Ideas banks	Shared resources for posting new ideas, exchanging and discussing them, etc.
Social profiles (networking)	Profiles of users, connected together in the form of a social graph, displaying each user's information (interests, expertise, etc.), activity stream and his/her personal social graph

Calendars and scheduling	Organizing meetings, tasks, etc.
Location trackers	Using GPS technology to provide information about the geographical position of a user's device
Content Management Systems (CMSs)	Controlling documents, workflows, etc.; this includes providing an interface that allows a user to control content on web pages
Enterprise mash-ups	Resources combining other existing resources including content, data or applications' functionalities

Table IV.1 List of workplace tools

IV.1.3.3 Methodology for developing the typology

For the typology creation phase, we follow Elman's guidelines on working with explanatory typologies. The author offers an account of analytic techniques, steps, and vocabulary that may be applied to develop a typology [Elman, 2005]. The author also argues that this type of typology is highly effective in qualitative studies as it combines both the descriptive and the classificatory functions. The resulting typology thus may be used to define types having descriptive labels of the concerned items, and also to classify the items into sub-sets.

According to Elman, the explanatory typology develops a multidimensional conceptual classification that categorizes, based on an explicitly stated theory, the patterns and themes that emerge while analyzing data about the items.

Based on his steps, we do the following:

- We first define dimensional measures that serve as criteria in describing our tools. As a starting point, we make these measures as wide as possible. That is, based on the criteria, we describe the workplace tools from diverse aspects (e.g. what their main behavior is, how they diffuse information, what type of artifact they produce, etc.).
- Each criterion (measure) relies on two or more variables, based on which, the workplace tools will be evaluated. For instance, one criterion is the method for accessing information using the tool. Two variables are defined for this criterion: *send-receive* and *deposit-retrieve*.
- Based on a criterion's variables, each workplace tool is then evaluated. Taking the same example from the above step, we evaluate one tool while asking the following question: does this tool have a *send-receive* or a *deposit-retrieve*

method for accessing information? Hence, a text messaging tool, for example, gets the following observation values corresponding to the two variables: (1,0), as this tool relies on a send-receive and not on a deposit-retrieve method. Values for a micro-blog will thus be as follows: (0,1).

- Having the criteria identified and evaluated for each tool using binary values, we apply Jaccard's coefficient calculation on the variables to measure their similarities in order to merge similar measures. Jaccard's coefficient calculation is used as correlation coefficients are not suitable for binary data [Warrens, 2008].
- The reduced set of criteria thus allows us to derive inductively a preexisting theory. We explicitly state this theory.
- We apply some of Elman's suggested compression techniques; specifically, the empirical compression.
- We finally classify our list of workplace tools using to the dimensional measures and according to the logic of the stated theory.

IV.1.3.4 Typology creation

To employ the methodology mentioned earlier, we start by stating the initial set of criteria and variables. For easier comprehension, we apply a sequential numbering to the criteria. Variables are also stated in italic font.

As a starting point, we relied on Grudin and Poltrock's two dimensions [Grudin, 2013] and apply them as the first two criteria in our typology, as follows:

- (1) Main behavior that is enabled by the tool; for this criterion, we detail the rough division in the framework and propose additional variables to have the following:
 - a. *communication* (e.g. voicemail),
 - b. *information sharing* (e.g. chatting),
 - c. *information browsing* (e.g. search tools),
 - d. *information editing* (e.g. blogs),
 - e. *organizing*¹⁸ (e.g. calendar scheduling).

Recall that each tool is then evaluated based on each criterion's variables. For instance, text messaging tools have observation values that correspond to each of the previous variables as follows: (1,1,1,1,1) whereas values for RSS &

¹⁸ We prefer using the label "organizing" to "coordination" so it would not be mistaken with the coordination process that links between parts of an organization [Okhuysen, 2009]

activity streams are (0,1,1,0,0);

- (2) Interaction method between users of the tool; it is done:
 - a. *asynchronously* where users interact at different times (e.g. email systems), or
 - b. *in real-time* (e.g. phones).

Moreover, we searched for further measures that also characterize the tools. As a result, we identified eleven additional criteria; some measure behavioral aspects of the tools and others are about their technical aspect. We list them as follows:

- (3) Information diffusion model within the tool [Eugster, 2003];
 - a. it follows a *sender-to-destination(s)* approach based on a traditional interaction scheme (e.g. text messaging), or
 - b. a *publisher-to-subscriber(s)/to-public* model (e.g. video conferences),
- (4) Information access method in the tool:
 - a. *send-receive* (e.g. chatting), or
 - b. *deposit-retrieve* (e.g. file sharing),
- (5) Design of Graphical User Interface (GUI) and human-computer interaction which influences the perceived user acceptance of the tool [Venkatesh, 2003]; the design model of the tool either conforms to:
 - a. a *common mental model* already constructed by users about the tool's design which facilitates the acceptance and the usage of the tool (e.g. email systems), or
 - b. has a *particular design* formed of the designer's creation for each tool individually (e.g. ideas banks),
- (6) Object instantiation model, i.e. how the main data objects of the tool are instantiated (e.g. a message in email systems, a file in file sharing tools); it is:
 - a. a *shared instance* to be accessed by different users (e.g. wikis), or
 - b. *different instances* (e.g. email systems, where the sender's instance is different from the receiver's instance),
- (7) Integration level of the tool; the same tool can exist in different forms:
 - a. as an *integrated functionality* inside an application or another tool (e.g. social bookmarks), or
 - b. as a *standalone application* (e.g. text messaging),
- (8) Universality of the tool and its capacity for supporting social collaboration with external users, i.e. users that do not own the same product; it is:

- a. a *cross-tool* that connects various users with different products (e.g. email systems), or
 - b. an *exclusive tool*, only for users registered on the same product (e.g. chatting tool),
- (9) Artifact that is involved or produced while using the tool; it is one or more of the following:
- a. *text* (e.g. in text messaging),
 - b. *audio* (e.g. in voicemail),
 - c. *video* (e.g. in podcasts & streaming),
 - d. *picture* (e.g. in whiteboards), and
 - e. *document* (e.g. in ideas banks),
- (10) Data storage; data is kept locally:
- a. on the *client side* (e.g. text messages), or
 - b. on the *server side* (e.g. content management systems),
- (11) Appearance of the tool; it has:
- a. a *static view* with no possibility to modify its display options (e.g. forums), or
 - b. a *customizable view* (e.g. blogs),
- (12) Technical aspect regarding the development of the tool; it is:
- a. a *web-based tool*, or
 - b. a *desktop application*,
- (13) Delivery model of the tool; it is:
- a. a *licensed tool*,
 - b. a *software as a service (SaaS)* for which services are hosted and a license is purchased on a subscription basis, or
 - c. *hosted*, i.e. purchased by the company and hosted on an external server (e.g. file sharing).

We merge the criteria showing high coefficient values (around 90%) between corresponding variables ((3) and (4)). We also eliminate criteria showing a significant absence of negative values ((12), (13)) or high similarities either among all their variables ((7), (9), and (11)) or a part of the variables while having very limited positive values on their other part ((10)). We finally adopt the three most significant criteria of the remaining six in order to avoid producing a typology that is too large to be used [Elman, 2005].

The three classificatory dimensions arbitrating the distribution of tools are: (1) main behavior, (3) information diffusion model, and (5) graphical user interface design. Based on the three criteria, we construct our theory as follows.

According to the model of information access and diffusion via the tool, do we observe a relation with the design model of the corresponding tool? Is there a predicted tool behavior that appears from intersecting the mentioned criteria? And finally, what is the case of each tool and is there congruence with the predicted theoretical claims?

	Behavior					Information diffusion			GUI	
	Communication	Information sharing	Information browsing	Information editing	Organizing	Sender-to-destination(s)	Publisher-to-subscriber(s)	Publisher-to-public	Mental model	Particular design
List of workplace tools	Phones	1	1			1			1	
	Voice mail	1	1			1				
	Text messaging	1	1	1	1	1			1	
	Email system	1	1	1	1	1			1	
	Chatting	1	1			1			1	
	Files sharing		1				1			1
	Data/Video conferences	1	1					1	1	1
	Location tracker	1				1		1	1	1
	Search tools			1					1	1
	Social search			1					1	1
	Wikis		1	1	1			1	1	1
	Blogs/Micro-blogs	1	1	1	1			1	1	1
	Social bookmarks					1			1	1
	RSS & Activity streams			1				1	1	1
	Podcasts/streaming			1				1	1	1
	Collaborative planning		1	1	1			1		1
	Ideas banks		1	1	1			1	1	1
	Content Management			1	1	1				1
	Whiteboards		1	1	1			1		1
	Forums		1	1	1				1	1
Calendar scheduling		1			1	1	1	1	1	
Social profiles				1			1	1	1	
Enterprise mashups									1	

Figure IV.1 Final matrix of three criteria and workplace tools evaluated based on them

Answers to these questions lie in the intersecting criteria. We apply empirical compression on the obtained cells in order to delete empty cells and get the final matrix shown in Figure IV.1. The final typology is proposed in Table IV.2.

IV.1.3.5 Typology results

As shown in Table IV.2, the proposed typology separates the tools into two main types, A and B. Each type is described based on the three final independent criteria retained to order the typology: interaction method, design evaluation and main behavior of the identified type.

- The first type, labeled as type A, stands for the tools that interact via channels following a sender-to-destination(s) model; tools of this type share common user beliefs that correspond to expected mental models of the tools' User Interfaces (UI); they also share the same main behavior which is about communication and information sharing. We equally label tools of this type as private matured communication channels which turn to be: phones, voicemail, chatting, text messaging and email systems.
- The second type, labeled as type B, stands for tools that interact differently from tools of type A. They all follow a publish/subscribe interaction model. As for their design evaluation, they are split into the two defined variables of this criterion which produces two subtypes of type B as follows:
 - Type B1 is about tools for which UIs are based on a recognized mental model; their main behavior is about organizing (social bookmarks) and information handling (search tools, RSS & Activity streams, podcasts / streaming, wikis, blogs / micro-blogs, whiteboards, forums / communities / discussion groups).
 - Type B2 represents tools that also interact via shared spaces but are, difficult to evaluate from a user perspective; each one has a particular UI design; tools of this type are used for communication and information sharing (conferencing), information handling (file sharing, social search, collaborative planning, ideas bank, social profiles) or organizing (calendars & scheduling, location trackers, content managing, enterprise mash-ups, business applications).

	Type A	Type B1				Type B2													
Interaction Method	Information distribution via channels from sender to destination(s)	Distributed interaction where information is distributed via shared spaces from publisher to subscriber(s) or to public																	
Design Evaluation	Mental model-based	Mental model-based				Particular design													
Main Behavior	Communication & information sharing	Information			Communication & information sharing	Organizing	Information			Organizing									
	Pure	With other behavior	Browsing	Sharing & browsing			Sharing	Browsing	Sharing, browsing & editing										
Tools	Phones	Search tools	RSS & Activity streams	Podcasts / streaming	Wikis	Whiteboards	Forums / communities / group discussions	Blogs / Micro-blogs	Social bookmarks	Conferencing (Data/Video)	File sharing	Social search	Collaborative planning	Ideas bank	Social profiles	Calendars & scheduling	Location trackers	Content managing	Enterprise mash-ups
	Voicemail	Email systems	Text messaging	Chatting															

Table IV.2 Typology of workplace tools

IV.1.4 ESM Platforms Assessed Based on the Typology

Our qualitative assessment of ESM platforms relies on a sample representative of current industrial ESM products in the market. The methodology we propose thus consists of the following steps:

- (4) Choosing a representative sample of industrial products.
- (5) Examining each selected product, identifying the workplace tools that compose its features.
- (6) Mapping each product's tool to the classified list of workplace tools in a typological form (as in Table IV.2).
- (7) Combining the multiple lists in one final list that represents the key workplace tools that reside in today's ESM platforms.

