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Evaluating the capacity of a virtual r&d community of practice : The case of ALSTOM power hydro

Marie Fraslin

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THÈSE

Pour obtenir le grade de

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Présentée par

Marie Fraslin

Thèse dirigée par **Eric BLANCO** et
codirigée par **Valérie CHANAL**

préparée au sein du **Laboratoire G-SCOP**
dans l'**École Doctorale I-MEP²**

EVALUATING THE CAPACITY OF A VIRTUAL R&D COMMUNITY OF PRACTICE

The Case of ALSTOM Power Hydro

Thèse soutenue publiquement le **3 septembre 2013**,
devant le jury composé de :

M. Michel TOLLENAERE

Professeur des Universités, Grenoble INP

M. Eric BLANCO

Professeur Ecole Polytechnique de Grenoble (Directeur de thèse)

Mme Valérie CHANAL

Professeur Université Pierre Mendès France Grenoble (Co-encadrant
de thèse)

M. Jean-Louis ERMINE, Professeur Institut Mines-
Télécom/Télécom Ecole de Management

Mme. Nadège TROUSSIER, Professeur Université de
Technologie de Troyes

M. Vincent RIBIERE, Professeur, Bangkok University, Bangkok



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A mes enfants,

Je vous aime plus que tout,

*Puisse ce travail vous
témoigner un jour le goût
d'apprendre.*

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ABSTRACT

Globalization has had a huge impact on the organization of product development activity within the Alstom hydro power company. Today, it is common to design products in Europe, make them in south-east Asia and sell them in Africa. In this context, engineers working on the same project are separated by long distances. These new types of teams are called “distributed teams”. By definition, a distributed or Geographically Dispersed Team (GDT’s) “is a team whose members are separated by distance and time zones, but linked together by some form of electronic technology with limited or no physical interaction... (Sessa V., Hansen MC. et al. 2004)...

These distributed teams have to be able to accomplish two goals: collaborate and share knowledge.

- Collaborate, because since globalization, product development activity has been completely spread out over the globe. Central teams are dedicated to creating rules that local teams are supposed to follow. However, when designing a special machine, this division of work is not so obvious. Designers, at the local level, have to be able to understand the rules to adapt them to an on-going project. Collaboration practices between central and local actors have to be set up.
- Share knowledge, because during the past decade, the manufacturing workforce has mostly been located in Asia. Manufacturing knowledge is developing on this side of the world. Having this knowledge is critical for the European engineers to continue to be able to design reliable products. They have thus to be able to learn from their colleagues in order to maintain a good knowledge of production while transferring their own knowledge to ensure that Asian Engineers can use the experience and skills acquired by the European Engineers over the years. This is critical to global engineering performance.

Management of Product Development activity has thus to set up the right mechanisms to reach both these goals.

In the business distributed context, the setting up of communities of practices (CoPs) (Wenger E. 1998) appears to be a way to leverage collaboration and knowledge sharing across the Product Development organization. CoPs are defined as “*groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis*” (Wenger E. and Sydney W. 2002). The Theory of communities of practice consists of observing groups of

individuals who share a common practice (eg professional practice). The “practice” is the key element of similarity.

With globalization, the notion of a virtual community appeared. This notion introduced the mediation of Information and Communication Tools (ICT) as the foundation of the community. The Virtual Communities of Practice (VcoP), are those where their members use ICT as their primary mode of interaction (Dubé L., Bourhis A. et al. 2006).

Some studies model the forms of online interaction in Virtual Communities of Practice (Stempfle J. and Badke-Schaub P. 2002; Xu Wen., Kreijns K. et al. 2006; Barcellini F., Détienne F. et al. 2008; Riverin S. and Stacey E. 2008; Scherngell T. and Barber M. 2009; Walthall CJ., Devanathan S. et al. 2011). These studies demonstrate that collaboration activity and knowledge sharing occur among participants. However, there are only a few studies that have been conducted on virtual communities of engineers working in product development (Détienne F. 2006). That is why, in this dissertation, we explore the potential of a forum to support collaboration and knowledge sharing among Virtual Communities of practice.

We also note that no study exists on the link between the configuration of a virtual community and its level of online interaction. We thus propose to explore this link and point out the main factors that will play a key role in boosting online interaction on a forum.

This dissertation is organized as follows:

We propose first a clarification of the concept of knowledge and a diagnosis of the knowledge management practices implemented within the R&D organization of Alstom Hydro. We then formalize the research problematic:

- In a global context, how does a collaborative platform improve the collaboration and knowledge sharing within a virtual community of practice related to product development?

Then, we propose a coding scheme based on the Rainbow model and test it in order to analyze the content of two forums of R&D VcoP. We demonstrate that a forum supports asynchronous argumentative activities and thus enhances global collaboration and knowledge sharing among R&D VcoP members.

We then propose an enriched model based on the work of Line Dube and test it, to characterize the R&D VcoP studied. We prove that the community configuration has a direct impact on the online dynamic of the community. We point out the main factors that play a key

role in fostering online collaboration and knowledge sharing between R&D Virtual community members.

Thesis Defended

Evaluating the configuration of a Virtual Community of Practice (VcoP) allows for the forecasting of its online activities, ranging from information transfer to the co-production of solutions and knowledge sharing.

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INTRODUCTION

“The ability to create cross-links of collaboration and knowledge sharing within global organizations is a challenge that the corporate management has to tackle” said the director of Alstom learning university in 2008, during the inauguration of the new ALSTOM Collaborative Way department. This interest expressed by ALSTOM for collaboration and knowledge sharing is shared by many multinationals since the companies’ globalization.

“Globalization” consists of *“the geographic dispersion of industrial and service activities, for example research and development, sourcing of inputs, production and distribution, and the cross-border networking of companies, i.e through joint ventures and the sharing of assets”* (From OCDE, Organization of Cooperation and Economic Development). Globalization strategy has usually been explained in Alstom with the famous slogan *“think global and act local”*. The idea is to obtain a local competitive presence by the acquisition of units abroad and ensure that each “new acquisition” is compatible with other locations, so that joint working activities can occur. In this context, technology transfer with knowledge capitalization and sharing has to be done between units.

Globalization has had a huge impact, particularly on the product development activity of the Alstom Company.

Product Development Activity (PDA) clarification

The “Product development activity” (PDA) consists in specifying a system (product, process, or organization) which must respond to well-defined functions and criteria (quality, cost, time)(Hatchuel A., Le Masson P. et al. 2006)

There are different representations of product development activity proposed by Pahl and Beitz (Pahl 1984), Ulrich and Eppinger (Ulrich KT. and Eppinger SD. 2004). The different stages are well represented in the generic scheme proposed by Clark and Wheelwright (Clark K. and Wheelwright S. 1992). Even if this generic scheme comes from the automotive industry analysis, it is commonly used as a generic model for product development activity.

In these representations often taught, the product development activity consists of different phases that are completely interrelated. The passage from one stage to another is usually conditioned by the crossing of a milestone. As underlined by Cooper (Cooper RG. 1996), the PD or « stage gate system » should be modelled as a funnel, which means it must include decision milestones such as (go / no go) and the crossing of each phase requires that the

activities of the previous phase be successfully carried out and the expected deliverables are available with the quality level requested.

The process proposed by Clark and Wheelwright includes 4 stages (see figure 1):

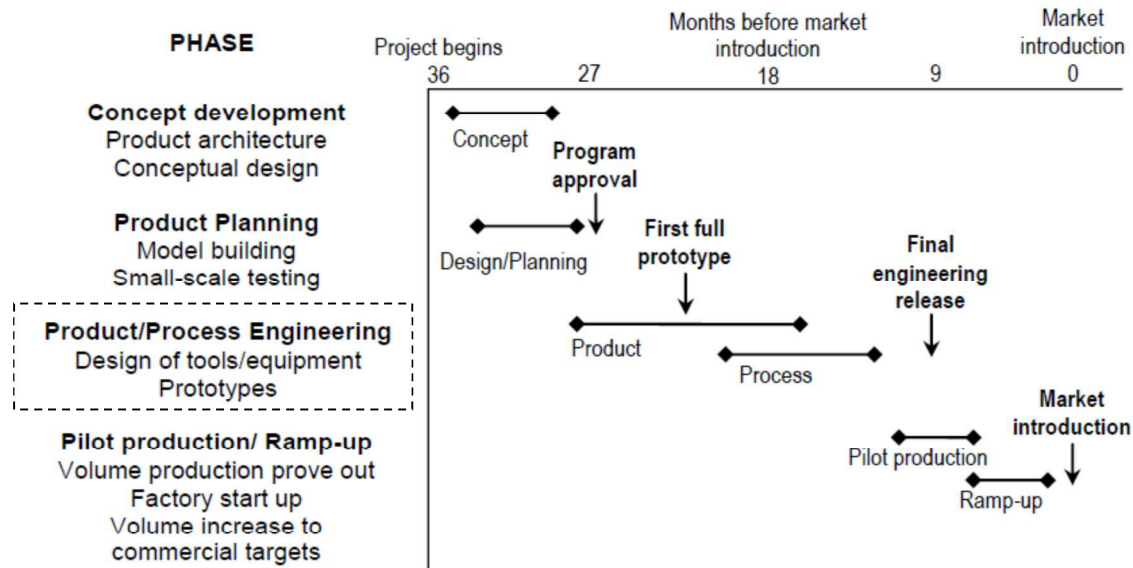


Figure 1: Typical phases of the Product Development process, according to (Clark and Wheelwright 1992)

In the Concept development and the Product Planning stages, the actors are focused on research activity and idea creation with the objectives of proposing and testing new technology and concepts that will suit market needs. In this stage, all of the production strategy will be set up as well as the organization of introducing the product to the market.

In the Product and Process Engineering stage, the actors are mobilized to design the product. They have to produce drawings necessary for the future manufacture that will be handled by the actors in the stage: Pilot production/ ramp up. Ramp up is, for instance, typical of the automotive industry and it doesn't exist in the Alstom Hydro industry which is an industry of special machines where product is designed to fulfill a special order. The product will be designed and produced as a prototype according to the customer request and ramp up will never occur.

Each stage is managed by different teams involving actors with different skills and knowledge. However, they need to understand each other as explained by Eckert (Eckert. C, Clarkson. J et al. 2001; Eckert. C and Clarkson. J 2002; Eckert. C and Clarkson. J 2003) in order to succeed in their respective missions. Indeed, the outcomes of each stage are used

in the input data of the next one whatever the engineering model (sequenced, parallel or collaborative).

In this thesis, we have focused on the stage "Product and Process Engineering". This stage consists of an operational phase break down in two stages called: basic design and detailed design. During the basic design, the frame (shape, size), the overall architectural diagram of the machine or part of it is designed, and during the detailed design, the concepts are transformed into drawings including operational specifications such as: Operating parameters for manufacturing, material requirements, external surface treatment, packaging requirements...

The globalization of product development activity has had a huge impact on product development activity organization within the Alstom Power Hydro Company. Today, it is common to design products in Europe, make them in south-east Asia and sell them in Africa. In this context, a basic design engineer and a detailed design engineer working for the same project are usually separated by a great distance. These new types of product development teams are called "distributed teams". By definition, a distributed or Geographically Dispersed Team (GDT's) is a team whose members are separated by great distance and various time zones, while linked together by some form of electronic technology and physically interacting with each other rarely or not at all. Other terminology with similar connotations includes virtual teams, computer-mediated teams (*when not co-located*), *remote teams*(Sessa V., Hansen MC. et al. 2004)...

International collaboration and knowledge sharing within distributed teams are in practice, difficult tasks.

To illustrate the difficulties of collaboration, we can quote the example of a Chinese designer working in the design office of Wuhan (China) of an international company. He used to receive sketches lettered by annotations from his French unit partner and he used to ask his French manager to translate these annotations. These annotations were important in order to successfully complete his mission. This example reveals some of the inconveniences inherent in the world of remote work. There is not only a question of tools but also a question of culture. In this example, the French engineer has to change his way of working to succeed in the collaboration with his Chinese partner.

In France, we can tell the story of a French expert who hadn't mastered the English language and confused the usage of the verbs "to be" and "to have". An Indian engineer called him one day in order to obtain some clarification about a technical instruction written by this French expert. The Indian engineer asked him a question and the French expert began his

answer with: “*You’re a Sheet of paper*”, in order to express: “*Do you have a sheet of paper?*” Hopefully the Indian partners had a good sense of humour and understood what the French expert was trying to say because by phone we couldn’t see the reaction of the Indian colleague.

The difficulties inherent to the remote work are interesting to study. Why such a gap between the rhetoric promotion of international collaboration and knowledge sharing and reality?

We propose in this thesis to look at collaboration and knowledge sharing goals in the “Product development” activity of Alstom Power Hydro, a French company progressing in the design and manufacturing of special machines.

ALSTOM Hydro Power

Let’s present briefly Alstom Hydro Power. This Business builds and provides various ranges of Turbines/Generators on the international market for the production of hydroelectricity. The characteristics of the business market lead to a huge variety of products since each sold turbine/generator is specific and must meet each customer’s tailored expectations and constraints. By constraints, that is to say, the whole environmental, geological, hydraulic or economic situation (for example: water head, the flow, type of fluid...). These data systematically influence the profile of the product and its design. Thus, we can speak about Complex products design such as the design of a new aircraft(C. Eckert, A. Maier et al. 2005).

The organization of the product development activity is global (Bartlett. and Ghoshal. 1998) and sequenced according to a prescriptive approach between upstream R&D activities that must provide methods and downstream R&D activities commissioned to develop and adapt these methods to local circumstances.

In essence, the mission of the central research and development teams is focused on knowledge creation and sharing with local Design offices. Central R&D teams work on the development and dissemination of rules and methods. They want to ensure that the designs done by designers all over the world are done uniformly, with regards to having the same rules and standards.

The objectives of the central teams can be summarized as follows:

-to ensure the correct application of the rules and methods produced to minimize the risk of failure on manufacturing phases linked to an incorrect engineering choice made during the design phase.

-to create a common language to enable experience sharing and global learning across the Product Development organization and facilitate a capacity load leveling in the worldwide design offices.

Globally, this sequenced organization of the Product development activity has to ensure the maximization of the production forces into the multinational. Indeed, the configuration of the current market imposes the reinforcement of the design teams in the world and the deployment of expertise and polyvalence in local units. The diffusion of rules and common languages has to facilitate the capacity of smoothing the load on a world level. Each entity must be able to design various components due to the appropriation of the guides and procedures developed by the central research team. There is also an aim, in terms of limiting the failure risks during the projects design phase. The central team has therefore to enhance the control of the design activity and provide designers with the right support to ensure that they can find the information and instruction requested in the right time, at the right place in line with lean engineering philosophy. Lastly, the issue regarding knowledge digitalization and transfer is to avoid the risk of crucial expertise loss.

Industrial question

Because, we speak about complex product design in a make to order mode, the mission of the central R&D teams cannot be reduced to formalizing and then providing methods, rules and instructions to designers. They also have to ensure that designers understand how to apply them on a project. That is to say, the information received by designers from central teams has to be combined and *transformed* to reach a new understanding of a previous situation (Anja M. Maier, Eckert Claudia et al. 2005). This process of knowledge acquisition by the individual will be facilitated through interaction with other people, negotiation and “reification”. Reification could be defined as the concrete use of the knowledge in daily work. Thus, a strict work division and a streamlining of the engineering activity based on a prescriptive approach and standardization processes is not suitable without strong collaboration practices among teams. As underlined by Jina (Jina J., Bhattacharya K. et al. 1997) and Maffin and Braiden (Maffin D. and Braiden P. 2001) the low volume context is a context where methods and tools cannot be applied and used “as is” in this specific context. The low volume context requires the adaptation of existing results or tools or the creation of new knowledge that is adapted. In practice, the “development teams” have to use the rules

defined by central research teams but also develop autonomy in order to adapt the products design to manufacturing facilities and clients' local specifications.

Collaboration and knowledge sharing between central teams and local teams is thus crucial.

The local engineering team also have to be able to collaborate and share knowledge themselves.

- Collaborate, because, the product development consists of different phases that are completely interrelated. Indeed, the outcomes of each stage are the input data of the next one. Engineers have to work together to ensure a complementary and collaborative work to gain efficiency in their design activity.
- Share knowledge because over the past ten years, most of the time the manufacturing workforce will have been located in Asia, the manufacturing knowledge will thus begin developing on this side of the world. This knowledge is critical for the European engineers to continue to be able to design reliable products. They have thus to be able to learn from their colleagues to keep a good knowledge of production while they have to transfer their own knowledge to ensure that Asian Engineers use the experience and skills acquired by the European Engineers for years. This is critical for the global engineering performance.

Central management teams have thus to set up the right mechanisms to allow global exchanges.

Our initial Research Problematic was stated by our industrial partners as follows:

- In a global context, how does one organize the collaboration and knowledge sharing within the Product development activity?

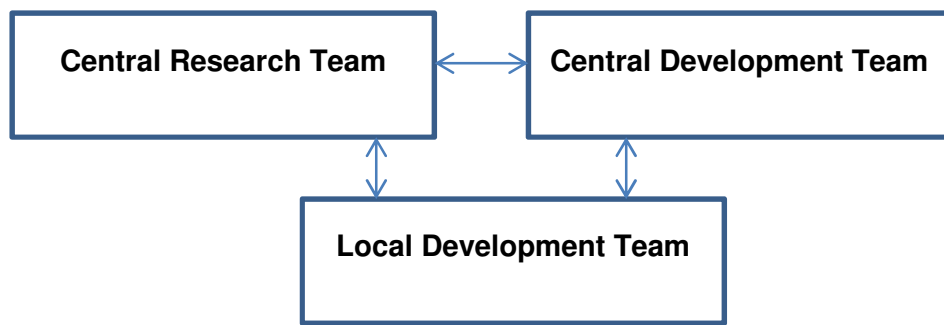


Figure 2: Collaboration goals between R&D actors

Research assumption

As Professor Shigehisa Tsuchiya (Shigehisa T. 1993) explained, the dialogue is what permits the exchange and mediation of knowledge. The interaction is part of the dialogue. Kerbrat-Orecchioni identifies interaction when "the discourse is caught in an exchange circuit: it is for a specific targeted population (whether individual or collective), endowed with the ability to speak in turn " (Kerbrat-Orecchioni C. 2005).

Christian Brassac claims that the co-construction of meaning is done thanks to the interaction: *"The interaction is not a message transfer exercise even implicit; the conversation is a meeting between cognitions involved"* (Brassac C. 2000; Brassac C. and Grégori N. 2000). This is inscribed in the cognitive approach and its sense-making perspective with the assumption that the meaning creation come from the interaction between a person and its environment.

Our research was based on the first assumption that the dialogue that will support the collaboration and knowledge sharing between actors all along the product development activity has to be improved.

But interacting in distributed teams is not easy and information and communication tools have to be mastered. Among Information and Communication Tools, we focus on "Collaborative Platforms" (CP). Collaborative platforms appear in litterature as good leverage to support collaboration and knowledge sharing among remote teams in the sense that it "more closely emulates a real verbal discussion, with the added feature of being persistent" (Cunningham W. and Leuf B. 2001). The main principle of a collaborative platform is to allow members to discuss and exchange ideas informally. These tools are based on the newer approaches to knowledge modeling from research in cognitive sciences. According to Aurélie Girard (Girard A. and Fallery B. 2009), "users become actors at the heart of information

sharing and act as consumers as well as content producers". Users and producers alike can switch roles during the knowledge management process.

Forum and Research Questions

To leverage the interactions on forums, communities appear to be also an opportunity. The idea is to gather people according to the "perception of similarity". Haas (Haas P. 1989) develop the concept of an Epistemic community built on expertise and knowledge proximity. The idea is that the cognitive proximity could be federative for the group and facilitate interactions whatever the medium used. The concept of community of practice was introduced by Wenger (Wenger E. 1998) defining "practice" as a key element of similarity. CoPs are defined as "*groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis*" (Wenger E. and Sydney W. 2002). The Theory of communities of practice consists of observing groups of individuals who share a common practice (eg professional practice). The "practice" is the key element of similarity. Originally researches on communities of practice have focused on collocated CoPs where members had face-to-face interaction. The empirical studies give evidence that the face to face interaction, the dialogue allow for knowledge exchange and co-construction. It builds on social-cultural theories of learning that view learning as a process of participating and interacting in a community of practice (Vygosky L. 1978; Greeno J-G. 1998 ; Lave J. and Wenger E. 1999).

With globalization the concept of CoP was extended to the concept of virtual community of practice. This notion introduced the mediation of Information and Communication Tools (ICT) as the foundation of the community. The Virtual Communities (VcoP), are those where their members use ICT as their primary mode of interaction (Dubé L., Bourhis A. et al. 2006). Within this framework, online interaction among members is the key mediator for the co-construction of shared perspectives. Some studies model the forms of online interaction in Virtual Communities of Practice (Stempfle J. and Badke-Schaub P. 2002; Xu Wen., Kreijns K. et al. 2006; Barcellini F., Détienne F. et al. 2008; Riverin S. and Stacey E. 2008; Scherngell T. and Barber M. 2009; Walthall CJ., Devanathan S. et al. 2011). These studies demonstrate that collaboration activity and knowledge sharing occur among participants.

However, there are few studies that have been performed on virtual communities of engineers working in product development (Détienne F. 2006). We also note that there is no study on the link between the configuration of a virtual community and its level of online interaction.

The research question is thus reformulated as follows:

- In a global context, how does a collaborative platform improve the collaboration and knowledge sharing within a virtual Community of practice working in Product development?

The research objectives are to improve the different collaboration and knowledge management practices all along the product development activity.

Research method

The focus of this thesis is thus on collaboration and knowledge management for Product Development Activity. The work sets out to generate knowledge in the area of engineering and management that contributes to industry and academia.

The originality of this research is that we borrow tools and methods from different disciplines and particularly from engineering sciences to solve management problems.

We were employed by ALSTOM Hydro power as a Knowledge management coordinator.

Our research is action research (Coughlan Paul and Coughlan David 2009). Action research should be conducted in real time and does not postulate a distinction between theory and action. It aims to contribute both to the practical concerns of people in an immediate problematic situation and the goals of science through joint collaboration.

A “question” was the starting point of our action research. After having well understood the ground of our research that was a prerequisite, we have managed our research around four actions: Diagnosis, Planning action, taking action, and evaluating.

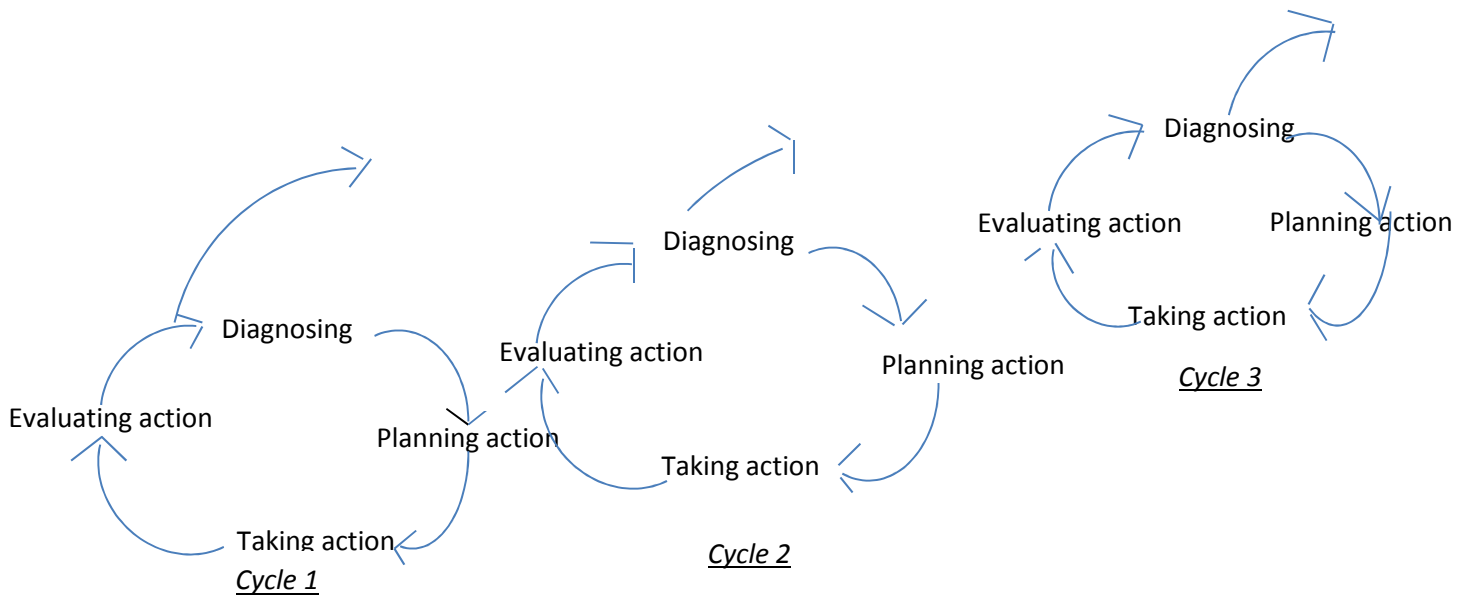


Figure 3: Continuing Cycles of Action Research (Coghlan and Brannick, 2005)

- *Diagnosis* may be defined as investigations that draw on concepts, models and methods in order to examine the current state of an organization and to help find ways to solve problems and to enhance organizational effectiveness (Coghlan and Brannick, 2005).
- *Planning Action* follows the diagnosis and is consistent with it. It lists action that has to be taken
- *Taking action* means to interfere in the current situation by doing something. The consequences of the action have to be measured and evaluated in the last stage to generate other adjustments for taking future action. *Evaluating Action* also involves a reflection on the outcome of the action taken, both intended and unintended, and a review of the process in order that the next cycle benefits from the experience of the cycle completed.

The particularity of the Action-Research is that data collection tools are themselves actions and generate data. For instance, our interview may generate feelings of anxiety, suspicion, or create expectations in the work force. We had to be aware of such consequences and allow for adapted answers.

The quality of action research is based on four criteria: Participation, real-life problems, joint meaning construction and workable solutions. These criteria have to be evaluated at the end of the action-research.

Action Research summary

Aim of research Knowledge in action	Knowledge in action, theory building and testing in action
Type of knowlegde acquired	Particular Situational, Praxis,
Nature of data validation	Contextually embedded, Experiential
Researcher's role	Actor, Agent of change
Researcher's relationship to setting	Immersed

Table 1: Action Research Summary (Coughlan and Coughlan, 2009, page 243)

Document structure

The document is organized in 3 parts.

The first part exposes the empirical framework within which our research is carried out. We present the Hydro business department of the Power sector of the ALSTOM Company. We expose the evolution of the Product development organization that has led to the current questions of hydro Management regarding knowledge management. We present a diagnosis/audit of the KM practices of Hydro Business including a clarification of the concept of Knowledge management gathering scientific findings that are supposed to be helpful to improve the current practice of Hydro. We then, expose the results of the audit done with the central research actors and the designers discussing the problems faced with regards to information flow in their daily work. This diagnosis reveals the current interface¹ problems and gives insight to the central team, helping to improve their services. We clarify for them the industrial problems found from a KM perspective.