Based on reports of global consulting companies [Koplowitz, 2014], [Mann, 2013], we select, as a sample, six products that are announced to be the leading ESM products on the market currently¹⁹.

- **Jive** (www.jivesoftware.com)
An enterprise social networking platform founded in 2001 and headquartered in the U.S.
- **Yammer** (www.yammer.com)
A collaboration software for business launched in 2008 as a private online social network and owned by Microsoft Company since 2012.
- **SharePoint**
(office.microsoft.com/en-gb/sharepoint)
A web application platform for collaboration and document management, launched in 2001 and developed by Microsoft Company.
- **BlueKiwi** (www.bluekiwi-software.com)
An enterprise social networking platform owned since 2012 by Atos; a company headquartered in France.

¹⁹ This work was established in the end of 2014. Thus, it relied on the latest industrial reports of that period to select its sample. However, we are aware that, by the time of writing this thesis, our sample could have been updated by a new recently launched product, which is "workplace" by facebook (<https://workplace.fb.com/> accessed January, 8, 2017). Nevertheless, as the official launch of this product is very recent (October, 2016) [Facebook, 2016], and only few information about it is yet available, we choose not to include it in our sample.

- **Tibbr** (www.tibbr.com)
An enterprise social networking platform launched in 2011 by TIBCO software, a company founded in 1997 and headquartered in the U.S. It provides add-ons that connect it to business applications and also offers a marketplace of applications that can be integrated in its platform as gadgets,
- **Zimbra** (www.zimbra.com)
A platform for collaboration subsequently purchased by Yahoo and VMware and currently owned and developed by Zimbra, Inc (formerly Telligent Systems). Zimbra offers an open source email and collaboration solution and an online community solution released in 2014.

To be noted here that identifying a specific tool means detecting its main functionality regardless of its supplementary features which can vary from one product to another. For example, a wiki editing tool is identified as being the tool that enables a collaborative editing of documents; this is done regardless of the observed variation of this tool's features in each product, e.g. the possibility of tracing previous modifiers of the document, locking up a document for a temporary or no further editing, etc. Again, we emphasize that we are only searching for workplace tools that are related to intra-collaboration between workers.

IV.1.4.1 Results of mapping the sample's tools onto the typology

Identifying tools in the examined products resulted in a specific tool list for each product. We map each list on Table IV.2. We then calculate the average of the multiple lists and present the results in Table IV.3.

The right column of the table shows the percentage of the presence of a specific tool in the sample. For example, the results suggest that none of the ESM platforms includes phones or voicemail in its features whereas all of them include social profiles and file sharing tools as structural components.

We consider every tool, for which the presence exceeds or equals a threshold of 50%, as a structural tool. In this context, we propose the following list as the key tools in the evaluated ESM platforms: email systems, RSS & activity streams, wikis, blogs and micro-blogs, forums with communities and discussion groups, social bookmarks, file sharing, social search, collaborative planning, social profiles and finally calendars & scheduling.

Type	Tools	Presence in ESM products
Type A	Phones	0%
	Voicemail	0%
	Chatting	67%
	Text messaging	0%
	Email systems	100%
Type B1	Search tools	17%
	RSS & Activity streams	83%
	Podcasts / streaming	0%
	Wikis	83%
	Blogs / Micro-blogs	83%
	Whiteboards	0%
	Forums / communities / group discussions	83%
	Social bookmarks	83%
Type B2	Conferencing (Data/Video)	33%
	File sharing	100%
	Social search	100%
	Collaborative planning	67%
	Ideas bank	17%
	Social profiles	100%
	Calendars & scheduling	83%
	Location trackers	0%
	Content managing	17%
	Enterprise mash-ups	17%

Table IV.3 Presence of workplace tools in current ESM platforms

According to the typology, our findings suggest that ESM platforms are a combination of tools belonging to different types. They are mainly composed of type B tools (distribution via shared spaces) with a minor existence of type A (distribution via private channels). This means that ESM platforms behave mainly as information handlers and organizers.

More concretely, our results suggest that the communicational features are only brought by two tools: chatting and email systems. This implies that, except for these two tools, private communication channels have no existence in ESM platforms.

As for the rest of tools in ESM platforms, represented by the publish/subscribe model of interaction, they are distributed throughout the two subtypes of type B. Some of them have a particular design (i.e. type B2, e.g. social profiles), whereas others conform to a users' predictable mental model (i.e. type B1, e.g. wiki) that makes them easy-to-use tools with higher user's acceptance probability.

IV.1.4.2 Discussion

Our findings and observation of Table IV.3 presented earlier suggest the following two main points:

- ESM platforms are mainly composed of information handling and organizing tools with a minor presence of pure communication tools. Direct communication methods (i.e. type A) seem to be somehow neglected. We explain this peripheral position as a consequence of the dominant opinion concerning ESM platforms: they have been designed with the belief that the use of Web 2.0 technologies will shift enterprise communication towards a new form. Private communication channels (e.g. phones and voicemails) are, however, still highly valuable for the daily work of employees [McAfee, 2013].
- ESM platforms may include, as features, tools that already exist in the company deploying the product; e.g. calendar & scheduling, chatting, or emailing systems. In fact, when a company decides to deploy an ESM platform, it may do it either in a superposition way in tandem with the existing tools, or in a substitution way [Kalika, 2007] by eliminating the old tools to overcome employees' resistance to the new system and force its adoption [Gourville, 2006]. The superposition way leads to a dual existence of the feature once the platform is deployed as follows:
 - An ancestor tool previously existing as a standalone tool and still being used in the company.
 - A newer tool as part of the new product's platform.

In this case, after an adoption period, employees tend basically to use the tool that is perceived as the more effective for their needs (perceived usefulness) and the more easy to use (perceived usability) [Davis, 1993]. Such a comparison between each of the equivalent tools usually turns to the advantage of the standalone tool.

Based on the above two points, we give this discussion's focus on the two remaining tools from type A (i.e. direct communication channels), given that this type is partially

missing in the design of ESM platforms. These two tools are: instant messaging and email systems.

Comparing the platforms' instant messaging features with their equivalent standalone client applications in the enterprise, the online chat service in ESM platforms lacks some advanced useful features such as conferencing or sending voice messages.

Concerning email systems, they exist in the form of private messages and conversations in current ESM platforms. Indeed, this tool has extra features that differentiate it from the equivalent existing tool in the company, such as automatically indicating when the message has been seen by its receiver. Nonetheless, specialized emailing clients (e.g. Outlook or Gmail) are yet more valuable than their equivalents in ESM platforms as they provide distinguishable functionalities (increased usefulness). For instance, they enable to reach external collaborators outside of the company's boundaries using the universal email address; they also enable to organize emails within folders, to set up filtering rules and auto-reply messages, etc. These differences between existing and newer products prevent the user adoption of current ESM platforms, especially since their reachability is uniquely limited to users registered on the same platform. In addition, standalone tools come along with a dedicated user interface, usually optimized to render this specific service (increased usability).

Thus, we deduce that, as standalone email clients are more advanced than the platforms' integrated email systems, the exchange of direct messages in companies seems to turn to the advantage of the standalone tools.

Nevertheless, an important question remains unclear. This question is related to the email tool which has been the subject of employees' complaints about its overload [Fisher, 2006], [Whittaker, 1996]. In practice, while ESM platforms are offering an alternative way to establish the communicative activities, the use of email continues yet to take place in companies [Sumecki, 2011]. The question is thus as follows: *How is the use of ESM platforms taking place along with the use of email? Moreover, could these ESM platforms substitute the use of email at the workplace?*

Answers to these questions are provided in the following sub-section.

IV.1.5 ESM Platforms Compared to Existing Workplace Tools: A Focus on Email

The above contribution has allowed looking into the ESM platforms within a scope that involves the overall set of workplace tools. Two questions have been thus derived from

the platforms' assessment based on the offered typology. The two derived questions specifically concern the email tool given that it is the existing tool, which is used the most at the workplace [Chui, 2012], and which may possibly be substituted by the more recently arrived platforms. Therefore, we devote paragraph IV.1.5.1 to address the first question related to comparing the use of these two tools in particular. Paragraph IV.1.5.2 is then devoted to addressing the second question about capabilities of these two tools and the ability of one of them to substitute the use of the other.

IV.1.5.1 Comparison of usage

In order to address the question related to evaluating the use of ESM platforms that is taking place along with the use of email, we propose an approach that compares the two usages based on the analysis of the generated networks of each tool. The purpose is to determine whether the people with whom an employee connects via the platform are different from those with whom he/she connects via email. Contrary to our analysis presented in Chapter III, our approach here is qualitative and not quantitative, because as suggested in [Miles, 1984], we need here to qualitatively obtain two data sets and have them compared with regards to employees' identity. Further, we focus here on the platform's network of relations only.

We highlight that, prior to using ESM platforms in companies, employees already had their own implicit social networks, expressed through their daily communicational activities. To this day, the majority of these activities are performed via email message exchanges. Email's residing social network is thus representative of workers' professional relations. Hence, we attempt to determine whether the platform's established social network reflects workers' real-life relations showing in the email social graph.

To that end, we conduct an experiment on a qualitative sample of participants. Further details about the collected data and the performed analysis are provided in the following paragraphs.

1) Experimental data collection and setup

The context of the host company within which this experiment was conducted is the same as the one described earlier in III.4.1 (see the mentioned sub-section for further details). However here, as the platform's data set is different, we will refer to this one as "Jive".

Our sample involved 37 participants. Profiles of the participants included employees who are active workers at the enterprise as well as active to moderate users on Jive²⁰. They were selected of various ages, types and backgrounds (i.e. project managers, team leaders, research and development engineers, academic researchers).

The purpose of selecting this sample was to build two social networks and have them compared. Each network reflected an environment, that is, email's and Jive's environment.

Jive's network was created based on each participant's established relations. As for email's network, it was created based on each participant's sample of messages. We highlight that, workers' inboxes contain a large portion of clutter. We did not want such unrelated messages to impact the credibility of our results, which is the reason why we asked each participant to provide us with an accurately selected sample of his/her own messages. Hence, each sample of messages was selected by the participant to be representative of his/her daily and recent activities at the workplace (i.e. containing exchanges with the most relevant persons as estimated by the participant himself/herself).

Consequently, and using NodeXL, two networks were created, based on the two collected data sets. Data set A concerned data from the participants' email messages. Building the network was as follows: for each message, collect the sender's name u and the recipient(s) name(s) v_i then create an undirected edge between the nodes as follows:

$$e(u, v_i); i = 1 \text{ to } n \quad (1)$$

Note that we only involved the recipients in the "To" field and considered the "CC" field as less relevant.

Data set B concerned data from Jive. The network was built as follows: for each participant u , collect his/her list of relations v_i then create an undirected edge between the nodes as in (1). Duplicate edges were eliminated from both graphs. Table IV.4 provides information about the two networks (i.e. graphs).