In the second part, we propose first to review the concept of interaction. We explain that it is through the dialogue and the interaction that collaboration and knowlegde sharing can occur. Then, we present the virtual community of practice (VcoP) as a unit of analysis of online interaction phenomena. We explain that encouraging online interaction among virtual Communities of Practice (VCop) can boost knowledge sharing and complement the current practices of Hydro business.

We present the coding schemes that allow for the figuring out of the online interaction dynamic of a Vcop, and that give evidence that co-construction of knowledge occurs. We

¹ The word "interface" is usually related to connections, links, interaction, networks, relationships, and interconnections between two or more organizations.

bring up whatever limits of the coding scheme and propose to set up our own coding scheme to code discussion among designers.

In the Product Development field, few studies have coded the forms of online interaction for virtual engineering communities and only few papers have tried to make a link between the configuration of a Virtual Community of engineers and the different forms of online interaction. That is why, we present an enriched method that helps us with detecting or implementing a favorable virtual community configuration in order to ensure the capacity of its members to go online and share knowledge. In order to fit with our industrial expectations, we make these grids operational. We finally present a visual management tool that allows one to see the link between a community configuration and its online interactions.

In the third part, we test our method. We focus on two Communities identified in the diagnosis both already supported by a collaborative platform. The analysis of these communities is conducted with two objectives. The first one is to characterize the group as a community by using the enriched theoretical grid; the second is to characterize the communication carried out using the platform by testing the enriched coding scheme.

We demonstrate the link between the community configuration and the interaction carried out on a forum.

We then use our method to analyze the failure of a launched virtual Community of Practice gathering engineers from Grenoble central teams, and engineers from design offices of Grenoble and Barcelona. We finally test the method on a strategic community: "The expert community." We advise the Alstom Hydro Company not to instrument this community, explaining that a forum is not the best means to improve the level of collaboration.

We end this thesis with a critical overview of our work and perspectives for future work.

Introduction

Action Research requires a breadth of pre-understanding of the corporate environment, the conditions of business, the structure and dynamics of operating systems and the theoretical underpinnings of such a system (Coughlan and Coughlan, 2009).

That is why, the first part of this thesis exposes the empirical framework within which our research is carried out.

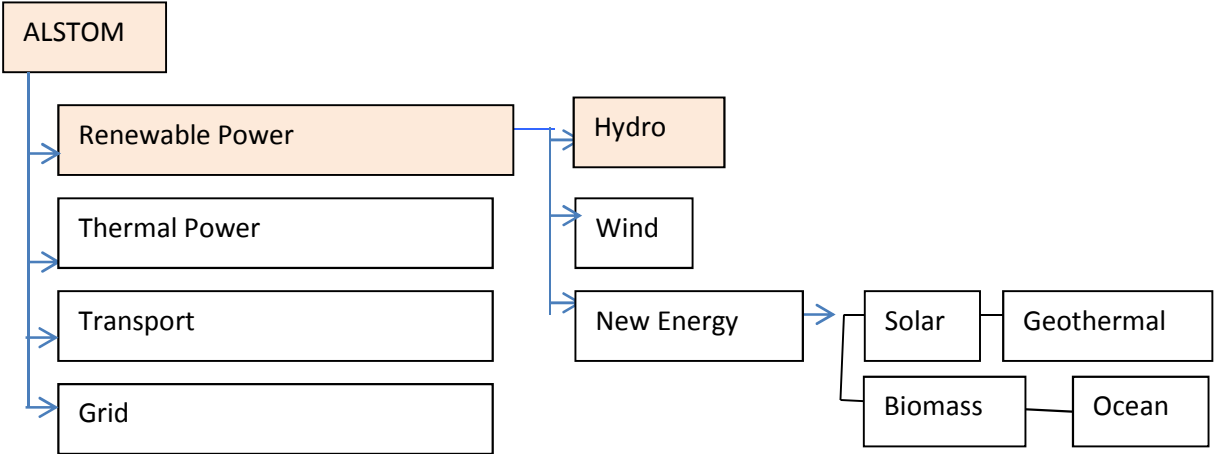


Figure 4: Visualization of the Hydro business of Alstom Renewable Power sector

We introduce the Hydro business department of the Renewables Power sector of the ALSTOM Company. We expose the evolution of the product development organization that has led to the current questions within Hydro Management regarding knowledge management.

Then, we present a diagnosis consisting of a qualification of the interface and the identification of the main issues in terms of knowledge management within Hydro.

To improve the situation, we finally expose the first actions undertaken.

The first part of this thesis corresponds to the restitution of the two first cycles of our action research.

Cycle 1	
Diagnosis	- Company discovery - Literature Review on Knowledge Management
Planning Action	- Preparation of the KM Practices Assessment Methodology - Interview planning
Taking Action	- Restitution of the industrial section of the Litterature review - Setting up of scientific model and grids to diagnose the KM practices
Evaluation	- First Steering commity with a validation of the method of the forecast diagnosis

Cycle 2	
Diagnosis	- Interface qualification between mechanical technology center (central R&D) and Grenoble design office (Interview, Workshops) <i>Findings</i> : Design engineer's access to the information and knowledge requested thanks to their social network, which is local. The KM codification ² practices have to be improved and completed by KM practices inscribed in a personalized and global approach.
Planning Action	- Work on the improvement of the codification practices of K.M (Common design, databases) - Plan meetings to share with our partners the Industrial Problem and propose action plan regarding the codification and personalization practice
Taking Action (In Yellow, action that has not been developed in this dissertation)	<ul style="list-style-type: none"> • Operational Improvements of the current interface system <ul style="list-style-type: none"> ○ Improvement of the intermediary objects to obtain the characteristics of boundary objects (Common designs) ○ Optimization of the technical databases and training of the R&D actors of the user centric method • Formalization of expert knowledge <ul style="list-style-type: none"> ○ Runner manufacturing guideline redaction:

² To sum up, the so-called "codification" refers to an "instrumental" understanding of knowledge management whereas with "personalization" one refers to a more pragmatic approach of knowledge management involved in the action and social interaction dynamic.

	<ul style="list-style-type: none"> ○ Publication of a feed-back of experience with a method to help similar initiative of knowledge formalization • Redaction of an Induction plan for new designers . <ul style="list-style-type: none"> ○ Document sent to the HR Business partner to be implemented • Organization of 2 workshops to defend the idea to create a common data-management and interface between the different central R&D antities • Harmonization of the naming of the technical instructions
	<ul style="list-style-type: none"> • Co-construction with partners of the Industrial Problem
Evaluation	<ul style="list-style-type: none"> - Improvement of the satisfaction regarding the common design and technical database (Satisfaction survey- 6 months later and 3 years later) - Set up of the manufacturing guidelines on each unit - Internal approvals of the diagnosis results: <i>Validation of the industrial partners of the need to globalize the current designers local knowledge management and collaboration practices</i> - Publication of article for Iced 13

Table 2: Part 1 as the two first cycles of our action research



	Done and implemented in Alstom but not developed in this document
	Done and implemented in Alstom and explained in this document

Figure 5: Legend of the table 2 “Articulation between the field work and the research work”

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CHAPTER 1 – Alstom Case Study Presentation

1.1 Alstom Hydro: A global company, a global market, with a unique product line that uses a make to order mode

1.1.1 Activity

If we take a look at the K BIS³ document, the activity of Hydro is described as follows:

The activity of the business consists of: engineering, design, development, manufacturing, installation, commissioning, maintenance, repair and distribution of all "material" for the production and distribution of Hydroelectric Power, pumping systems and irrigation, as well as the electrical, electromechanical and hydro mechanical components and control systems engineering, pumps, pipelines, steel structures, including the operations and maintenance of hydraulic systems.

The business consists of designing and manufacturing various ranges of turbines/generators and installing turnkey projects in an international market of hydraulic and electrical production. A turbine project is part of a dam project. On average, turbine projects run between 3 to 8 years for large projects (100MW to 10000MW) and a dam is constructed within 5 to 15 years.

³ The K-bis is an official document that can be compared to an "identity card" of a company attesting to its legal existence in France. The K-bis exposes the main characteristics of the company from its identification number (SIREN), name, symbol, address currency and amount of share capital etc. to a detailed description of its activities.



Figure 6: Schematic view of Hydro plant Equipment (Hydro Business Presentation, August 2012)

Hydro Business includes generators, turbines, control systems, hydro mechanical and ensures rehabilitation and services.



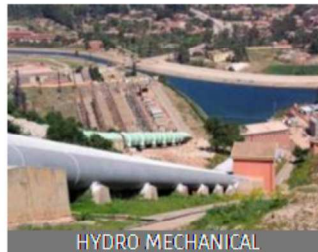
TURBINES



GENERATORS



CONTROL SYSTEMS



HYDRO MECHANICAL



REHABILITATION & SERVICES

For new plants and the installed base

Figure 7: The broadest range of products and services (Hydro Business Presentation, August 2012)

1.1.2 Turbine: A complex product

In this research, we have worked particularly with the actors specialized in turbine design and manufacturing.

The main function of a turbine is to transform the potential energy of a water fall (head, discharge) into mechanical energy (torque, rotational speed). The shaft transmits this energy to the generator which transforms it into electrical energy (tension, intensity). The Hydraulic energy is the foremost renewable energy resource among solar, wind, ocean energy etc. To give an idea, a turbine produces 200 times more energy during its lifetime than the amount of

energy needed to build and maintain it. It is one of the highest in the energy generation business.

There are several types of turbines (Pelton, Francis, Kaplan, Bulb, and Pump Turbines). Each one is adapted to a special environment.

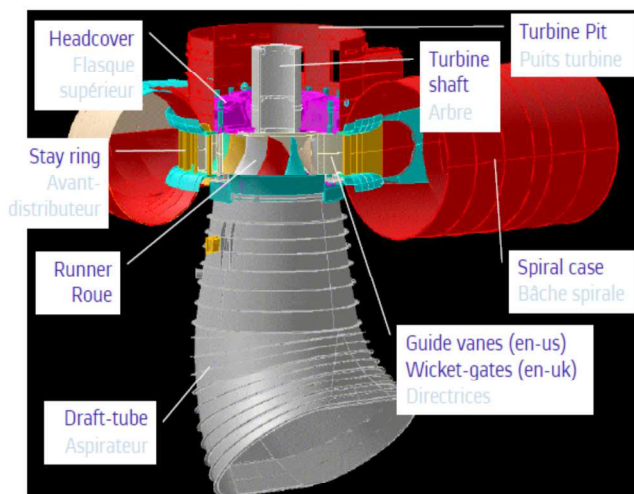
- The Pelton turbine is used for high waterfalls (from 200 to 1500 meters in altitude).
- The Francis turbine (the most common) can reach 1000MW. This is a machine operating at an average head (from several ten to 700 meters).
- The Bulb and Kaplan turbines are suitable for low waterfalls (between 12 and 50 meters). Their Power reaching up to 220 MW. The bulb turbine also adapts to large ranges and can operate in pumping mode.
- The pump turbines are used to store energy during periods of overproduction.

Table 3: Types of Turbines designed within Hydro Business

A turbine is a complex system with difficult systems and huge constraints to take into account. By constraints, we mean the whole environmental, geological, hydraulic or economic factors (for example: water head, the flow, type of fluid...). These data systematically influence the profile of the product and its design. The turbine design will have to be adapted to a specific environment.

The product is broken down into Partial Assemblies (PA). There are eight main Partial Assemblies which define the turbine architecture.

Case of a Francis turbine



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Figure 8: Turbine description with the 8 main PA (Slide from the Hydro discovery tour 2010)

Within each main PA, a decomposition is also performed. An instruction, available in the Hydro management system, explains the entire breakdown structure of the product. This rationality is shared by all Hydro engineering members and has to be mastered by new comers. Indeed, this rationality is used for the storage of the technical documentation within Hydro. For instance the technical R&D database is structured according to the product PA rationality. There are around 20 technical instructions for each main PA. The aim of these technical instructions is to describe the methodology used to design a turbine. The instructions stored in the database gather information about dimensioning criteria with hydraulic and mechanical calculation sheets.

To sum up, a new product is designed according to each project's constraints and adapted according to the technical instructions defined and formalized by the central authorities.

Hydro management has estimated that to design a turbine, up to 15 000 engineering hours are necessary and for designing a turnkey project (turbine+generator+Balance of Plant+Control system+Hydromechanicals), up to 70 000 engineering hours.

Today, the technology of Hydro products is mastered. R & D investments are now devoted to the optimization of the performance capabilities of existing turbines as well as non-polluting solutions.

1.1.3 Implementations

Today, Hydro Organization is located in five regions (North America (HNA), Latin America (HLA), Europe (HEU), China (HCN), India (HIN) supported by central functions. The slogan from Hydro Business Presentation diffused in August 2012 is: “We are where our customers are!”

Each region is able to design each type of turbine. However, each region is specialized in a type of machine which corresponds to the region’s market needs. It has to be adapted according to a cycle of 5 to 10 years. Europe is is composed of 12 Design offices. Each of them works with Asia. In Europe, the engineering activity represents 50 million Euro and around 400 persons (20 % of the Europe Hydro Headcount (around 2000 employees).

Region	Speciality
North America (Hydro North America-HNA)	Bulb and Refurbishment (all types of machines)
Latin America (Hydro Latin America-HLA)	Kaplan Turbine
Europe (Hydro Europe-HEU)	Pump Turbine (fixed or variable speed)
China (Hydro China-HCN)	Jumbo and medium Francis Turbine
India (Hydro India-HIN)	Pelton Turbine

Figure 9: Product Specialty by Region

Within Hydro, 1, 400 million hours are dedicated to engineering (2010) and 66% of the total Hours of engineering are related to Turbine and Generator Design.

Around 13 projects are managed simultaneously in Europe.

Also, note that only Europe and Latin America regions design the whole system (Plant integration and General layout, Mechanical Balance of Plant (BoP), Electrical BoP, Hydromechanics, Control Systems, Generator, and Turbine). In these regions, there is a high diversity of capabilities, competencies and skills.

Europe also has the lowest number of machine-tools. In Hydro, nearly all the machining factories have been relocated to low cost countries such as Brazil, China and India. This situation is prejudicial for the European Region that has started a specialization in research and engineering activities without having access to the manufacturing capabilities which makes it pretty inconvenient to maintain manufacturing Knowledge required for design.

Country	Location	MECHANICAL SHOP - KEY MACHINES				
		Extra Heavy Vertical Lathe	Heavy Vertical Lathe	Heavy Boring Machine	Boring Machine	Heavy Horizontal Lathe
	Taubaté Brazil	3	3	2	4	3
	Tracy Canada	2	-	2	-	-
	Tianjin China	7	3	9	4	3
	Grenoble France	1	1	1	1	-
	Baroda India	3	2	5	1	3
	Bilbao Spain	-	-	-	-	-
	Birr Switzerland	-	-	-	-	-
SUMMARY		16	9	19	10	9

Figure 10: Number of key machines, Mechanical shops (Global Engineering Management Meeting 11)

The figure 10 shows that the manufacturing capability of Alstom Hydro is mainly located in low cost country such as India with 14 key machines, China with 26 key machines and Brazil with 15 key machines. This indication of key machine-tool consumption is an interesting reflection of the evolution of industrial production because in order to produce, specific machine-tools are required. According to Georges Dureault⁴: “it is the consumption of a country’s machine-tools that is representative of the entire mechanic industry”.

Today, as we can note, the manufacturing capability are moving to Asia. However, Western engineers have to keep knowledge on manufacturing to be able to continue to design machine.

1.1.4 Head count evolution by region

⁴ The Weapons engineer Georges Dureault has made his entire career in the mechanical industry. He has spent more than 20 years in machine-tools, with the French leader of the epoch, H. Ernault Somua, a company that he directed from 1968 to 1978. During this period, his presence in the Union of French machine-tool manufacturers (where he served as president from 1974-1976) and to the European comity permitted him to gain a deep understanding of the whole sector. After the machine-tool, he went in the direction of working with large diesel engines at Alstom Atlantic, then into the technical center for mechanical industries. During this time, his presence in directoral positions in mechanical industries permitted him to continue to follow the evolution of the machine-tool until the end in 1995.

The Hydro business has around 8000 employees.



Figure 11: Alstom Hydro A worldwide Presence (Presentation August 2012)

If we consider the headcount since 2006, there is a constant increase of the Headcount in every region. It reveals the health of the business which benefits of the worldwide preoccupation regarding the environment and the global trend to adopt clean energy. However, the growth of each region is different.

For instance, the headcount in India has increased of 104%, in HNA by 87%, in HLA by 71%, in Europe by 30% and in China by 36%. Europe has the lowest growth but still remains one of the most representative regions of the global business with 25,6% of the global headcount just after the LAM with 29%.

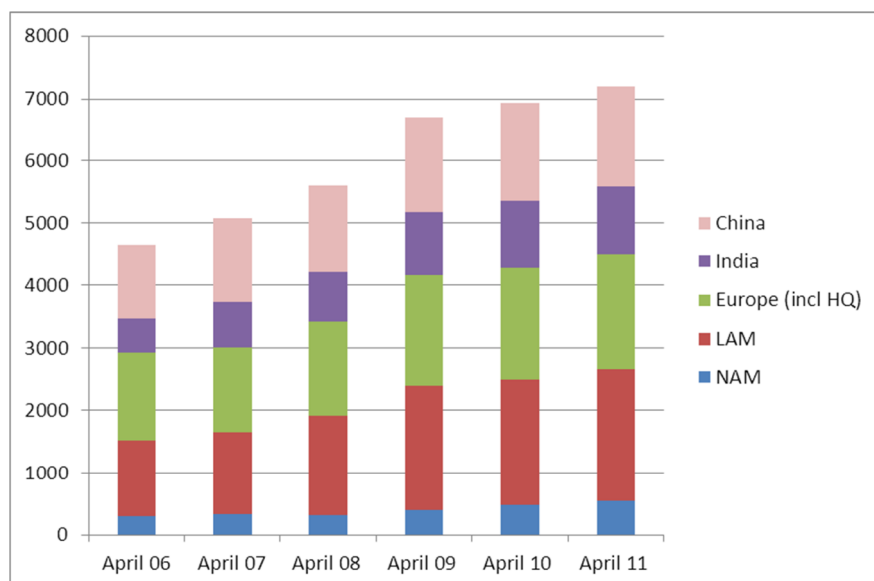


Figure 12: Headcount evolution per region (Source HR Data, from Business Object Request)

The data from 2012-2013 were not given for confidentiality reason.

1.1.5 Customer expectations and market configuration

The customers of Hydro business are mostly public or semi-public institutions operating in energy production.

R&D Manager, Mechanical Technology Center, 2010

“The first priority of our customer is safety. Our client is not seeking innovation but wants a safe machine that guarantees energy production without any problems. A minor problem within a turbine can lead to disaster. Take for example the Fréjus disaster, the dam failure that killed over 400 people in 1960. The Malpasset Dam, located in the Esterelle River at 2 km upstream of Frejus collapsed, spilling 50 million tons of water. You understand why safety is the priority so that if a competitor makes a mistake on technology mastered by ALSTOM, this technology will never be purchased by the customer due to lack of confidence. Our client is not seeking innovation but safety.”

The second priority of customers is price. The most telling example is the evolution of awarded contracts in the Three Gorges project in China. The conditions for obtaining the “underground” contract were drastic. The prices of the megawatt have been divided by two compared to the first contract. Everything was supposed to be designed and manufacture by Chinese teams.

In Europe and North America, the market for the manufacturing of new equipment has poor growth. However, the rehabilitation market is growing rapidly. In fact, the market for new equipment in Europe is saturated. All the big projects have already been realised and the forecasted business revenue is mainly in refurbishment instead of construction.

On the contrary, the market for new equipment is growing in Asia (India and China).

In Latin America the Taubate unit in Brazil is living thanks to the Jumbo Contract that makes its business sustainable for several years. The Brazilian production site is even overloaded. Management tries therefore to transfer the manufacture of certain equipment on under loaded sites. However, the load transfer is not an easy task. In fact, the production system cannot be moved or copied without heavy investment and expertise is not the same from one region to another. The load levelling is complex and we will come back to this complexity later in the thesis.

The globalization of the business Hydro has a direct impact on the product development activity and on the R&D organization as we will present in the next section.

1.2 Globalization of the Product Development Activity

1.2.1 A historical perspective: From a multinational organization model to a global organization model

For more than 30 years, Europe, where Nerpic⁵ was born, used to be the most important region. Even if Neyrpic was progressing in an internationalization strategy, the Grenoble site was completely autonomous gathering all the expertise related to turbine design and manufacturing. Grenoble engineers were committed to ensuring a certain technology transfer to the acquired units but the relationship had clear boundaries because of the clear market segmentation.

Headquarters used to decentralize its power to the Business Unit (BU) managers. These managers were similar to business portfolios that had to generate earnings that central team controlled.

To serve the European market, nearly all the turbines were designed and manufactured respectfully by the Grenoble design office and Grenoble workshop. Only some minor components were manufactured by suppliers and local partners. However, the assembly of the machine was ensured in the Grenoble workshop.

During this period, the co-location of the different departments and the proximity with suppliers was really helpful in terms of information and knowledge sharing. All engineers were French, sharing the same language and culture which helped to avoid a lot of difficulties in terms of communication and understanding.

Engineer, Mechanical Technology Center, 2009

“The proximity between the design office and the workshop had a direct advantage in terms of communication and learning.”

“The workshop was located just near the design office and as a design engineer; I progressed with the help of direct feedback from the blue collars and colleagues working in the workshop. The organization allowed us to have oral communication and direct contact with colleagues from different departments. For instance when I had a question, I used to consult the welding specialist. As soon as he had a look at

⁵ Neyrpic is the previous company named that has change when Alstom bought it in 1993.

my drawings, he was able to tell me the problems that he would face during the welding stage. It was because of this direct interaction that we were able to progress and learn from our staff. I used to take notes and give them to my colleagues to share, things I had recently learned in the workshop for instance.”

At that time, proximity relations and mutual adjustment was more appropriate than the formalization of behaviour and the rules issuance. This organization had similarities with the adhocratic according to Mintzberg model. Companionship among colleagues was promoted.

1.2.2 From a multinational R&D model to a global model

Bartlett and Ghosal (Bartlett. and Ghoshal. 1998) propose a vision of the evolution of international Organizations.

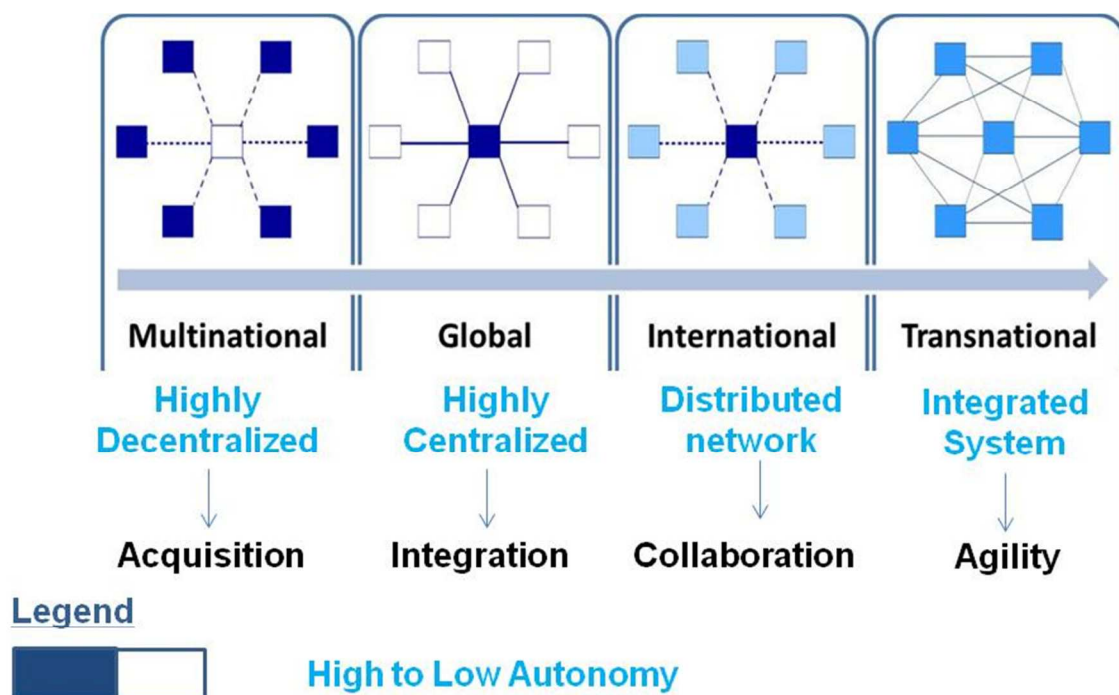
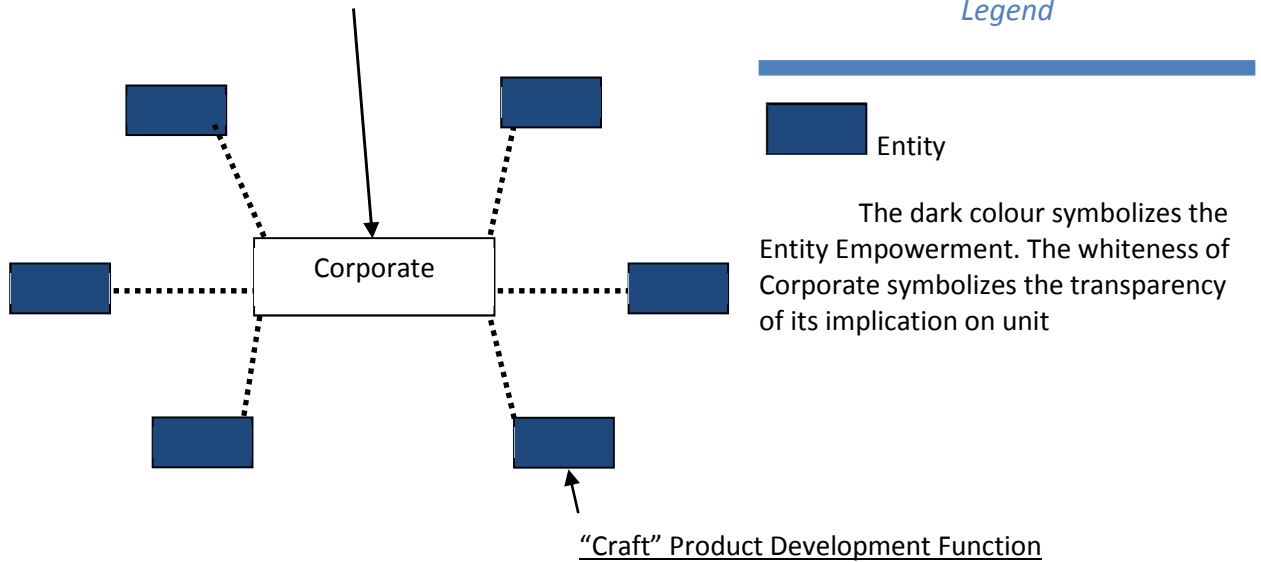


Figure 13: Evolution of the organization model adapted from Bartlett and Ghoshal.