²⁰ The experiment relied on the use of the same ESM platform that we analyzed in Chapter III and described as less focused on to the creation of social relations. However, the sample of participants was qualitatively selected to only involve employees who had established network of relations on Jive

Type	Nb of nodes	Nb of edges	Connected components	Diameter	Average distance
Email network	193	282	16	10	4.4
Jive network	177	492	3	5	2.69

Table IV.4 Information about the networks of email and jive

2) Similarity Comparison

The next step in our analysis after the networks' creation is to compare the two resulting graphs. We approach the similarity comparison between the two built graphs at two levels. The first level provides an overall comparison between the two graphs whereas the second level looks into the correlation between the two graphs based on their common nodes and corresponding distances. More details are provided below.

- Overall similarity:** To make an overall comparison between the email graph A and Jive graph B, we apply a method that measures their similarity and provides a single similarity score [Nikolic, 2012]. The advantage of this method among the other measures proposed in the literature is that it involves nodes' neighbor matching while performing an iterative calculation of the nodes' similarity. The algorithm was implemented and tested in Java using Eclipse IDE²¹. The concept of the algorithm is to calculate the similarity value based on a repeated number of iterations for each node similarity value. The iterations are repeated until a convergence is determined with a defined epsilon value ϵ . Details about the algorithm as well as the formulas applied are offered in Appendix I.
- Correlation between corresponding nodes and edges:** The second level of comparison involves the node's identity in the analysis. It searches for correlation between pairs of nodes based on their corresponding distances. This approach applies the following method:
 - define the Jive distance d as the calculation of the shortest path between a given pair of nodes (i, j) in Jive graph B; and then
 - for each pair of nodes in email graph A, calculate its corresponding value d in B.

3) Results

²¹ Eclipse is a free and open source Java Integrated Development Environment (<https://eclipse.org/ide/> accessed January, 8, 2017)

- Regarding the overall similarity:** Applying the first measure indicated a low level of similarity between the two graphs. Details about the results of the algorithm are as follows: the optimal ϵ value that allowed obtaining the convergence of iterations according to our tests was 0.1. For a better estimation of this value, we provide the similarity calculation results for two given identical graphs in Table IV.5.

For our two graphs, the returned similarity percentage was as follows:

Similarity score for graphs A & B = 24.97%

Epsilon	0.1	0.01	0.001
Similarity score	93.75%	99.22%	99.90%

Table IV.5 Similarity scores for two identical graphs calculated according to different ϵ values

- Correlation between corresponding nodes and edges:** Regarding the Jive distances of the email graph's pairs, Figure IV.2 gives the summary of the Jive distances' calculation for all the email pairs. Recall that a Jive distance d represents the shortest path calculation for a given pair of nodes (i, j) . As seen in the Figure, Jive distances range between 0 and 3. The value of 0 indicates that a given email pair does not exist in the Jive graph (i.e. no relation is found between the two people in a Jive graph). On the other hand, a value of 3 indicates that a given email pair is related in the Jive graph, however not directly. The majority of Jive distances (72%) have a value of 0. However, the majority of distances found range between the values of 1 and 2. Only a few Jive distances have a value of 3. These results are discussed in the next sub-section.

4) Discussion

The low percentage of the measured similarity calculated based on neighbor matching provides a first indication of the lack of overall correlation between the two graphs. The distance calculation also demonstrates this low correlation by the variation of distances between 0 (non-existent relations) and 1 to 3 (existent; however, not always directly). Our results indicate that the majority of email relations located in the email graph could

not be located in the Jive graph; the relations in the two graphs are not correlated. Only 16% of the email relations directly took place in the Jive graph.

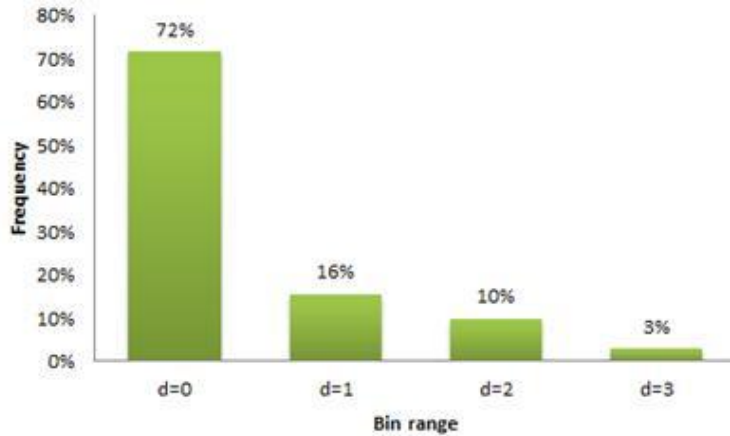


Figure IV.2 Histogram of Jive distances

We infer from these findings that the Jive relations do not reflect the worker's existing activities at the workplace. Reciprocally, identified Jive relations that are not located in the email graph express the new channels of communication that were created with the use of the platform. These channels may be seen as the weak ties of the email's social network [Granovetter, 1973]. They demonstrate the potential of an ESM platform to expand a worker's scope of relations for future collaboration or communication.

Based on the above, we conclude this contribution by highlighting that, although the use of ESM platforms takes place in tandem with the use of email, the purposes of these two uses are different. ESM platforms may be used to establish employees' communication with expanded circles of relations.

IV.1.5.2 Comparison of capabilities

With the same focus that specifically concerns the tool of email compared to the ESM platforms, the contribution here addresses the question related to the ability of one of two tools to substitute the other.

To answer this question, we assess the two tools based on a set of communicative capabilities that we derive relying on Treem and Leonardi's contribution [Treem, 2012]. We build on their work and extend their analysis of ESM platforms to involve the email's perspective as follows.

Treem and Leonardi pursue an affordance approach based on Gibson's formulation of affordance that studies the relationship between new technologies and social practices [Gibson, 2014]. This approach looks at the communicative actions of tools' properties in the enterprise context [Gaver, 1991], [Markus, 2008]. The authors reveal four affordances that are distinguishing the use of different social media tools²² in organizations and then present how these affordances differ from those of traditional communication tools such as email. They individually study five tools of ESM that are considered as the most popular tools in enterprises. The five considered types are: wikis, social networking, blogs, social tagging applications and micro-blogs.

For each tool, they discuss the following four affordances:

- Persistence or reviewability.
- Editability
- Association
- Visibility

The authors' findings suggest that ESM, with their different tools, afford a consistent high degree of each of the four affordances, whereas email lacks the affordances of association and visibility (see Table IV.6).

Building on the presented analysis, we firstly consider the affordances of ESM platforms as residing capabilities as these platforms are no longer emergent in the enterprise. Secondly, we argue that inferring these capabilities should put together, in the same scope of analysis, the email's perspective along with the platforms' one. Hence, two additional capabilities arise: universality and plasticity.

The extended perspective of the six capabilities is provided here. The comparison is then discussed and illustrated in Table IV.6.

1) Persistence

Persistence (also referred to as reviewability [Clark, 1991], recordability [Hancock, 2007] or permanence [Whittaker, 2003]), represents the ability of a communication act to remain accessible, in the same form as in the original display, after a communication whether real-time or asynchronous [Bregman, 2001], [Clark, 1991], [Donath, 1999]. The persistence of email is a key factor in the availability of its messages for users [Panteli, 2002].

²² Treem and Leonardi's approach consider ESM as separate tools and not as features integrated in platforms

Both email and ESM tools afford the capability of persistence. When an employee sends an email message or posts to a social platform, the sent/posted information remains available to its readers. A record of the information remains and prevents eventual confusion about the interaction's contained information [Gergle, 2004], [McCarthy, 1991]. This record does not expire or disappear when the sender is not connected, as in the default case of a voice call. Its availability enables further development and new uses of the content (e.g. restructuring, searching, etc. [Erickson, 2000]).

2) Editability

Editability concerns the ability to craft and re-craft a communication act before it is viewed by others [Walther, 1993]. The literature agrees on how email affords a high degree of editability. Email users can carefully craft messages and attach them with resources prior to sending [Barnes, 1994]. This capability is also afforded in social media tools to different degrees. For instance, employees can modify and revise their content with the use of a wiki tool [Yates, 2010].

3) Association

Association stands for the ability to establish connections. It exists in two forms: between a person and another person and between a person and content. ESM tools support those two forms. For example, in online social network sites [Boyd, 2007], [Steinfeld, 2009], ESM tools enable the creation of explicit relationships between users, also known as social ties [Granovetter, 1973]. They also provide the association between a person and a piece of information such as in a wiki contribution or a post tagging [Ding, 2007], [Zhang, 2010].

Contrary to ESM tools, classical email lacks this capability. While some scholars are providing mechanisms for tagging email messages [Nairn, 20013], [Stem, 2013], [Meek, 2012], [Koren, 2011], these scholars are failing to capitalize on the social connections this tagging is carrying.

4) Visibility

Visibility means the ability to make their behaviors, knowledge, preferences and previously invisible communication network connections visible to others in the organization. Email lacks a certain degree of visibility [Bird, 2006], [Lerman, 2010], [Liben-Nowell, 2008]. It does not allow public communications as messages are always limited to recipients selected by the sender(s). In addition, the only possibility for a user

to establish a connection is to know the other person's precise email address or name in the case of having an organizational directory.

In fact, affording visibility implicitly relies on the created associations, whether between persons or between persons and contents. For example, allowing tags to be displayed publicly helped attracting employee's attention to specific contents according to multiple experiments [Damianos, 2007], [Millen, 2006]. ESM tools therefore enable employees to easily and effortlessly see information related to colleagues' activities, shared knowledge, etc. [Boyd, 2010], [Grudin, 2006].

5) Universality

Universality concerns the ability of email messages to reach email clients independently of their platform. The message queue interaction scheme of the email system allows messages to pass through private channels between the sender's and the recipients' servers using the Simple Mail Transfer Protocol [Postel, 1982]. The standardization of the transfer of messages between email servers allows all email clients to reach each other across servers.

This universality of access gives email a great advantage as a communication tool, while all types of ESM tools still lack this universality of communications. Their model requires their users to be subscribers in order to access their services, which are usually limited to the enterprise's circle. For example, a member of a specific social network cannot publish a micro-blog in another network without becoming a member in the new platform too. This situation implies that employees cannot communicate with external collaborators by using this tool [Figueiredo, 2009].

6) Plasticity

Email was originally designed as a communication application. However, the use of this tool has been evolving and additional functions have been associated with it [Fisher, 2006], [Whittaker, 1996].

The literature reveals four main functionalities of email:

- Asynchronous communication concerning interactions across time [Whittaker, 1996]
- Task management allowing users to track the progress of ongoing tasks [Bellotti, 2003]

- Personal information management enabling to search, sort, and archive messages [Whittaker, 2006]
- Knowledge management, providing the common characteristics of knowledge management systems [Fischer, 2001].

All of these functions are enabled by the same tool using the same mechanism, which makes it a plastic tool. ESM tools however do not afford the plasticity in an individual tool. Only full-featured platforms such as an enterprise social networking platform may have a multi-functional activity enabled by its integrated tools (e.g. a wiki to edit a document collaboratively and micro-blogs or blogs to publish information). However, the plasticity of their use varies according to each platform’s richness of functionalities and intuition.