Before 2000, the organizational model of Hydro was the multinational one.

Multinational Model

- Management regards overseas operations as a portfolio of Independent Business



- Basic Design and Detailed Design are done by each unit according to their own way of working and Processes

Figure 14: Multinational Organization Model adaptation (Barthlett and Goshal)

In the multinational model, the organization is geographically divided into different entities. Each entity comes from either an acquisition or a creation. Each entity should generate earnings that are controlled by the central management. Each entity operates autonomously and has its own way of working and, in short, its own way of designing. The company operates as a constellation of small companies with heterogeneous working methods as represented in the figure 14.

In this context, the corporate management team was unable to create synergies that would, among other things, reduce costs. Headquarters was unable to ensure that projects and human resources were managed efficiently. There were no effort of normalization and all was done according to the local exigency of the customers.

In the 90s, the context has changed. Several events can explain the need to reorganize Hydro organization. Since the market crash in steel in 1992, it's happen a reduction of the price of a megawatt by 50% between 1990 and 1997.

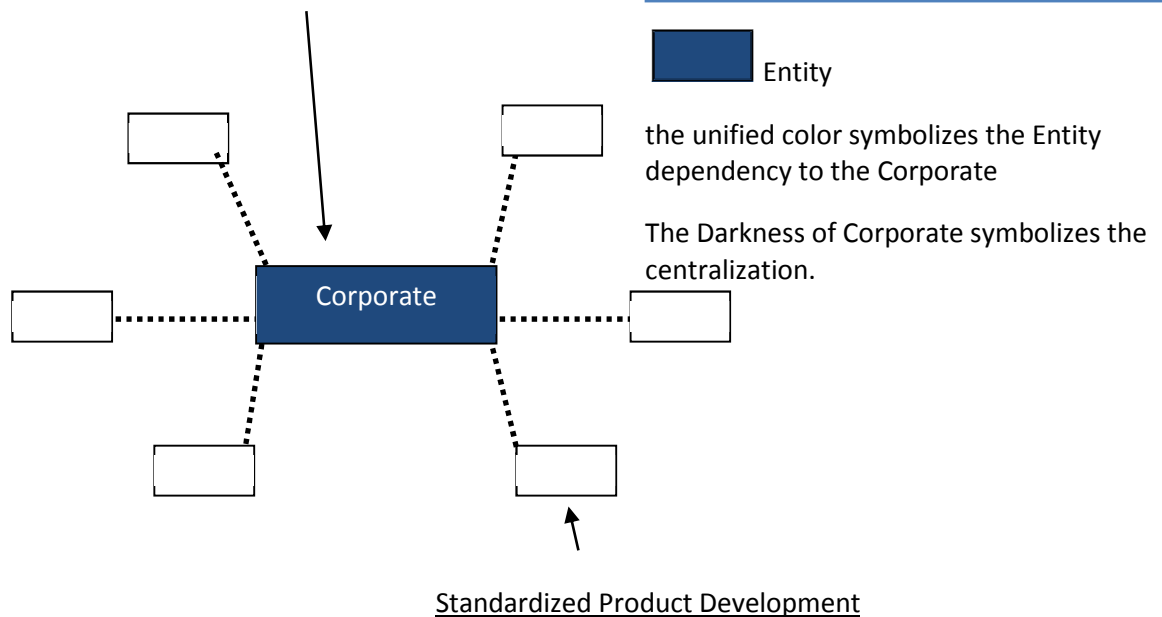
We also see the European energy market liberalization in 1998. Lastly as mentioned in the introduction, the market for equipment manufacturing in Europe was saturated. All the big

projects have already been realised and the forecasted business revenue was mainly in refurbishment instead of new construction.

That is why Hydro has moved from a "multinational organizational model" toward a "global organizational model" (Bartlett. and Ghoshal. 1998) See figure 15.

Global Model

- Management treats overseas operations as delivery pipelines to a unified global market



- BD and DD are done by unit according to a common way of working: Strong Process and methods are set up by central R&D team.

Figure 15: Global Organization Model

The global organization model answers to the needs for closeness to the new markets and streamlining of development costs. In the global organizational model, central management has adopted a rationality of integration. The challenge to achieve global operation is to standardize practices, tools and methods on units in order to be able to set up an integrated industrial scheme enabling teams to smooth out the global workload and to optimize on costs by pooling expenses. This global organization ensures the maximization of the production forces throughout. Indeed, the configuration of the current market imposes the reinforcement of design teams in the world and the deployment of expertise and polyvalence to local units. The knowledge production and transfer, thanks to the diffusion of rules and common languages, aids in facilitating the workload on a world level. Each entity must be able to design various components with the help of guidelines and procedures developed by the central research team. Also at stake is the potential for limiting failure risks during the

projects' design phase. The central R&D team has therefore to enhance the control done on the design activity and provide designers with the right support to ensure that they can find the information and instruction requested in a timely manner, at the right place, in line with lean engineering philosophy. In this model, the primary role of the central R&D Headquarters is to decide the technical direction that the Group should take, and through R&D actions, to provide leading-edge technologies.

The main objective pursued by corporate in R&D with the globalization strategy is to frame the designer's activity to avoid to "reinventing the wheel".

However, it is widely admitted that there is no single solution to the goal conflict between local effectiveness and global efficiency.

So, how alstom Hydro has organised the product development activity to succeed in its globalization strategy?

1.2.3 Central functions to coordinate Product Development Process

In 2000, the technology center (TC) was created as part of the Hydro Research and Development function to frame the engineering activity worldwide. The objectives of the TC were to initiate the harmonization and development of common turbine and generator technologies worldwide.

Expert of the mechanical Technology Center, 2009

"The TC was created with people who had expertise. The idea was to bring together people who had experience trying to keep the know-how and raise difficult problems faced by units worldwide".

The TC members have to formalize and capitalize on the knowledge through common design and technical instructions. They aim at formalizing all the product know-how. In order to structure and facilitate the generic and specific design of new products and then ensure their sharing with other sites.

Technical Project Management, Project on Completion department, 2010

The creation of the technology center was the beginning of the normalization of the engineering activity. As mentioned by a designer working since 1990 at Alstom Hydro: Before 2000, it was possible to design and manufacture a valve in three places in the house (the house refers to Grenoble unit). One person could design in the design office, and another in the service department. Each designer according to his department proceeded with his own methods. Obviously, in Grenoble we all had the Neyrpic book⁶ to respect R&D rules and principles. A person was even in charge of looking after the archives that make it easy to find technical documentation when needed. However, we have to admit that at this period, we had time and money. The situation and atmosphere were not as tough as today. It was a good time for Hydro.

In 2006, Hydro advanced further in this globalization and normalization strategy of R&D. A separation within the central R&D function between the actors in charge of product development and manufacturing (Central Team D); and those of research and product innovation (Central Team R); and a strict division of the product development between the central teams, Hydro Research Development (HRD) and Hydro Engineering and Manufacturing (HEM) that must provide methods for downstream local engineering teams working in design offices.

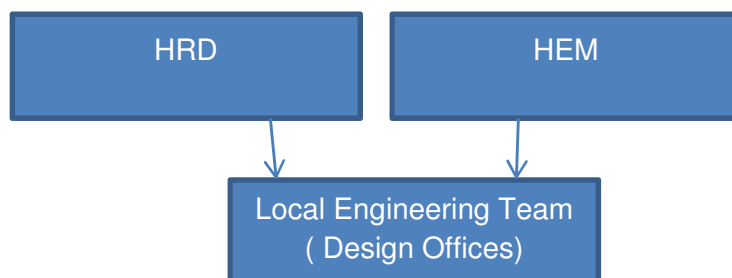


Figure 16: R&D central teams' vs Local Engineering teams

The main objective of HEM and HRD was to work on the development and dissemination of rules and common language in order to facilitate a global capacity load. Each entity must therefore acquire a certain versatility and ability to design different components due to appropriation of developed guidelines and procedures. These rules should also contribute

⁶ Neyrpic is the official name of the first workshop specialized in turbine production created in 1857 (ref. Appendix 4.2)

minimizing the risk of failure during the design phase applied to projects, and reduce design and manufacturing lead time.

1.2.4 Focus of HRD mission

The mission of HRD is to articulate three key points (synthesis of different internal presentations 2011):

1. Capitalizing on product knowledge and design techniques with the objectives of securing and enhancing technical know-how in the HydroPower industry in order to maintain Alstom's position as the world's leading Hydro Power equipment supplier and to offer clients advanced technologies.
2. Transfer, and share globally "the design rational" to frame the design in the design offices with the final objectives of successfully identifying, developing and introducing new products and offerings to the market on time, enhancing the company's financial results and its position on the market.
3. Create new knowledge; validate new concept and product innovation with the objectives of proposing the best hydraulic design at the tender stage and for each awarded contract define hydraulic design that allows for performances required by contract.

HRD is composed of a technology center, hydraulic laboratories and research centers of excellence. We present only the Technology center in this dissertation. The Grenoble technology center (TC) is divided into three activities:

- Hydraulic: hydraulic design and calculation simulation,
- Mechanical: mechanical design and calculation simulation, internal supervision of the unit design
- Laboratory: Measure and scale model testing

The TC members are responsible for mechanical and hydraulically based research on the product. They also manage the technical assistance of units around the world. They work on the deployment of new tools and software to harmonize and rationalize the engineering activities within all the Hydro design offices. They have to ensure that each site is able to create all products with a high level of quality.

To sum up, the TC members have to capitalize, share and create knowledge on products.

1.2.5 Focus of HEM mission

The HEM missions are, in turn:

1. Capitalizing on process knowledge
2. Optimizing the rationalization of the design activity to reduce design cycles in terms of QCT (Quality Cost Time).
3. Establishing an overall industrial model, and defining standard manufacturing methods.
4. Creating new knowledge on process innovation.

The HEM members are responsible for engineering and manufacturing research on process. They also manage the technical assistance of units all over the world. They work on collaboration with HRD on the deployment of new tools and software to harmonize and rationalize the engineering and manufacturing activities within all the Hydro design offices. They have to ensure that each site is able to manufacture all products with a high level of quality.

To sum up, the HEM members have to capitalize, share and create knowledge on processes.

1.2.6 Current Product Development Activity

The Product Development is divided up around the globe between:

- Research and development “central teams” located in Europe,
- “Engineering local teams” split between design offices around the world and,
- “Production sites” mainly localized in “leading cost countries” named also “low cost countries”.

According to Zedtwitz and Gassman (Zedtwitz M. and Gassman O. 2002), Hydro evolves today in a “National treasure R&D” model where R&D management is geocentric that is to say that R&D is kept at home because core technologies are easier to control. There is little R&D at the international level, although important technological advances may be monitored from home via representative offices. The researchers working at the representative office publish different technical documentations like calculation notes, design instructions, standard recommendations and quality advices to frame the development activity. In this model, the work done by an engineer in basic and detailed design is extremely framed and a huge amount of knowledge and information has to be used to design a product. The “Product and Process engineering” phase gather hundreds of manuals and written processes to ensure that designers make the right choices by taking into account the experience

accumulated by the company. The basic and detailed design activities are extremely documented and foreign experts are committed to advisory or consulting roles.

In this context, one of the stakes for central R&D managers is to help designer teams to access to the right information and acquire all related knowledge to be able to reach the contract expectations and design the machine with the quality, cost and lead time performance respected.

Here below, some examples of processes that could help us to explain how a project is managed within Alstom Hydro from the concept development to the final delivery to the customers. The global objectives of these processes are to structure the Product development.

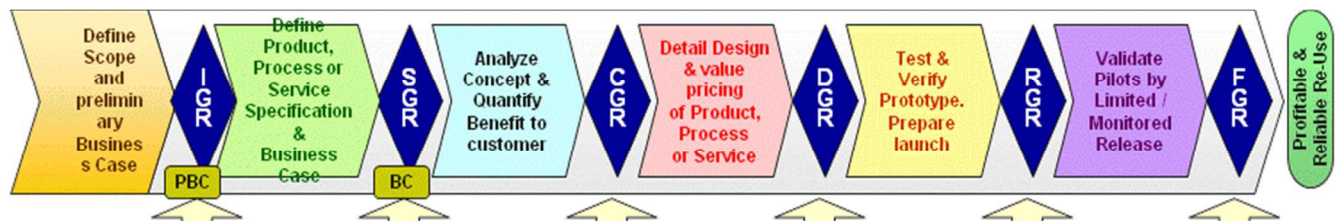


Figure 17: Product Development Quality (PDQ) - Tender Development Quality (TDQ) Process, August 2008 (Full process in Appendix 4.1)

Let's start with the Product Development Quality (PDQ) Process managed by the central research team. The PDQ process has similarities with the stage "Concept development" presented in the generic "Product Development Process" (Figure 1) presented in the introduction.

Without entering in the detailed explanation of each coloured box within the process presented above, we will explain the global idea of this process. The PDQ Process consists in analysing societal and market trends in order to propose new concepts and products. The central research team proposes different concepts in order to select finally one and defines the whole product strategy around the technology selected. The central research team defines medium- to long-term product introduction plans to be achieved according to the market need and the competitor product's offer.