Results of comparison

Based on the extended scope presented above, Table IV.6 builds on the findings of [Treem, 2012] while offering a broader perspective of comparison between email and ESM tools relying on a final set of six of communicative capabilities.

Tool	Capability					
	Visibility	Persistence	Editability	Association	Universality	Plasticity
ESM tools	High	High	High	High	<i>Low</i>	<i>Low</i>
<i>Wikis</i>	High	High	High	High	<i>Low</i>	<i>Low</i>
<i>Social networking</i>	High	High	High	High	<i>Low</i>	<i>Low-high</i>
<i>Blogs</i>	High	High	High	High	<i>Low</i>	<i>Low</i>
<i>Social tagging</i>	High	High	High	High	<i>Low</i>	<i>Low</i>
<i>Micro-blogging</i>	High	High	High	High	<i>Low</i>	<i>Low</i>
Email	<i>Low-high</i>	High	High	<i>Low</i>	High	High

Table IV.6 Comparison of the communicative capabilities of email and ESM tools

Drawing upon this table, we highlight the higher degree of consistency of email’s capabilities compared to ESM tools. Email is highly affording two critical communicative capabilities that are not far highly afforded in ESM tools. These advantages make email a unique tool that will continue to last in enterprises in tandem with ESM tools.

IV.1.6 Summary

This Section evaluated the ESM platforms from a broad scope that is not specifically limited to the ESM tools. Our scope involved the overall set of workplace tools in order to assess the platforms within their hosting environment. The typology we proposed allowed us to characterize the platforms based on the types of tools they contained. It highlighted that the platforms' design was limiting its direct communication channels exclusively to instant messaging and email. While these channels are imperative for employees' communication at the workplace, we highlighted that their use is maintained via the enterprise's pre-existing solutions because of the advanced features of these solutions.

As the use of ESM platform seemed to be taking place in tandem with the enterprise's existing workplace tools, we pursued our evaluation of the platforms against the workplace tools while giving a sharper focus on email. Given that email is a widely used tool for various purposes including the communication, we compared it to the platforms from two aspects.

In term of usage, our qualitative analysis of an experiment indicated that the platforms were used as means to expand the user's scope of relations, contrary to the email that was limited to connecting with the strong ties.

In term of capability, ESM platforms showed a high degree of consistency of visibility, persistence, editability, and association. However compared to email, the platforms seemed to lack plasticity and universality, which were highly afforded in email.

Based on the above, we conclude that the ESM platforms are highly beneficial to the workplace's activities as they consistently support four of six communicative capabilities. Nevertheless, as two remaining capabilities are afforded in the email in a better way than in the ESM platforms, we infer that the use of email in companies cannot be substituted by the use of platforms. Yet, email, as it currently is, lacks the ability to afford the visibility and the association. Further research on this tool is thus needed, particularly to develop its affordances of visibility and association like in ESM platforms. To that end, we offer our next contribution.

IV.2 Enrichment of Existing Workplace Tools: The Case of Email Social Tagging

IV.2.1 Introduction

As discussed earlier, email is a ubiquitous communication tool in enterprises, being used as part of the employees' daily activities in the workplace. Although the rise of ESM platforms has altered the way email was regarded, our contribution in Section IV.1 elaborated how this tool possesses some intrinsic capabilities that make it one of the most popular tools in the enterprise. However, we argued how further research on this tool is thus needed, particularly to develop its affordances of visibility and association like in ESM platforms.

ESM platforms offer a way of communication that capitalizes more on the social aspect compared to the traditional user-centric email tool. Technically, the platforms exploit the users' social graph while benefiting from useful Web 2.0 features such as enabling dynamic rich user experience [O'reilly, 2007]. As regards email, blending this tool with Web 2.0 features for that same purpose has been disregarded.

In terms of products, although a new enriched wave of email systems has emerged in markets recently (e.g. IBM Verse²³, Google Inbox²⁴, etc.), however, these solutions are mainly addressing the problem of email management. Reducing the overload of email through automated organizing solutions for users is their main focus of interest [Jackson, 2015].

This has also been the case of research on email where mechanisms for message organization and content classification have been proposed [Dolata, 2013], [Koren, 2011], [Meek, 2012], [Nairn, 2013], [Stern, 2013]. Scholars are considering email as a user-centric tool for personal information management rather than a tool for groups' collaboration as it was originally designed for (e.g. [Sumecki, 2011], [Whittaker, 2006]), whereas email system is in itself a social network [Bird, 2006], [Godoy-Lorite, 2016]. With multi gigabytes of capacity nowadays, employees' inboxes are becoming important sources of information. Nonetheless, unlike in ESM platforms [Merz, 2015], studies on email are failing to socialize and capitalize on its underlying knowledge.

²³ A cloud business email hosting platform and messaging software that engage contacts' social information [Mullen, 2014]

²⁴ An application by Gmail offering a different way of organizing messages <https://www.google.com/inbox/> (accessed January, 8, 2017)

We argued in Section IV.1 that current ESM platforms do not have the ability to substitute the use of email despite the new way of communication that they offer. This argument thus suggests offering an elaborate study of email given that this tool continues to play a central role in enterprises along with the platforms. Hence, this section proposes to enhance email's deficient capabilities relying on one advantage of ESM features.

As highlighted previously, the email adequately affords neither the visibility nor the association. We thus focus on developing these two capabilities in email. Association can be enhanced by applying tagging mechanisms. This concept is not new to email (e.g. approaches in [Koren, 2011], [Meek, 2012], [Stern, 2013]), however, their implications are different from the ESM's association. The email tagging approaches are so far neglecting the aspect of tags' visibility to the whole community of users. Compared to social tagging of different contents (or social bookmarking), this latter carries a social capital that produces a greater diffusion of knowledge to potential audiences [Damianos, 2007], [Pan, 2008], [Thom-Santelli, 2008].

Hence, inspired by the advantages of ESM's features, we propose a service of social tagging on an email client. Our approach goes beyond the user-centric perspective delivering the benefits of collaboratively tagged email contents to the social workforce. It leverages the visibility of the social connections underlying exchanged email messages. Assessing the perceived utility of this proposed service requires to design, to implement and to experiment a prototype of it [Sjoberg, 2007], [Wohlin, 2012]. We therefore conduct a qualitative experiment on a typical sample of employees and evaluate the service based on the measured use as well as the participants' feedback. The sub-sections are devoted to this contribution.

IV.2.2 Related Work

IV.2.2.1 Social approach on email

It has been made clear that the key factor of ESM success is that they are able to capitalize on an explicitly established social network. But email has, as well, its own latent social network. Yet, although it was originally designed as a tool that supports asynchronous collaboration between multiple users [Rama, 2006], few are the scholars considering its people-centric aspect and the implications of this aspect on the transparency of communication.

The few studies that address the underlying email-based social network are yet user-centric. The social status and relationships created between users during email activities

are mined in [Bird, 2006]. The dynamic nature of these relationships is observed in [Juszczyszyn, 2012] providing the possibility to predict changes to the structure of networked communication systems. A macroscopic analysis of the individuals' behaviours on these networks is provided in [Godoy-Lorite, 2016]. Yet, these studies are failing to explicitly capitalize on the email's latent social network in order to make it more visible and useful for members of the community within which this tool is being used for communication.

IV.2.2.2 Email tagging

Email tagging (i.e. associating relevant pieces of information to its content) has been explored through different mechanisms and for different implications. For the purpose of distributing information, [Nairn, 2013] introduces a method to automatically process and send emails to targeted users based on established user-to-tag records. However, they don't involve users in tag processing.

The authors in [Meek, 2012] provide an improved classification and description of users' emails based on an automatic machine learning tag generator. Reference [Dolata, 2013] allows further user adjustment to the generator. However, in both approaches, tags are merely exploited at the end-user level whereas their collective benefit is omitted.

Within the same scope of personal information management and organization, [Stern, 2013] enables a collaborative and dynamic tagging process wherein both senders and users identified as having received the email have the possibility to add tags to the email. Further, [Koren, 2011] proposes a tag-based email classification that makes it possible for passive email users to learn from the wisdom of crowds in terms of how to better categorize messages. We build on the mechanisms used in these two approaches; however, we propose a different implication for our service.

IV.2.3 Design of Email Social Tagging Service

IV.2.3.1 Description

Email social tagging service delivers to the service's users the capability of collaboratively associating tags to their email messages. The mechanism consists of the following:

- (1) Automatically analyzing a user's incoming messages and providing that user with a list of automatically suggested tags.

- (2) Enabling users, who are related to a specific message (i.e. its sender and recipients), to collaboratively process the message's tags. This includes:
 - a. Confirming suggested tags.
 - b. Adding tags.
 - c. Removing tags.
- (3) Providing users with access to the collection of his/her personal tags as well as the enterprise's tags. Social connections are therefore created between relevant tags and the persons concerned with those tags. The collection of tags is provided to users based on their frequency of appearance in messages.

IV.2.3.2 Advantages and challenges

The email social tagging service accumulates the advantages of the email tagging approaches mentioned in paragraph IV.2.2.2 and adds its own. However, several challenges face the feasibility of the service. We detail them in the following and describe how they have been tackled in our prototyped service.

- The system's automatically suggested tags enable the affordance of association to all the messages, even if it is not manually provided by users. The relevancy of the suggested tags depends on the text analyzer and its semantic capacity to extract relevant keywords, even from short texts. Thus, automatically generated tags are considered as "unconfirmed" until they have been confirmed by one of the concerned users.
- The collaborative tag processing allows concerned users to commonly accomplish the task of tagging a message. On a larger scale, a user benefits from his colleagues' processing of his own messages. This allows avoiding passive users.
- The social connections that associate persons and tags are as interesting as the associations between persons, especially in organizational contexts. They are indicators of activities on different levels: employee's personal level, group's level and enterprise's level.
- Privacy of the content of user's email messages is a first priority in designing this service. Although contents pass through a text analyzer, the service only retains in its repository a pointer to the message with the output set of keywords. Contents of messages are therefore not exposed to the workforce. Moreover, the user has the possibility to un-tag the message.

- The language used in user's messages is a challenging point for the text analyzer. In business contexts and especially in multinational companies, users often communicate using more than one language. They even mix the use of different languages in a single message. This requires a powerful analyzer able to detect these differences.

IV.2.3.3 Prototyping the service

1) Architecture

For experimental purposes, we developed a prototype that enables users to experience the utility of this service. Two models are possible for such a service. The first model consists in delivering an integrated functionality of an advanced email client application. Implementing such a model entails either providing a new email client application and requiring users to shift to it, or plugging-in the new service into the employees' currently used email application. However, plug-ins are only compatible with their specific applications. For example, a plug-in for Microsoft Outlook does not function for Mozilla Thunderbird; whereas both of these email applications can be used, side by side, in the same company.

The second model, which we adopt for our service, is to deliver an on-demand explicit service that is accessible to the entire enterprise users independently of their local email applications.

The prototype of our service is thus a web application delivered as Software as a Service (see Figure IV.3). As the mechanisms of semantic text analysis are not the target of this research, our system externally calls another service in order to semantically analyze the content of emails and extract relevant keywords out of it.

The main components of our proposed architecture are as follows:

- An application server where tags and their related data are stored. The system's core functions and stored procedures related to the data processing are also stored on this server.
- Client-side application where user's emails associated with tags and their collections are displayed.
- The system communicates with the enterprise's mail server from which it extracts users' emails.