The outcome of this PDQ Process is a kind of concepts catalog where each technology used has been previously tested, validated and approved by central authority and that fit with the targeted market needs. The role of the research central authority is also to write all the technical instructions necessary to frame the work of designers in charge of basic design that would use the technology and concept proposed. Central research authority has a role in terms of knowledge product capitalization.

The concepts catalog will be used by the “tendering team” in the phase of product development⁷ which is more “concrete”.

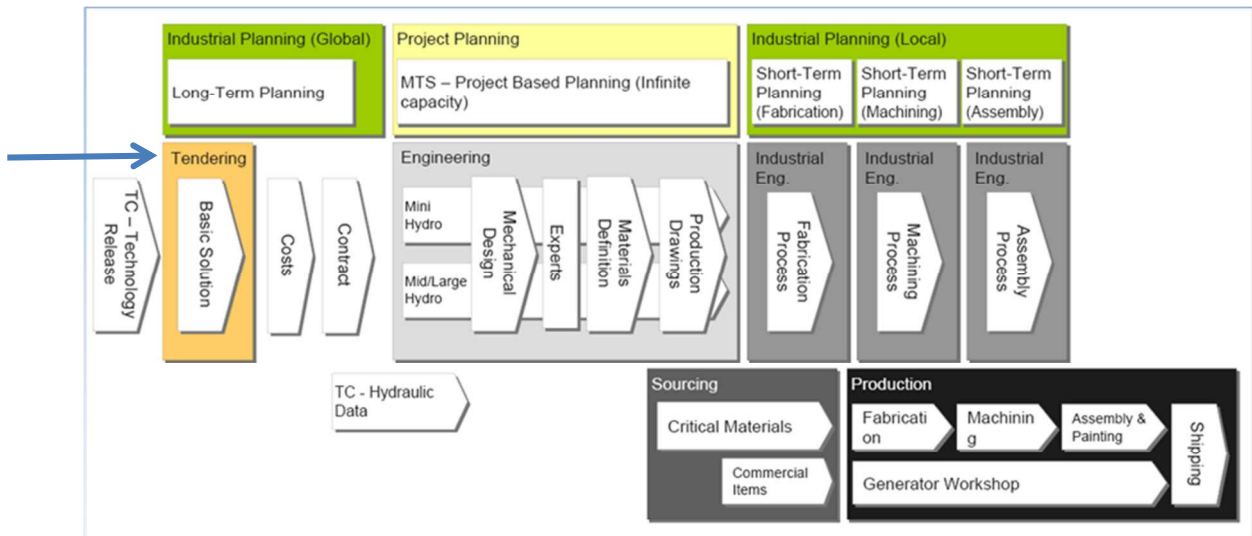


Figure 18: Product Development Process, August 2008

In order to realize a bid and produce a basic solution, the 'technical tendering actors' (in orange in the process here-above) would draw a concept from the concepts catalog. According to the customer' needs, they would have to slightly adapt this concept to the constraints. That is called the “engineering to order or make to order” mode. Then, the 'technical tendering actors" would propose an industrial scheme and a global price using central tools such as «AAAA» (to dimension the machine and then to estimate the weight of the whole components) that has to be validated by the development central authority. The role of the development central authority is to write all the technical instruction necessary to frame the work of designers in charge of detailed design and industrial engineers that would ensure the manufacture of the product. Central development authority has a role in terms of knowledge process capitalization.

The outcome of the tendering process will be a global bid.

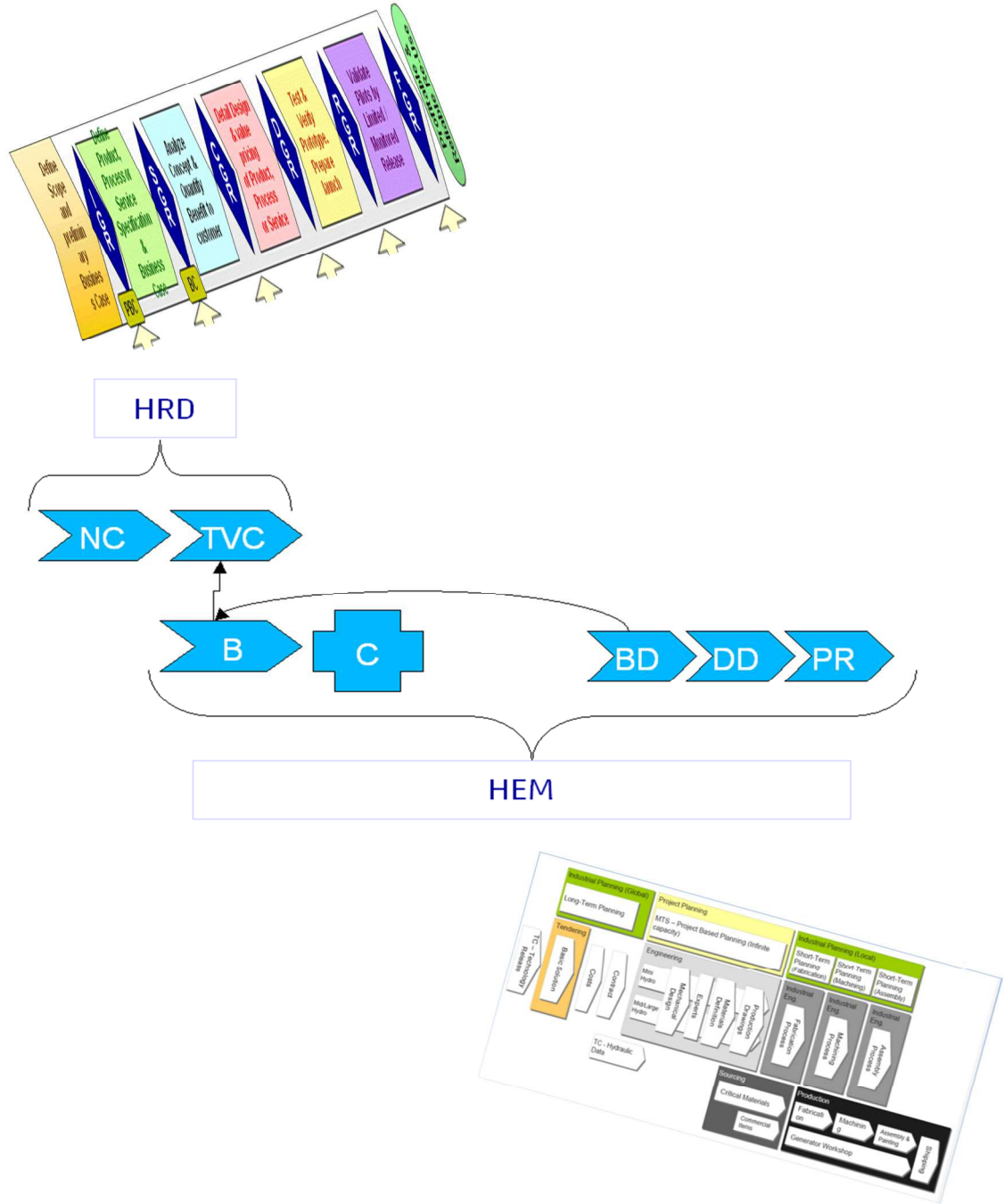
Then, if the bid is won, the signed contract will be forwarded to the design office in the engineering phase represented in the figure 18. According to the industrial scheme, the "detailed design is transferred to "Sourcing" in the case of an industrial scheme of "Buy" or to the unit in charge of the "Production" in the case of an industrial scheme of "Make”.

⁷ The Product Development Process within Hydro corresponds to the two last stages of the generic process presented in figure 12: Product and Process Engineering stage, Pilot production/ ramp up.

Synthesis

Within Alstom, we haven't found a macro Process representation exposing at a glance the entire Product Development Process. We have thus proposed the following one.

The overall product development process at Hydro can be represented in summary as follows:



NC

TVC

B

C

BD

DD

PR

New Concept	Technical validation concept	Bid	Contract	Basic Design	Detailed Design	Production
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Figure 19: Product Development Process representation at Hydro (Proposal done on September 2009)

This pattern can be explained as follows: a new concept must be systematically tested and validated by research central authority called with Alstom HRD. To realize a bid, the 'technical tendering team" draws a concept from a library of approved and validated concepts by development central authority called ALSTOM HRD. Then, the 'technical tendering team" proposes an industrial scheme that has to be validated by HEM. Then, if the bid is won, the signed contract is forwarded to the design office responsible for creating the "basic design and detailed design" and according to the industrial scheme, the "detailed design is transferred to "Sourcing" in the case of an industrial scheme of "Buy" or to the unit in charge of the "Production" in the case of an industrial scheme of "Make".

1.3 Focus on Grenoble Design Office

1.3.1 Mission, Organization

Let's see how the Turbine design office of Grenoble is organized since the setting up of a global strategy. The engineering activity of the Grenoble design office consists of the creation of the basic design and the supervision of the detailed design on the following products: turbines, bearing, and valves. Each design is unique and will answer to different constraints. The design office of Grenoble is specialized in « large Hydro », that is to say the design of machines over 50 MW.

The missions of the Grenoble Turbine design office are to design products meeting the requirements of each contract, which technology is defined by HRD following a standardization approach.

The objectives are:

1. To improve positive Gross Margin movement
2. To respect the Quality, cost and lead-time target
3. To Generate no under-absorption (Ensure that the Full time Equivalent are well staffing)

Before, 2006, the design office was organized by product. Now, it is organized by project: that means that a designer is affected on a project and has to be able to design a whole machine composed of several products. This polyvalence has several advantages mainly in terms of career management and motivation. An engineer should be motivated to handle a project instead of just a part of it. But, one of the major disadvantages is that as designers have to be able to design a whole machine, they have to know an increasing amount of information related to the product and process.

→ They have to master standards and rules from each PA. The amount of information to be absorbed by designer has been multiplied by 8

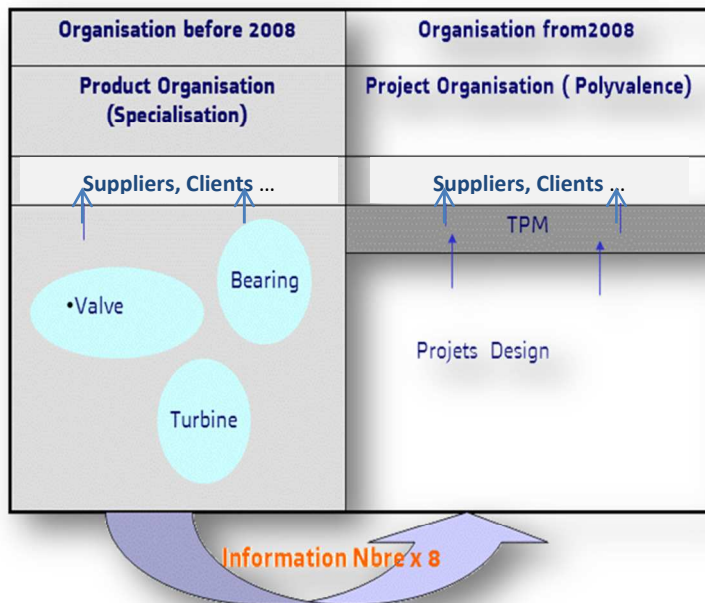


Figure 20: Grenoble Turbine Design Offices' new organization

In this context, the designers are more inclined to use rules and methods which frame their activity.

To enable this new type of organization, a function called Technical Project Managers (TPM) was created. The objective was to let the designer progress exclusively on the drawing without being disturbed by customer requests or other interlocutors. The TPM are supposed to support a part of the work of the designers in order to let them have time to search and apply the right rules. As shown in figure 20, the technical Project Manager becomes the technical interlocutor for all technical business in order to allow designers to focus only on design activity. TPM become the interface between the designers and the suppliers.

Supervisor, Grenoble Design Office, 2010

The new organization set up in the Design office of Grenoble leads to a certain isolation of Product engineer⁸ (PE: Designers in charge of the Basic Design). In fact, the Technical Project Manager (TPM) serves as a kind of protector, allowing designers to design without being constantly bothered by various problems. Originally, the idea of protecting designers from customers and other problems related to the project was interesting. In short, they design a product without having to

⁸ The Product Engineer is in charge of the basic design. A job description is available in the Hydro Management System.

deal with all the problems of construction and manufacturing. However, it is important to stay in a dynamic learning environment where the PE obtains some feedback on the components they design. Knowledge is essential to making progress in design. The progress of PE is infinitely linked to experience feedback from the production of the field.

In 2006, the management has decided to stop work relations with the local partners to ensure the detailed design (For more than 30 years, Grenoble turbine design office worked with local partners), replacing them with international Indian partners. A design office and a workshop were set up in India to serve Europe⁹.

In Hydro, Europeans are in charge of basic design and the Indian people are in charge of detailed design. Although the distinction between basic design and detailed design is prescribed and defined in the instruction above, it remains problematic: negotiation around the perimeter of the two areas is complex.

1.3.2 Engineering team characterization

In Hydro France, the population is stable with a low turn-over. However, pyramid of ages' is imbalanced. A high number of experienced people are approaching retirement.

The knowledge possessed by these European experienced engineers must be capitalized upon. This is where the sustainability of the organization and its ability to continue to produce high quality machines worldwide lies. Remember that this is a key factor in customer choice.

On the other hand, in Asia, the turnover is critical. The average length of service in the company of a young Indian is 3 years (internal HR report 2009). For reference, it takes approximately 3 years of training to be able to design a turbine. That is to say that as soon as they are trained the young Indian and Chinese find more attractive offers on the labor market (This is called "jumping" in Human Resources vocabulary). In this context, collaboration and knowledge exchange between Europe and Asia are much more complex. The European experienced engineers are often baffled at the idea of having to train young Asian partners when they have already experienced their volatility.