- The system also communicates with a text analyzer named TiLT (see details in [Heinecke, 2008] and [Gaillard, 2010] in order to extract keywords relevant to an analyzed content. Certainly, the privacy of user's emails content is considered; the system only stores data related to the tags and the header of messages (i.e. message's identification, sender's and recipients' names and addresses).

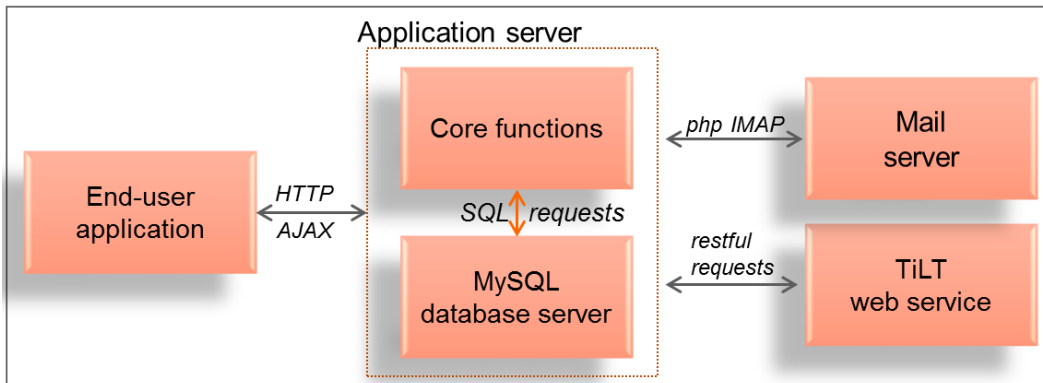


Figure IV.3 Architecture of Email Social Tagging service

2) Implementation

The implementation of the prototype made use of dynamic web technologies in order to ensure interactive real-time processing and browsing of the tags on the client-side. The following languages and techniques were used:

- (1) PHP language for the system's data processing, including PHP IMAP functions for the mail server's communications, PHP cURL for the keyword extraction web service's communications, and MySQLi extension for the database communications.
- (2) MySQL for the database server.
- (3) HTML5, AJAX, and jQuery for the end-user application and real-time client side interaction with a service server.
- (4) CSS5, JSON, and D3 JavaScript library [Bostock, 2013] for visualizing the collections of tags.

A screenshot of the user's main interface is shown in Figure IV.4.

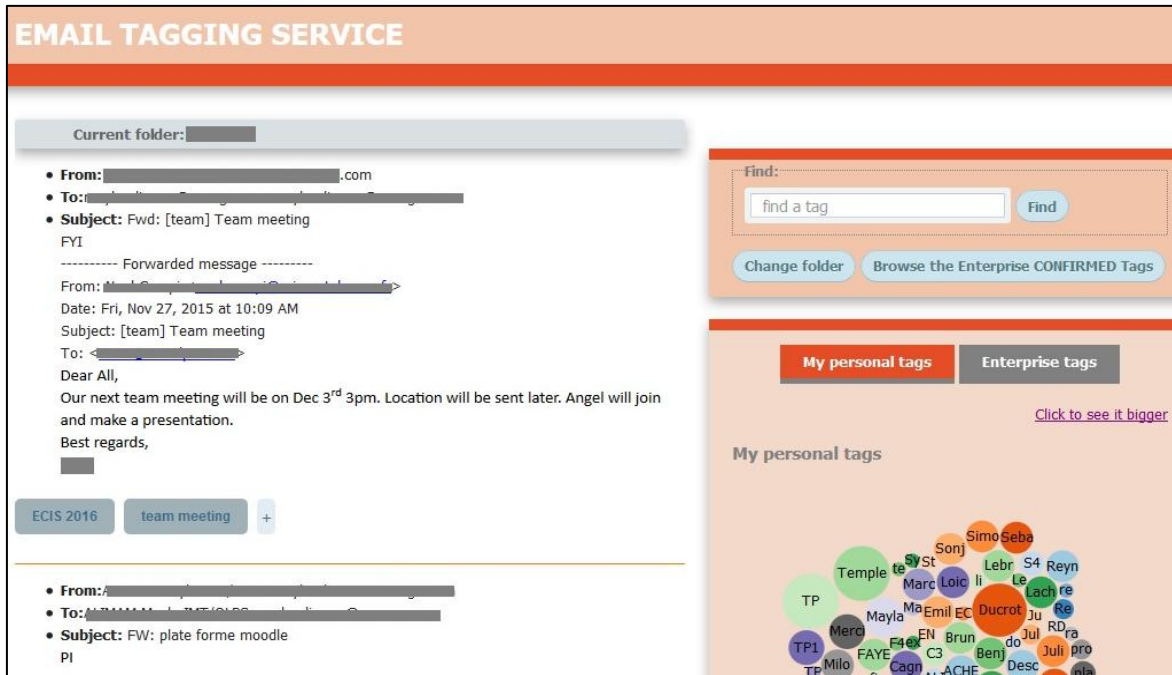


Figure IV.4 A screenshot of the prototype's main interface - Email Social Tagging service

3) Operational details

After logging in, the user is asked to select a folder to analyze and display. The messages contained in this folder are then displayed in the user's mail interface with their associated tags as shown in Figure IV.4. In case of selecting a folder for the first time to browse with this service, all the messages contained in this folder will be analyzed. However, for the next browses of the same folder, only messages that are newly added to the folder will be analyzed and hence, associated with suggested tags.

Technically, the content of messages is displayed asynchronously while the content is under analysis using the AJAX techniques for reloading only certain panels in the page. This guarantees not to get an empty interface in case the analysis takes a longer time than expected. It also allows instantly updating the state of tags between confirmed and unconfirmed for all the concerned users (see Figure IV.5 for an excerpt from this part of the implementation).

From the same interface, the user also has the ability to search for a specific tag in the messages either by typing the desired word or by directly clicking on the corresponding word in the colorful collection displayed below. The interface thus displays the messages in this folder that are tagged with the searched tag.

```
function modify(tId,pId,flag) {
  if(tId!=-1){
    var tag = window.prompt("Please insert your tag");
    if (tag==null)
      flag=0;
  }
  else
    var tag=document.getElementById("p"+pId.toString()+"t"+tId.toString()).innerHTML;
  if (window.XMLHttpRequest) {
    xmlhttp = new XMLHttpRequest();
  } else {
    xmlhttp = new ActiveXObject("Microsoft.XMLHTTP");
  }
  xmlhttp.open("GET","modifyTag.php?t="+tag+"&pId="+pId.toString()+"&flag="+flag.toString(),false);
  xmlhttp.send();
  document.getElementById("tagPanel"+pId.toString()).innerHTML = xmlhttp.responseText;
  if (tagWord==null){
    generateCloud(1,null); // generate personal cloud
    document.getElementById("resultPersonal").innerHTML = "<h3>My personal tags</h3>";
    generateCloud(4,null);
    document.getElementById("resultAll").innerHTML = "<h3>Enterprise tags</h3>";
  }
  else{
    generateCloud(2,tagWord); // generate tag cloud
    document.getElementById("resultPersonal").innerHTML = "<h3>Tags related to: <span class='tag'>"+tagWord+"</span> in My personal tags</h3>";
    generateCloud(5,tagWord);
    document.getElementById("resultAll").innerHTML = "<h3>Tags related to: <span class='tag'>"+tagWord+"</span> in Enterprise tags</h3>";
  }
  displayCloud("#resultPersonal","tags.json");
  displayCloud("#resultAll","tagsAll.json");
}
```

Figure IV.5 Excerpt from the prototype's implementation - updating tags

The user also has a panel wherein two collections of tags are displayed in two tabs. The first is a collection containing the set of tags contained in the selected folder. The second is a collection containing the set of tags generated from all of the service users (i.e. the enterprise in the real case). These collections are refreshed, using AJAX, on a real-time basis to stay instantly updated with the users' continually modified tags.

Clicking on a specific tag in the collection displays a new collection containing only the tags related to the clicked word. That is to say, to display the tags appearing in the same messages as the clicked tag. The names of the persons concerned with the clicked tag are also displayed to allow the user to identify the persons related to a specific activity (i.e. tag). For a better visualization, the user may browse the collection on a new page in which a zooming function is offered (see Figure IV.6).

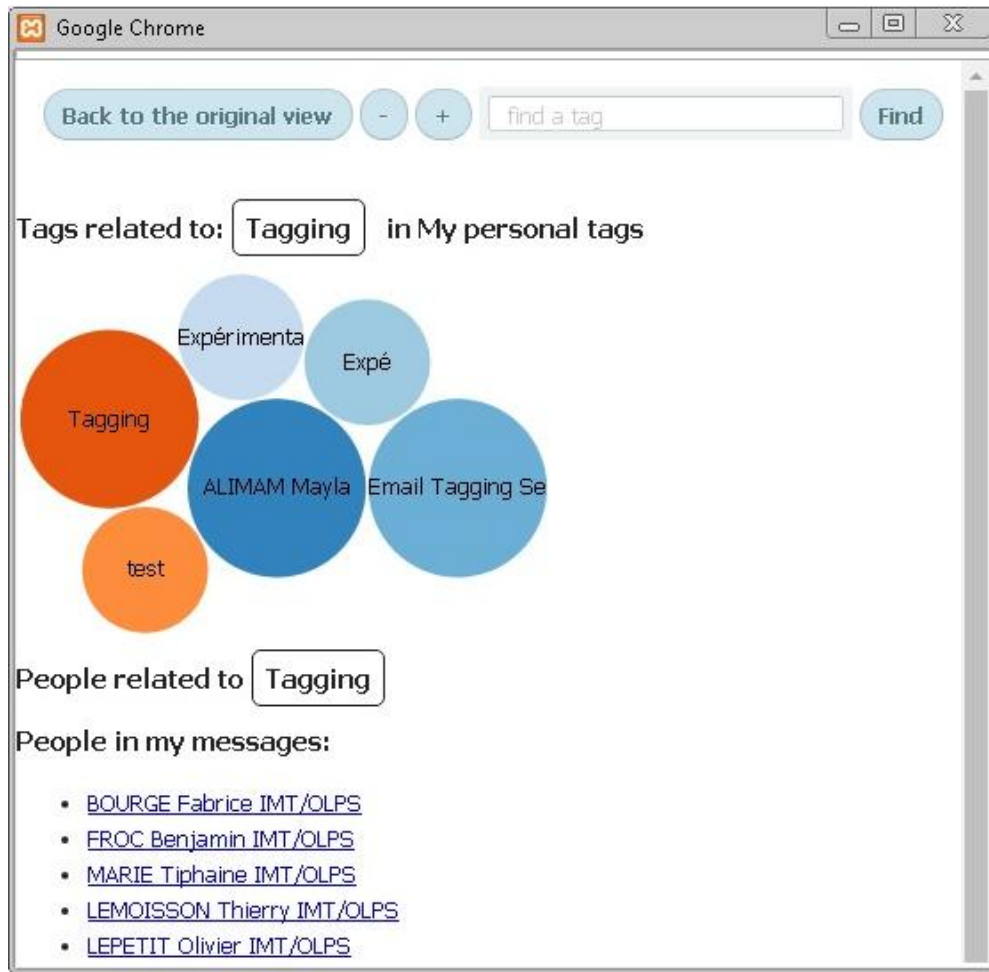


Figure IV.6 A window for browsing the tags' collection

IV.2.4 Experiment

In order to investigate the potential of the prototyped email social tagging service described above, we conducted a qualitative experiment in which participated a selected sample of 36 employees of a large telecommunication provider²⁵. We additionally conducted semi-structured interviews with 16 of the participants.

The purpose of the experiment was to create a large collection of the sample's tags (i.e. the tags generated by participants representing the entire enterprise), and to assess the user's perception of the service. Profiles of the participants were accurately selected to include employees of various ages, types and backgrounds (i.e. project managers, team leaders, research and development engineer, academic researchers).

²⁵ Further details about the context of the host company are provided earlier (see Section III.4.1)

The qualitative interviews allowed making an exploratory assessment of the utility of the email social tagging service [Spencer, 2003]. The interviews contained 9 categorized questions including questions about the context in which participants were using their enterprise email, questions about the usage of the proposed service, questions about their anticipation of the utility of the proposed service and finally their sentiment and global satisfaction.

For participants to experience the collaborative aspect of the tag processing, it was necessary to require each of them to carefully select a sample of his/her own message on which the service was going to be launched. Participants' samples of messages had to mutually contain common messages (i.e. participant A adds, to his sample, message A that he sent to participant B and participant C; reciprocally, participant B and participant C also add message A to their sample along with other messages).

Prior to launching the experiment, we distributed test guidelines containing an overview of the service and a precise description of tasks to be carried out by the testers. We describe in the next sub-section a simple scenario that a participant has performed during the experiment.

IV.2.5 Use Cases

IV.2.5.1 Collaborative tag processing

Bob connects to the application using his email's login credentials provided by the company. He navigates to the folder in which his email sample is located. He notices his messages displayed and appended each by few tags. As tags are color coded, he notices that a message he has received with Alice from Carlos is already having confirmed tags. He understands that either Alice or Carlos had previously processed these tags; he finds them adequate. Another message he has privately received from Carlos is having unconfirmed tags. He starts processing tags of this message: while he's removing an irrelevant tag, he recognizes a new confirmed tag that has just been appended to the message and understands that it has been added by Carlos. He thinks that this message still need another tag that he also finds relevant so he adds the new tag, confirms one suggested tag and removes the rest. He recognizes the change of his personal tag collection displayed on his panel.

IV.2.5.2 Organizing

Instead of the default view of messages arranged by date, Bob displays separately all of his messages that are having the tag "ECIS 2016 paper" for a quick access to these

messages. He recognizes the collection of his personal tags that are related to this particular tag. He browses the quick access menu that is linking to people related to the tag “ECIS 2016 paper” according to his messages.

IV.2.5.3 Socializing

Bob browses the entire collection of his enterprise tags and recognizes the most popular tags while having direct access to people in his enterprise who are related to these tags. Being interested in ECIS, Bob needs to know whether someone else in his enterprise is also concerned with this term, he particularly searches for “ECIS 2016 paper” tag and finds out that his colleague Alice as well as Dave (another colleague whom he hasn’t met before) are related to this term. He has the contact details of both of them through his direct access menu.

IV.2.6 Measures

The method we used to structure the interview’s questions and the service’s evaluation relies on an evaluation template of top-down evaluative framework for collaboration technologies [Steves, 2005]. This framework maps service goals to evaluation objectives, metrics and measures.

The measures are constituted of two levels of abstraction: conceptual and implementation-specific. However, given the distinction between a prototype and a full-featured system, we only involved the Conceptual Measures (CMs) in our evaluation. Table IV.7 provides a set of metrics and measures used for the evaluation. Each metric scopes, by its own, a set of associated measures. Some measures are compared with the participant’s previous use of email.

Goal statement 1: The email social tagging service will support the email’s capability of association

Evaluation objective 1: Assess the real-time collaborative tagging between the participants

Metric 1: What was the user’s evaluation of the automatically suggested tags?

CMs: user rating, recommendation

Metric 2: Can this tag processing be improved?

CM: recommendation

<p>Evaluation objective 2: Assess the perception of personal organization</p> <p>Metric 3: What was the user’s perception of the service’s utility for organizing user’s own messages? CMs: user rating, time estimation with & without the service</p> <p>Metric 4: What was the user’s perception of the service’s utility for finding a specific message? CMs: user rating, time estimation with & without the service</p>
<p>Goal statement 2: The email social tagging service will support the email’s capability of visibility</p>
<p>Evaluation objective 3: Assess the perception of connecting tags to other tags and people</p> <p>Metric 5: What’s user’s perception of the service’s utility for reaching people concerned with a specific topic? CMs: user rating, time estimation</p>
<p>Goal statement 3: Adding a social tagging service to email will add value to organizational processes</p>
<p>Evaluation objective 4: Assess the impact of this service on the ways of working at the workplace</p> <p>Metric 6: To which level a user anticipates that this service will impact the usage of email? CM: user percentage</p>

Table IV.7 Metrics and measures for evaluating the utility perception of email social tagging service

IV.2.7 Results

The conducted experiment targeted a qualitative sample of various accurately selected profiles of users for the purpose of obtaining valuable indicators concerning the potentials of the email social tagging service. Analysis of the interviews and the collected measures reveals that participants indeed perceive a potential utility in this service (see Table IV.8).

IV.2.7.1 Goal 1: supporting association

Participants are aware of the capability of association and the advantages of collaboratively tag processing of messages (quote of interviewee 8 (i8)).

“It’s great to know that even if I forgot or maybe didn’t get to tag my message each time, someone else can do it for me!”

However, they criticize the relevance of the system’s automatically suggested tags. 56% of them think that the suggested tags are not always appropriate. They also find that the tags suggestion process needs more enhancements to be able to deliver terms that emerge from the evolving corpus (i15).

“Suggesting tags is a great idea, only when the tags are exact. It would have been a lot more useful if the system was capable of suggesting for me a tag that I use often in similar contexts”

Despite their awareness of association, participants are uncertain about the impact of this service on their ongoing processes related to information management such as the classification of email messages. 31% of them assess the use of tags for the organization of messages as useful against 25% finding it unhelpful. This is probably due to the evolution of such a requirement. In fact, participants estimate receiving an average of 40 email message per day. If needed, these messages are then manually classified by each user in categorized folders as declared by 89% of the participants. Messages organization is no longer a priority (i12, i2).

“When I need to get back to an older message I use the search field to find it. Classification is not important for me!”

“Indeed, I use a folder-based categorization, but I only do that to my most important messages”

On the other hand, searching for a specific message, artefact, or for a person related to a specific topic is becoming a first priority as highlighted by the participants. They all confirmed the potential of the service for this context. As the task of finding a message was estimated to be taking longer than 5 minutes in 19% of cases, a regression of 3% is estimated for this task.

IV.2.7.2 Goal 2: supporting visibility

Regarding the expansion of the social connections and the reach of new people related to a specific topic, 88% of the participants perceive a utility potential of the email social tagging service for this purpose (i9).

“During my travel last year, I was introduced to a colleague, from the branch of Spain. He was also working on a particular project I was interested in, so we collaborated together for six months. It’s funny to remember though how it was only the coincidence that brought us together that day!”

They think that email continue to have its particular usage and thus, would need more visibility (i14).

“Although I am identified as an active member on our enterprise social network, I am not sure that my colleagues are aware of my entire activities of interest. What I share on the platform is sometimes different from what I deliberately send to specific colleagues by email”

IV.2.7.3 Goal 3: adding value

Participants’ evaluation indicates a potential of 65% for this service to add value to the organization.

Goal statement	Measure	Result
Goal 1: supporting association	M 1	56% saying: tags are not always appropriate
	M 2	Applying machine learning algorithms to adapt the system’s suggestions to users’ choices of tags
	M 3	31% saying: tags are useful for classification 25% saying: tags are not useful for classification
	M 4	100% saying: tags have a utility potential for finding messages, artefact or persons
Goal 2: supporting visibility	M 5	88% saying: email social tagging service has a potential for expanding a person’s social network
Goal 3: adding value	M 6	65% is the potential of email tagging service for adding value to the organization

Table IV.8 Evaluation of the utility perception of email social tagging service

IV.2.8 Discussion

The comparison between ESM platforms and email (sub-section IV.1.5) suggested developing email's affordance of association and visibility, for which, a social tagging service was proposed and evaluated in this Section. Evaluation results revealed a perceived utility of the service. We discuss in the following, each of those two capabilities, their limitations and implications as the experiment has demonstrated.

IV.2.8.1 Association

The semi-automatic collaborative tagging of messages allows users to easier accomplish the association of tags. However, the tag suggestion algorithm is reported as needing more enhancements. Indeed, as mentioned previously, for simplicity reasons and due to some limits of the text analyser, the prototype's architecture only made use of the analyzer's output. No machine learning mechanisms were applied to the tag suggestion algorithm. Further modifications are therefore possible to allow the service to suggest keywords that are adapted to the user's usage.

Also, our findings indicate that the association is interesting for users mostly for the purpose of navigating and searching through the personal messages. This implies delivering this service as an integrated functionality in an advanced email client as has been proposed to the participants. A second delivery model is also possible for this service, which is proposing it as an on-demand service independent of the email client. The advantage of this second delivery model is that the tagging service can be more opened in terms of the type of the tagged object. In this case, several new sources can be added to the service to be tagged and merged together into a single tags collection. Such inputs would be data from the user's videoconference meetings, instant messages, or even social activity on the enterprise's platform of social media tools.

IV.2.8.2 Visibility

The visibility of tags referring to messages and people while maintaining the privacy of email messages' content is declared useful for employees for the purpose of expanding their professional social network. Our insights confirm the legitimacy of pointing out the social connections underlying employees' emails messages. Users consider these connections as important as their social networks that are created through platforms of social media tool.

These highlighted patterns have several implications. In addition to enabling employees to mine for expertise and reach new people [Varshney, 2013], these connections can be

integrated in an automatic skill assessment system to improve the existing business processes in the enterprise [Campbell, 2004]. Skill profiles are problematic as they have to be manually updated by the user who, practically, often fails to keep them current. Thus, in addition to the Human Resources maintained data about the employees, new indicators of this type are now rising for the expertise mining in corporations. Some approaches are thus considering elements from sources such as ESM platforms [Guy, 2013]. Email communications also rise as a legitimate source.

IV.2.9 Summary

This Section contributed to improve email's ability to afford association and visibility. We applied a social tagging mechanism to email and developed a prototype of the service. We finally conducted an experiment to perceive the utility of this service. Profiles of participants were selected formerly to provide an accurate evaluation of the service.

Our findings highlighted the utility of the prototyped service for supporting the email's weak capabilities. The email social tagging service enables organizations to capitalize on the power of its workforce. We finally highlight the need for further research to consider how the email tool can become a more innovative service in complement to the studies on new ESM tools.

Chapter V: Conclusions and Future Work

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V.1 Summary and Implications

In tandem with the rising phenomenon of ESM platforms, flexibility has become a must for enterprises facing internal and external challenges such as growing size or competitive environment. ESM platforms have been thus increasingly deployed, especially in large organizations, with the aim of supporting a planned shift towards agility. Yet, as a systematic step following the adoption of a new IT tool, the resulting benefits of these deployments are failing to be translated into tangible measurement values. Today's management is yet uncertain about how the deployment of an ESM platform may be assessed in order to determine whether the strategic expectations are being met.