⁹ An Instruction published by HEM: «Product basic and detailed design definition and scopes» HEM 7.03.1004 proposes a definition of the activity Scope of each part. This instruction is available in the Hydro Management system database.

However, today these people with very different profiles must somehow create performing teams that are able to design and produce all kinds of products while maintaining the quality, cost and time objectives of as per contract.

1.3.3 Design mode in Hydro

Note that in Hydro, because each product sold is unique, designers work on redesign mode. Redesign mode, inspired by the work of Pahl and Beitz (Pahl G. and Beitz W. 1996), consists in modifying an existing design to satisfy new requirements or improve its performance. Two subcategories are proposed: variant design and adaptive design. For both subcategories, the known and established solution principles of previously designed products remain unchanged but for variant design, a few changes will be considered and for the adaptive design, huge adaptations with solutions already tested and known will be used during the process to adapt new requirements and constraints.

As represented in the figure 21, “freezing the design when it gets to the engineering phase” is to block any initiatives from designers if it hasn’t been previously validated by HRD. When the designer has an idea to improve the design, his idea has to be stored and tested by the central research team, before being applied to another project.

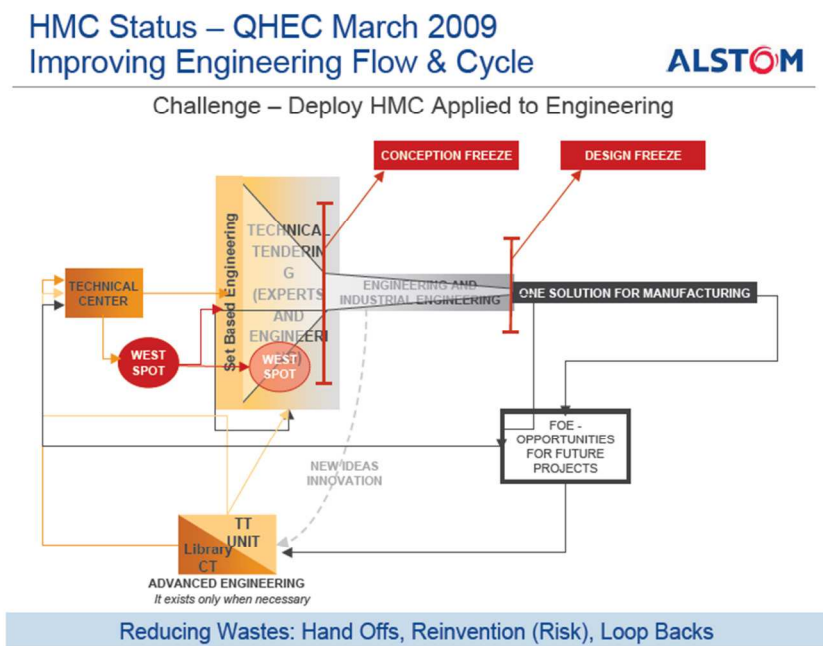


Figure 21: Representation of the Engineering process and the design freeze challenges

Technical Project Manager, Project on completion, 2010

Recently, I turned in a note to the center of technology about the bucket of the Pelton Runner that continues to break. You see, the Pelton Runner are made in the shape of spoons. So when we speak about the bucket, they are the spoons. In short, there are several nozzles that delivery water jet against the buckets. The jet pulverizes the bucket with dirty water full of silica. These buckets are stainless steel but are degraded extremely quickly in spite of the coatings. I was on site when I realized that the customer made them turn at maximum speed. I did however, note that the bucket even when cut on the sides did not derail. This indicated that mechanically, at least, they were capable of sustaining much more stress and that we could in fact reduce their overall thickness. I said to myself, 'why don't we make an interior envelope contoured to the bucket which give no mechanical resistance to be placed inside the bucket and when it wears, you extract it and replace it with another?' That would eliminate the need to re-weld, and grind. So I wrote a note to 'x' which I spent a considerable amount of time composing. I thought that the idea merited further looking into but, I got no response.

Much later on and a bit by chance, in a discussion with the materials expert, I learned that part of my idea had been retained. They went on the principle that we use the buckets to a certain period or there will be too much silica. So what needs to be done is to measure the water in the buckets and when it is too dirty we stop the turbine. At times by stopping the turbine for 3 hours you save 6 months of bucket life. We know that we deteriorate the buckets starting at 1000 particule per million. The water varies depending on the monsoons. When you pass the threshold, is when you deteriorate the runner. So the CT said that if we survey the water we'll reduce wheel deterioration. That would make the runner lasts 6 months longer, and to top it off, we're going to look into a finishing system.

This denunciation of the local actors concerning the lack of consideration for their ideas is not exempt from question. In fact, it shows that the objectives of "design freeze" presented in figure 21 consisting of prohibiting innovation on an ongoing project, but allowing engineers to test their ideas outside of the project is not operational. In fact, when the PE has an idea, they are not allowed to spend time in trying it with HRD members.

1.3.5 Conclusion: a new R&D paradigm

During over the years, Hydro has had different entities with their own way of working. Hydro headquarters used to decentralize its power to the unit managers. To serve the European Market, mainly all the turbines were designed and manufactured respectfully by the Grenoble design office and workshop. In this context, the product development was handled by co-located actors. The communication and collaboration between actors was thus not so complicated. Actors spoke the same language, had the same culture, and when problems occurred they could organise easily a face to face discussion with each other to solve it. At this time, the unit used to work according to the local way of working. The knowledge transfer was done locally and supported by the existing documentation and local companionship.

In the 2000, this way of organizing was not sustainable for Hydro business and the steering committee had to review its strategy.

The idea was to think global and integration. The acquisition of China subsidiary in 1998 and India subsidiary in 2006 was thus not only to obtain a local competitive presence in Asian markets but also to balance the global European poor bidding context and reduce the engineering and production costs in Europe thanks to the integration.

The R&D technology center was thus created in 2000 with an objective to formalize and diffuse a common knowledge on products. The members of the R&D technology center initiated:

- The creation and diffusion of standards among the entire Hydro product development organization,
- The identification of experts in charge of diffusing a common design methodology and controlling the design activity worldwide.

The first objective was to upgrade the operations of the respective location and bring its engineering, manufacturing and finished products all up to the level of top class world standards in order to effectively complete the local and export objectives and to smooth out the global workload while optimizing on costs by pooling expenses.

In this context, all the knowledge available in Grenoble had thus to be transferred to Asia and the French engineers did not feel directly concerned by the instructions and processes initially formalized by the technology center. A lot of designers met during our research explained that it was more an effort of translation of “french Neyrpic existing documentation”

than an effort of knowledge formalization done by the technology center members and that is why they did not feel concerned by these technical documentations.

The instructions were formalized in English, they were published in a technical database. This database was supposed to store all processes and instructions. Designers located in different design offices around the world were supposed to find the instructions published by the technology center members in this database with the support of the expert in charge of assisting the abroad staff.

It was a way to standardize the practices, tools and methods among all units and especially among all design offices.

These efforts were made in order to enable designers to handle a design according to the same methodology to avoid margin slippage due to design failures.

In this previous information system of different databases, the roles were clear. Central teams had the responsibility of creating and publishing the instructions, while the local team, with delimited access rights, had the responsibilities of accessing and using the instructions published.

In 2006, Hydro steering committee divided the Technology Center into two main R&D central functions with the mission of supporting all Product development process.

- Hydro Engineering and Manufacturing (HEM) was responsible for the creation and dissemination of knowledge on Process and,
- Hydro Research and Development (HRD) was responsible of the creation and dissemination of knowledge on Product.

It was a second step toward more design and manufacturing activities, normalization and control.

The local engineering teams of Grenoble design office that used to manage all product development process from the basic to the detailed design had been reorganized. The main change lied in the fact that the local partners in charge of detailed design were replaced by internal abroad partners. The designers of Grenoble (France) in charge of basic design were thus inter-connected with the designers of Baroda (India) in charge of the detailed design.

However, the industry of specialized machines and the make to order engineering mode in which the Hydro business evolved doesn't permit one to consider the teachings taken from the Taylor organization.

The rationalisation brought by the central team has not to be done at the expense of the actors whose involvement and engagement is crucial for ensuring project performance and adaptation of rules for each new contract and, in fine, new demands.

The separation of Product development actors must be overcome by forging communication between actors. The communication efforts are critical for the Product Development but these efforts within Hydro come under pressure with the performance models which does not include clear indicators related to knowledge sharing capabilities. Actors are under continuous pressure to perform more quickly (Reduce design cycle time by several months) but under increasingly complex conditions. In this context, how could they share their knowledge?

Considering the complexity of this work division within the Product Development and also the necessity to ensure a good collaboration between these distributed actors, our problematic was initially set up as follows:

- In a global context, how does one organize the collaboration and knowledge sharing among the Product development activity?

This problematic raised questions about the interfaces set up between these teams which we can call design back-office and front-office.

To tackle this large question, the first operational questions were:

- Are the design guides published by the technology center well implemented and used by the designers of the design office of Grenoble?
- Are the exchanges between the central teams and the designers of the design Office of Grenoble efficient?
- What are the main Knowledge management practices within Hydro business?

These questions led us to conduct a first exploratory diagnosis between 2009 and 2010. This diagnosis and the findings are presented in the next chapter.

CHAPTER 2 – Theoretical framework used to make the diagnosis

Before starting the diagnosis, we propose to clarify the Knowledge concept.

2.1 Knowledge Management (KM) concept clarification

Companies adopt different understanding of Knowledge that will influence the management practices set up to ensure knowledge management. The aim of knowledge management is to improve a company's ability to acquire, develop, preserve, distribute and use knowledge.

The two different approaches of KM proposed by Cook and Brown (Cook Scott D-N. and Brown JS. 1999) are those of possession and practice.

The possession approach ambassadors consider knowledge as an object. Knowledge is perceived as a substance that can be extracted from the individual and placed on a support through a process of codification. Knowledge transfer is thus possible and enriches the capital of the global organization. Globally, the field of "encodability" is strongly linked to the characteristics of the knowledge. Only "explicit" knowledge is easily encodable. All other knowledge seen as tacit is difficult to encode and at times impossible. In order to illustrate this point, Herbert Simon (Simon 1991) takes the example of a doctor. A doctor has done long studies that allow him to acquire a theoretical knowledge of the human body, the symptoms of disease, etc. During a medical diagnosis, the doctor connects symptoms. He then associates the possible treatments to be given. His internal expertise is difficult to access for the organization (E.g. hospital).

The practice approach focuses on the socially constructed character of knowledge and the learning phenomena. In this second approach, the central idea, borrowing the words of Hatchuel (Hatchuel A. 1999), is that knowledge cannot be "transferred" despite the familiarity of such an idea: An individual must build his own knowledge through interaction with others. It is therefore through action when being confronted with concrete problems, and interacting that individuals will learn, integrate and give meaning to their working situation.

In this approach we prefer to use the concept of "knowledge mediation" instead of "knowledge transfer." Knowledge can not be transferred to the mind of an individual because knowledge is different blocks of information combined by an individual to reach a new understanding of a previous situation. Knowledge acquisition by an individual will follow a mental tracking. This mental tracking can be facilitated in interaction with other people and "reification". Reification can be defined as the concrete use of said knowledge in daily work. The proposed understanding of knowledge is more a human product of relationships

between a person with his own frame of reference, the objects that surround him and the experience he acquired in practice that he enriches with interactions with others.

This distinction is also reported in the research of Hansen (Hansen M-T., Nohria N. et al. 1999) who distinguishes two main strategies adopted by consultancy companies to manage knowledge according to these approaches:

- The codification strategy,
- The personalization strategy

In some companies, the strategy centers on technology. Knowledge is carefully codified and stored in databases, where it can be accessed and used by anyone in the company. Authors call this strategy the codification strategy.

In other companies, knowledge is closely tied to the person who developed it. Knowledge is shared mainly through direct person to person contact. The chief purpose of computers is to help people communicate knowledge, not to store it". It is calling the personalization strategy.

To sum up, the so-called "codification" refers to an "instrumental" understanding of knowledge management whereas with "practice" or "personalization" one refers to a more pragmatic approach of knowledge management involved in the action and social interaction dynamic.

In this thesis, we do not want to oppose these two approaches but rather understand each one and observe their respective declination in the ALSTOM Hydro business.

In the next section, we will draw particularly advices from the literature to improve KM practices inscribed in an instrumental practice.

2.1.1 Codification strategy and practices

In this codification approach, knowledge sharing is done through information because information is a raw material that generates knowledge. The information can be defined as "a collection of data organized to generate a message". The information is meaningful, a meaning that individuals will create individually or collectively. Without human interpretation, information has no meaning. The key success factor of the organization engaged in this instrumental knowledge dynamic is based on the performance of the technology. Knowledge is a strategic resources (Boisot MH. 1995; Nonaka I. and Takeuchi H. 1995; Grant R-M. 1996; Grant R-M. 2002). The management focuses on the production and management of

knowledge and considers it as the most important resource in the enterprise. It is one of the most important assets for an organization to create added values and is seen as a main source of sustainable competitive advantage. In this approach, knowledge is seen as something malleable: that can be codified and transformed into information.

Knowledge codification is the process of converting knowledge into a message, which can then be manipulated as information (Foray D. 2000). This task is complex because an expert has approximately 50,000 relevant knowledge segments in their field of expertise (Simon 1991). Jean-Louis Ermine (Ermine J-L., Chaillot M. et al. 1996; Ermine J-L. 2000) offers an interesting approach to codify the knowledge. Knowledge "encoding" is supposed to allow the company to «retrieve» the knowledge from the individual and to place it on a support that can be transferred in order to enrich the overall organization. It is according to Hatchuel (1996) a "rational myth" of the organization where an activity can be carried out by an employee thanks to the appropriation of knowledge codified and transformed into information.