Further, since these platforms emerged as a new wave of enterprise communicative workplace tools, they have altered the way existing workplace tools were regarded. The shift towards these platforms has been privileged through enterprises' transformation strategies. However in practice, existing workplace tools such as email continue to play a central role in companies. Beyond the socio-organizational barriers facing their adoption, the ability of ESM platforms to substitute the use of existing workplace tools is yet unclear.

While the research focus was overlooking these critical needs, the present thesis proposed its contributions to this area. It tackled the described problematic situation from two perspectives complementary to each other: an internal perspective focusing on the platforms independently of their surrounding environment of workplace tools, and an external perspective exploring the interplay between the platforms and their hosting environment of workplace tools.

V.1.1 Focus on the research question RQ1

Following the comprehensive survey of literature on ESM in Chapter II, the internal perspective on the platforms was elaborated in Chapter III. While addressing the first research question, RQ1, related to assessing the deployment of ESM platforms, we offered a quantitative analysis of real usage data. Based on a proposed research model, we characterized the activity of an ESM platform in order to describe the correct use of the platform and hence determine the success of its deployment based on tangible values. A transparent information transfer seemed to take place on the platforms and users seemed to give attention to exchanging information and building knowledge rather than to building social capital.

We believe that this Chapter's contribution will be beneficial for both researchers and practitioners as it represents one of the few studies in the domain offering an empirical exploration of the business use of a professional social networking tool. It acts as a foundation for researchers studying how the use of this type of tool is taking form in organizations. Distinct from findings sourced from Facebook or Twitter data, our findings can be more appropriate reference material for comparison with other enterprise case studies as the results of public online social network analysis do not apply to the enterprise world.

The insights provided into the actual use of an ESM platform could also interest practitioners. Administrators who are responsible for the promotion and control of these platforms at companies would be interested in identifying and recognizing active contributors, as the latter demonstrate best practices to other members. Managers who are still trying to measure the value of these platforms for their companies may be motivated by the evaluation of correct usage.

We finally conclude this Chapter's contribution by highlighting that, since information sharing and knowledge management seem more valuable than building social capital in corporations, functionalities enabling such usage should be thus reconsidered and further enriched by solution providers. ESMs should be looked into as social knowledge management systems rather than as content generators that rely on the user's social relations

V.1.2 Focus on the research questions RQ2 and RQ3

Chapter IV was devoted to elaborate on the external perspective on the platforms. It tackled the second and the third research questions, RQ2 and RQ3, related to determining the impact of introducing ESM platforms on their hosting environment of workplace tools. This perspective explored the characteristics of ESM platforms from a scope that involved the overall set of workplace tools. Based on a developed typology of these tools, we described the design of ESM platforms as one that neglects the presence of advanced direct communication channels. A further comparison between the platforms and the email showed how each of these two tools was used for a different communicative purpose. It also showed how ESM platforms would not lead to the eradication of email. Thus, the latter result suggested an evolution of the existing workplace tools towards a more innovative design enriched with social features. As an example of this innovation we proposed the email social tagging service. An evaluation based on a qualitative experiment highlighted the utility of the prototyped service for capitalizing on the social power underlying the email's latent social network.

Building on findings of the evaluated service, we argue that associating people to contents, while relying on a legitimate source of information such as the one of email, has several advantages for enterprise management. The automatic streaming of employees' activities enables managers to correlate the different groups' activities with the enterprise strategy. This streaming thus reflects the type of activity that is exclusively performed via this direct communication channel and not via the platform.

Also, providing a temporal exploitation of this association allows observing the evolution of the activities of entities (i.e. employee, team, hierarchal entity, ..., the whole enterprise). The proliferation in the database is dissolved here according to Monads, which is a navigational practice where the overlapping entities (employee, team, enterprise) inherit from one another to relocate the notion of a whole [Latour, 2012]. Groups of persons having similar activities can also be automatically identified. This can, for example, lead to the creation of reliable communities to be suggested for the users' collaboration over social platforms.

V.2 Main Conclusion

The present thesis contributed to determining the place of ESM platforms in today's enterprises within a hosting environment of powerful existing workplace tools such as email. Drawing on the findings summarized above, a main conclusion may be derived as follows. The use of ESM platform in today's enterprises is imperative to empower employee's new ways of working while facing the continual challenges of the competitive environment.

These platforms bring to enterprises the advantages of the social dimension that have been distinguishing the phenomenon of social media in the public world. Employees are now able to rely on their company's platform to perform professional social networking activities such as identifying experts or potentials collaborators based on their skills. Apart from that, the publish/subscribe model that underlies the interactions over the platforms is probably the key factor that makes these platforms indispensable for enterprises. This model offers a high level of visibility of interaction in a new style that is completely different from the old broadcast style of content management. Thus, when used for information sharing activities in enterprises, it allows capitalizing on the enterprise's knowledge sourced from its workforce while expanding the scope of its visibility to the whole company. We highlight that, although very limited, a sort of social networking capability is already made available for the employees via the company's accessible directory. However, this collaborative creation of user-centered knowledge base is new to enterprises compared to the capabilities of its existing tools.

We thus envisage that this use will be the main use and hence, the main reason to deploy future ESM platforms.

As regards the email, we envisage that the use of this central tool will be complementary to the use of the platform. While the information sharing is the type of activity that will be mainly performed via the platforms, the direct communications will take place via the email. As long as no standardization effort is being made to open the accessibility of communications between different platforms, the email will continue to be regarded as a tool for official communications, including in the inside of the enterprise.

Further, we argue that the enterprise management should be aware of the value retrieved from the activity of its workforce on the platform. Monitoring this activity during the adoption ensures the accomplishment of the targeted objective. For instance, the active contributors should be identified and recognized by the management as they show examples of good practices. However, serious efforts need to be made to set up effective governance and security policies on the platform's usage.

Nevertheless, since ESM platforms seem to penetrate the workplace as a supplement tool working in tandem with the existing ones, this suggests a reconsideration of the transformation strategies. Rather than eradication, an incremental evolution of the enterprise's digital services seems more feasible. Business strategies might therefore consider applying services to their enterprise tools for new innovative purposes such as in our proposed email tagging service.

Drawing upon the above conclusion, we finally argue that the described state of ESM platforms in enterprises suggests developing the current understanding of the workplace tools from a systemic perspective. In the same way as information systems, we argue that these IT tools, empowering the informal work processes at the workplace, should be considered under the umbrella of an ecosystem that ensures the data coordination and identity management between the various workplace tools. We name this system as the Enterprise Social System (ESS). Building basically on the typology offered in Chapter IV, we finally propose, and briefly discuss two scenarios of possible future ESSs. The two contrasting scenarios reflect the conceptual design of the coexisting workplace tools, which may be either in the form of a complete integrated platform (scenario A) or in the form of a set of standalone tools (scenario B). Nonetheless, other scenarios may be derived from the intersection of scenario A and B (see Figure V.1).

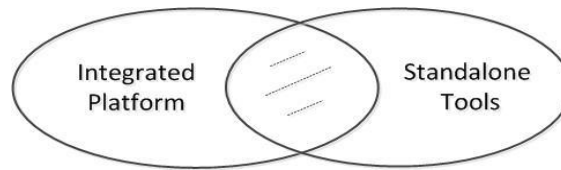


Figure V.1 Intersection of the two contrasting scenarios of ESSs

V.2.1 Scenario A: Integrated Platform

The first scenario is to build a system that encompasses all the types of workplace tools and assembles the entire range in a single integrated platform. This system provides the unique interface that enables employees' interaction with the tools after authentication. Missing tools in current ESS products are included in this structure (e.g. private communication channels along with publish-subscribers). As in multi-layered web services platforms [Gambhir, 2013], [Guoli, 2010], the blended tools should be implemented as web-based services, designed as features of the new system (e.g. sharing files, exchanging messages).

A typical example of such a system is illustrated in Figure V.2. It represents a web-based application, hosted either on an internal enterprise server or on a cloud-based server depending on the company's policy. The login procedure, performed by the client's browser, creates an online transaction session. Closing the browser or logging out of the session prevents the user's access to his workplace tools, even when accessing his local machine (i.e. using the operating system account of his machine such as a Windows or Linux account).

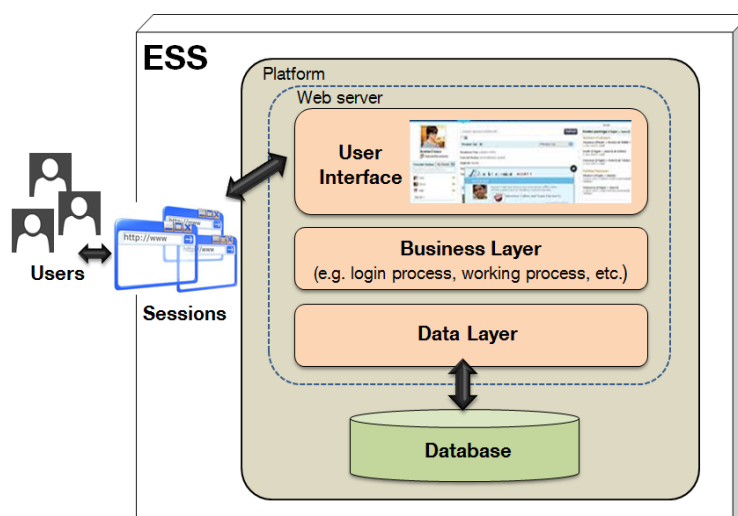


Figure V.2 Example of scenario A: ESS as an integrated platform

Such a system raises the challenge of usage complexity, especially that it may become counter-intuitive, as they will contain features of different mental models as shown in our typology. Deploying it goes beyond the mission of IT executives in the company. A strategic deliberation is required of the top-level management in order to agree on the substitution of the existing workplace tools.

V.2.2 Scenario B: Standalone Tools

The second scenario consists in building a system that keeps the workplace tools as separate entities while ensuring data synchronization between them. The behavior of each tool takes into account the other interacting tools like in relationship-aware applications and services [Burégio, 2013], and like in ubiquitous environments where all sort of devices communicate and share data over the Internet [Zeng, 2011].

Figure V.3 illustrates an example of this system. In this example, tools coordinate and achieve synchronization across a communication middleware platform [Nakazawa, 2006]. Users' data such as activities and published information, issued by each tool, are captured and aggregated through data mining mechanisms. They are sent to the control platform, which provides an interface displaying different users' data along with other features such as users' profiles and personal dashboards.

The logging to the system takes place once a user connects to his work environment, requiring a separate authentication in order to access each tool. Accordingly, data capture is performed on each tool once the user's authentication succeeds, which is independent of being connected to the platform. Users' data issued from their tools, whether on the client or the server side, is then coordinated and synchronized on the platform.

In fact, a kind of coordination already exists within enterprise collaboration tools, but only between client applications from the same software vendor which enables a bidirectional update of data. For example, Microsoft provides compatibility and integration between Skype for business²⁶ and Outlook by enabling communications between Skype and Exchange server through Exchange Web Services and Messaging API; thereby, Skype presence information, for instance, can be reported in Microsoft Outlook and likewise, Skype can use Outlook calendar to automatically update that presence information.

²⁶ Skype for business is a calling, instant messaging, and conferencing client provided by Microsoft for corporate environments: <https://products.office.com/en-us/skype-for-business/online-meetings> (accessed January, 8, 2017).

However, in this second scenario, the return of updated data towards each tool is hardly implementable. This would indeed require a modification of the architecture of each tool to take into account these returns (typically to be performed by its vendor), while adjusting a product's behavior based on unpredicted data may risk the product's stability

For top management, this scenario prevents having to source and deploy a brand-new solution. But the required compatibility between the existing tools and the new system requires a tight control from the IT department.

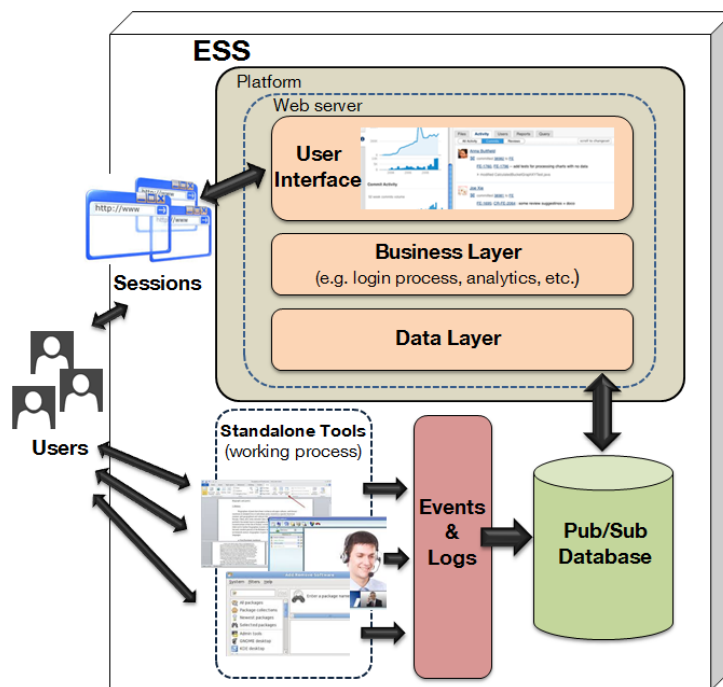


Figure V.3 Example of scenario B: ESS as a federation of standalone tools

V.2.3 Intersection

Various new scenarios can result when intersecting the two ones introduced above. A possible scenario is for instance to build a system that aggregates the workplace tools and provides a single point of access to them. Such a system brings together the platform characteristics from scenario A and the feature of retaining the architecture of each tool from scenario B. Different mechanisms exist for adding tools to this single point of access, as for example a widget-based mechanism where widgets get executed as parts of the user interface [Laga, 2010], or a mechanism where applications are installed from a marketplace. In this vein, some tools propose APIs for ESS vendors or third-party programmers.

To sum up, we highlight that both academic and industrial works seem today to privilege the first scenario. However, we prompt the business informatics community not only to consider ESS as the unification of all social features within a single product, but also to study how existing tools can be federated to answer ESS requirements.

V.3 Limitations

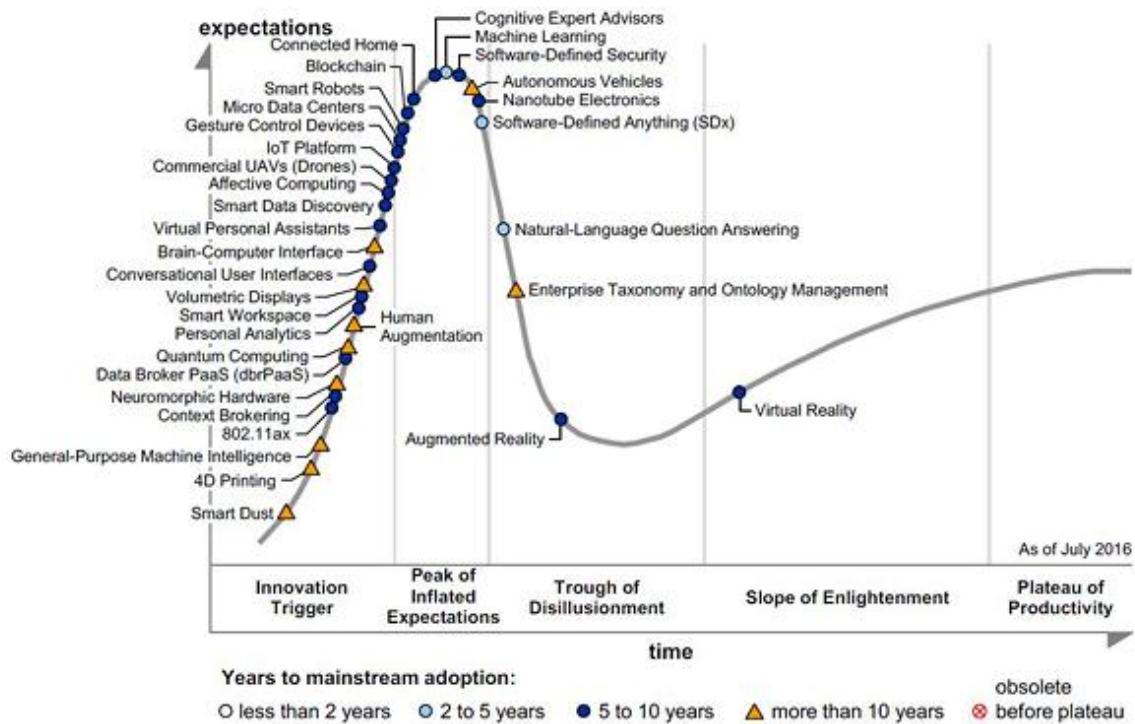
Certain limitations remain in the present work. We list them accordingly with their corresponding chapters in the following points:

- As regards the literature review in Chapter II: The review limits its focus to publications appearing in academic journals while overlooking practitioner and academic-practitioner journals. However, evidence has been produced that academics usually succeed in capturing and addressing the practitioner interests [Straub & Ang, 2011].
- As regards the quantitative usage analysis in Chapter III: The findings are provided based on the investigation of a single company's use of an ESM. The use of one case study is fairly satisfying in terms of validity. However, performing the same analysis on other data sources would have allowed comparisons between the multiple cases to generalize the findings at a larger scale.
- As regards the email tagging service in Chapter IV: Due to time limitations, we restricted the delivery of the prototype to a first iteration only. The developed tag suggesting algorithm remains thus basic and the tags registered in the database remain in an unstructured form. This leaves, to the user, the task of verifying whether or not a potential tag to be added already exists in a similar form.

V.4 Future work

Building on the contributions of this thesis, we propose, in the following, some promising areas for future research. Referring to Gartner's announcement of the set of technologies that will have a high priority and a great impact on the organization's strategic planning over the next five to ten years (as of July 2016) [Gartner, 2016], we highlight that the areas we are suggesting are aligned to the predictions of future business expectations (see Figure V.4). The presented hype cycle in the figure shows

also the maturity of each technology through its position on the cycle. The perceptual smart machine age is revealed as one of the highest priority areas for the coming years.



Source: Gartner (July 2016)

Figure V.4 Gartner's hype cycle of emerging technologies

V.4.1 Analysis and Mining of Enterprise Networks

As user's interest in the company's social networking tool is different from his/her interest in an equivalent tool in the public world, the results of public online social network analysis do not thus apply to the enterprise world. The insights provided into the activity of an ESM platform may be used in future work and compared to different social network communities such as in the health, education, or public area. The main characteristics distinguishing ESM users from users of different communities may be thus derived.

V.4.2 Performance Metrics

The present thesis contributed to assessing the success achieved from the launch of an ESM platform at a workplace based on tangible values. As metrics of public social networking sites do not apply in the professional context, extending this work entails

proposing unified metrics and then validating the acceptability of the proposed metrics on various case studies.

Another direction will be to measure the performance of individuals based on a wider scope of workplace activities. This scope should involve the analysis of data generated from the use of various workplace tools. The purpose is to achieve a better assessment of employee's skills and knowledge based on their overall activities.

V.4.3 Semantic and Machine Learning Techniques for Smart Services

Exploiting machine learning mechanisms in the innovation of new smarter workplace services should be considered in the future research. Bringing our email tagging service into focus, the functional prototype design may be advanced to improve the tag suggestion algorithm. The machine learning may be applied to adapt the text analyzer's corpus and provide a suggestion of tags that corresponds to the user's previously approved or eliminated tags.

The machine learning may also be applied to advance the development of recommendation algorithms on the social networks. This type of algorithms organizes the content streamed to each user's news feed in order to manage the overload of the delivered information. It also provides personalized suggestions of persons or groups potentially interesting for the user. The use of this type of algorithms is currently limited to the public social networks. Applying them to social networks within an organizational context should however imply further considerations. The user's evolving domain of interest, which corresponds mainly to his/her current professional activities, should certainly be taken into account.

Finally, an evolution of the web 2.0 mechanisms towards the semantic web should arise in the context of corporations. For example, as regards the association of workplace tools, the current tagging approaches need to start relying on the semantic dimension.

A created semantic structure of the generated tags should thus distinguish between various entities such as User, Activity, Time, etc. and their similarities. The resulting semantic social network of meta-data can be then used for a wide range of purposes; including, for example, to be used as entries for the recommendation algorithms, or for extracting knowledge from the big data analytics.

Appendix I

The concept of the developed algorithm is as follows: two nodes i in A and j in B are considered similar if the neighbor nodes of i can be matched to similar neighbor nodes of j .

$$x_{ij}^{k+1} = \frac{s_{in}^{k+1}(i,j) + s_{out}^{k+1}(i,j)}{2} \quad (2)$$

Equation (2) calculates the similarity of the i th node of graph A and j th node of graph B in $(k+1)$ th iterations where $s(i,j)_{in}$ is the in degree similarity of node i in A and j in B , and $s(i,j)_{out}$ is the out degree similarity of node i in A and j in B . These degrees are calculated in (3) and (4), respectively, using the summation of the neighbors' similarity in the previous iteration.

$$s_{in}^{k+1}(i,j) = \frac{1}{m_{in}} \sum_{l=1}^{n_{in}} \max(s_{in}^k(l,f)) ; f = 1 \text{ to } m_{in}$$

$$m_{in} = \max(id(i), id(j))$$

$$n_{in} = \min(id(i), id(j)) \quad (3)$$

Note that $id(i)$ stands forth in-degree of node i and $od(i)$ the out-degree of node i .

$$s_{out}^{k+1}(i,j) = \frac{1}{m_{out}} \sum_{l=1}^{n_{out}} \max(s_{out}^k(l,f)) ; f = 1 \text{ to } m_{out}$$

$$m_{out} = \max(od(i), od(j))$$

$$n_{out} = \min(od(i), od(j)) \quad (4)$$

Iteration of node similarity calculation is repeated until convergence. An epsilon value ϵ is defined to determine that point, based on the difference between node similarities in two iterations.

$$x_{ij}^k - x_{ij}^{k+1} < \epsilon \quad (5)$$

A matrix of similarity scores of the nodes in the two graphs is then calculated. The final similarity value is provided in (6) as the sum of the maximum similarity values of the two graph nodes divided by the size of the smaller graph.

$$s(A, B) = \frac{1}{n} \sum_{i=1}^n \max(s_{if}^k) ; f = 1 \text{ to } m$$

$$m = \max(A, B)$$

$$n = \min(A, B)$$

(6)

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