However, the field of "encodability" is strongly linked to the characteristics of the knowledge. Only "explicit" knowledge is easily encodable. The "explicit knowledge" is aware, easily expressible and therefore codified and formalized. Conversely, the "tacit" knowledge is implicit, and sometimes even unconscious and internalized by the actors who own them and only transmitted in the interaction and practice through observation, imitation and experience. Polanyi illustrates what is meant by "tacit knowledge" with the example of the codification and transmission of knowledge constituted by the practice of a sport or a musical instrument, *"if I know how to ride a bike or how to swim, this does not mean that I can explain how to successfully keep my balance on the bike or not to sink"* (Polanyi M. 1966) According to him, tacit knowledge can be only expressed and transmitted in the action by the person holding them.

In general, according to Markus (Markus. 2001), a good formalization involves a "decontextualization" of the explained phenomenon and a written structuration into key questions that the receiver is supposed to ask. In other words, think during the knowledge codification of the questions that have to be address and formalize then the document in relation to the target receptor? To be effective, questions shape the organization of the document.

If we turn to an engineer's population, empirical research shows that the design objects (drawings, diagrams, representations, etc.) are essential components of the activity. In a design situation, we know that there is a dialogue between the design and the designer. Visual reasoning occupies 40% of the activity. Visual reasoning is used to describe the

cognitive processes of designers (Blanco E. 2003). Thus, the use of diagrams and drawings to codify and explain may be more effective than a literal explanation.

In the majority of R&D departments, designers receive structured information already validated and do not have access to the different stages of the work done by the emitter to reach the result. However, it is widely understood that in order to ensure proper adaptation of information, it is crucial to understand the rationality of the emitter. Recent studies (Bracewell R-H. and Wallace K. 2003) show that the digitalisation of codified knowledge is limited because of the need for cooperation inherent in the understanding and appropriation of the information by all actors involved. In fact, the codified knowledge often exposes the result of reasoning. The latter is based on the choice rationale of the emitter according to a given context. It is then possible to understand the intellectual process of the emitter as well. In the design field, studies on the representation of the reasoning models of the design activity (design thinking) showed the impact of capitalization on design rational. Their representation in argumentative traces demonstrates promising results with the use of certain tools (Compendium, Dred...) exposing the different steps followed by the emitter to codify his knowledge.

According to Markus (Markus. 2001), three major roles appear in KM inscribed in instrumental approach. There are the (1) knowledge producers—who record explicit knowledge or make tacit knowledge explicit, (2) knowledge intermediaries—who prepares knowledge for reuse by eliciting it, indexing it, summarizing it, sanitizing it, packaging it, and performs various roles in dissemination and facilitation, and (3) knowledge consumers—the knowledge re-user, who retrieves the knowledge content and applies it in some way. The three roles require specific and different abilities and skills

Markus gives advice also on how to store the formalized Knowledge. She focuses her researches on 'Knowledge repositories'(KR) that are passive modes of knowledge transfer. When opening a Knowledge repository, it is critical to have thought out how the updating process of its content will be managed. The first pitfall is that KR contains too much information leading to difficulty in all of its content unless one already knows where to find the requested information.

With the development of the new technology of information and communication (NTIC), companies have attempted to capitalize and store explicit knowledge in database. It has led to the multiplication of knowledge databases or repository which most are according to Grundstein(Grundstein M. 2005) unusable now. Nowadays, worker has to find information

within different databases that are completely overloaded. Indeed, the knowledge transfer in a global company is a difficult exercise that has to be mastered to avoid « Waste » as expose in « lean information management » (Morgan J-M. and Liker J-K. 2006; Hicks. 2007). Empirical work in Lean information management denounces the slaughter of information and databases in multinationals and lists all existing waste. The old adage "too much information kills information" summarizes in brief the analysis. Often the process of information updating are not enough thought or even the real value of the information published. Which is encouraged in the lean philosophy is "pull rationality" instead of a "push rationality ". The challenge is to encourage producers of information and databases to the following questions:

- What is the value of the information that I want to post on a database?
- Does my receiver speak the same language as me?
- Is the channel that I chose is relevant to submit this information?
- What is the significance level and frequency for uPDting the information I post?
- How is ensured the uPDting of information?
- Finally, it is also advisable to ask:
- How does my receiver will be able to transmit Feedback

To succeed in the knowledge formalisation, a lot of efforts have to be made to qualify the information manipulated by an employee. Qualifying information consists in giving a status to posted information in a database or elsewhere in order to facilitate the interaction between the receiver and the object. The qualification of the document has to enable the receiver to identify at a glance what type of information he is reading. For example, it could be a document with a status of "updated information", or "a document under-construction". A common understanding will facilitate the identification of the nature of the document and will indicate to the receiver to what extent it's content has to be handled (Grebici., Blanco. et al. 2007).

Gardoni (Gardoni M., Spadoni M. et al. 2000) explain that information can pass through several stages defined by as follows :

- Un-Structured Information: informal drafts without any information about their context and objectives, therefore they can't be understood.
- Semi-structured information: are less formalized. They contain sufficient detail to be interpreted, but their lack of structure can make understanding difficult.

- Structured information: The form and substance are usually governed by rules or standards. They contain the information necessary for a clear and unambiguous understanding.

These different levels will condition the information diffusion to others and their usage.

Grebici (Grebici., Blanco. et al. 2007) distinguishes different workspaces:

- the “private space” meaning the personal work space of an individual referring to explicit knowledge visible as physical documents held by the individual (folders in his office, documents, etc.)..,
- the “proximity space” meaning spaces such as department repository where colleagues share a common work space,
- the “public space where several actors can have access to a document stored in a public database. The information stored in public space can be reached by all stakeholders in the organization.

All these elements show that the formalization of knowledge within an organization is a complex process that will take time. The status of a piece of information will change according to the information lifecycle proposed by Beylier (Beylier C., Pourroy F. et al. 2009) also:

- Creation: when the information is added to the the system,
- Change: When the Information itself is changed,
- Documentation: when the description of the information is changed
- Verification: when the information is checked according to a standardized procedure within the organization,
- Validation: when the information is validated and ready to be diffused.

And is completed by:

- Annotation or Comments when the information is enriched or just commented upon by users.

Even though all this efforts to qualify the information will promote the understanding of the receiver, the understanding and learning of the audience is not at all ensure at the end. Databases will enable to store explicit knowledge, which is formal, timeless, standardized, structured and methodical documented (Radding A. 1998). However, they offer no mechanism to manage implicit knowledge. According to a number of studies, a pure storage

of knowledge does not contribute much to the company's success. That is why it is crucial to get people interacting with one another to learn and share knowledge.

Researcher such as Flanagan (Flanagan A-J. 2002) notes that most technologies set up to capture and disseminate explicit knowledge of individuals, neglecting the important elements of tacit knowledge as well as the social process by which knowledge sharing emerge. We propose to highlight two of the issues expressed by Flanagan : (1) the tendency to artificially reduce knowledge complexity (Contractor N., Zink D. et al. 1998); (2) the focus on the individual as the primary source of knowledge.

Therefore, companies may adopt another vision of knowledge management that we propose to expose in the next section.

2.1.2 Personalization strategy and practice

In the personalization approach, knowledge cannot be reduced to the status of a codified and transferable object like information. Knowledge is created and mediated through action - by the practice of individuals- and through the socialisation and interaction of people. (Devillers C. and Henri T. 1996 ; Gherardi and Nicolini 2000) summarize the process by the following formula: "to transfer is to transform." Communities of practice, then, are places of socialization, of exchange and co-creation of organizational practices if they meet the criteria set by Wenger (Wenger E. 1998): common enterprise, mutual commitment, shared repertory. This raises problems for these communities in terms of animation, support, control and recognition.

Nonaka and Takeuchi (Nonaka I. and Takeuchi H. 1995) provide a famous example of socialization: the one of the bread machine developed by Matsushita. In the late 80s, Matsushita could not create a machine reliable enough to make bread, a machine designed for individuals. In fact, the engineers were not able to reproduce the movement of the "knack" of the baker for kneading dough. So they found the best baker in Japan and were trained in the basic principles of the bakery. At his side, they discovered that this baker did not just knead the dough but he also twisted a certain way to make it more flexible. Engineers understood the "trick" and integrated it, this double movement into their machine functions. So they acquired this knowledge through observation, imitation and practice.

To ensure knowledge observation, imitation and practice, the setting up of communities of practices appears to be a good means. The concept of community of practice was introduced by Wenger (Wenger E. 1998) defining "practice" as a key element of similarity. CoPs are define as "groups of people who share a concern, a set of problems, or a passion

about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis” (Wenger E. and Sydney W. 2002). The Theory of communities of practice consists on observing groups of individuals who share a common practice (eg professional practice).

How define Practice?

Emanuelle Cappe, in her thesis page 52, proposes to define practice such as “*the implication of the individual in action*”. She takes the example of a violonist who says: « *become violonist requests a lot of practices* » in order to express that “learning violon need time, exercice and a lot of efforts”. The notion of practice refers in that case to the process of learning that can be linked to the personnel experience of the individual.

The exercise of common practice, and exchange generated, create resources (including knowledge) that constitute the common ground of community knowledge (called "shared repository"). This unit of analysis allows researchers a simple observation of learning phenomena (Cappe E., Chanal V. et al. 2006; Cappe E. 2008; Cappe E. 2009).

While CoPs were previously conceptualized as a phenomenon emerging spontaneously in organizations, it is now believed that organizations play a critical role in nurturing these communities (Brown P. and Duguid J. 2001). Thus, literature distinguishes “Cultivated Communities of Practice” (Wenger E. and Snyder W. 2000), set up or pushed by the management, from communities 'in the wild' (Chanal V. and Chris K. 2010), naturally federated by the members. The stake for companies is to find the conditions required, the “ba”¹⁰, to set up cultivating CoPs which effectively collaborate.

According to Cross (Cross R., Parker A. et al. 2001): “. Commonly called Communities of Practice (CoPs), some of these lateral networks include members spread out all over the

¹⁰ Nonaka and KonoNonaka I and Konno N (1998). ""The Concept of 'Ba': Building a Foundation for Knowledge Creation." Management Review **40**((3): 40-54. examines and appoints the space of interactions that allows the co-construction of knowledge. He called it the Ba. Ba is the context in which knowledge is shared, created and used. The Ba can take many forms in companies. This can be an office, meeting room, a conference, an electronic discussion forum, a chat, shared experiences and ideas. The Ba can be a physical space, virtual space, a mental space or a combination of these frameworks to the interactions of individuals.

world. Because interacting face-to-face on a regular basis is costly and time-consuming for distributed CoPs, organizations are increasingly implementing ITC tools to support Virtual Communities of Practice (VcoP). With the globalization, the notion of virtual community appeared. This notion introduced the mediation of ICT as part of the cement of the community. Following Porter (Porter E. 2004), a virtual community or e-community is defined as “an aggregation of individuals or business partners who interact around a shared interest, where the interaction is at least partially supported and/or mediated by technology and guided by some protocols or norms”.

By extension, the Virtual Communities (VcoP), are those where their members use ICT as their primary mode of interaction (Dubé L., Bourhis A. et al. 2006). VcoP ou e-Cops encompass a lot of management expectations such as crossing boundaries and harmonizing the practices thanks to the improvement of knowledge sharing across the company, but also fostering communication across boundaries to break the silo effect.

Some interesting studies demonstrate the motivation and barriers in the process of knowledge sharing among VcoP. We have quoted 5 really interesting one and summarised their findings in the table 22:

References	Critical Success Factors
<ul style="list-style-type: none"> ▪ (Ardichvili A., Page V. et al. 2003; Bourhis A., Dubé L. et al. 2005; Gannon-Leary P. and Fontainha E. 2007; Correia AMR., Paulos Al. et al. 2009) 	<ul style="list-style-type: none"> ▪ Leadership ▪ Community oriented team with objectives to achieved ▪ Context : Time to build up the CoP Good use of Internet standard technologies ▪ ICT skills ▪ Institutional acceptance of ICTs as communication media ▪ Good communications ▪ Trust ▪ Common values ▪ Shared understanding ▪ Prior knowledge of membership ▪ Sense of belonging ▪ Regular interaction ▪ Good coordination to achieve regular but varied communication

Figure 22: Synthesis of Benefits, barriers and Critical Success Factors for Knowledge sharing in a VcoP

Conclusion

In these previous sections, a knowledge concept clarification has been proposed and company's knowledge management practices have been presented.

Usually, these practices and visions coexist in the organization. There is no strict separation but moreover complementary actions involved in the different approaches. Now, our objectives are to understand the main knowledge management practices deployed within Hydro. However, how could we diagnosis the knowledge management practices within Hydro? To do that, we propose to base our diagnosis on the interface assessment method that we will present in the next section.

2.2 Interface concept clarification

Our purpose is to diagnose the formal and informal communication systems set up between the mechanical central research department and the product development actors of the Grenoble design office.

The operational objective is to clarify, describe and model the interfaces implemented and their uses. The capacity of the central research team to capitalize and transmit its knowledge and know-how has been evaluated just like the potential of the product development actors in engineering phase to use this knowledge and to communicate to the central teams.

2.2.1 Interface concept

Observing the interface system is a good way to measure the nature of interactions between stakeholders and evaluate knowledge management practices. The word “interface” is usually related to connections, links, interaction, networks, relationships, and interconnections between two or more organizations.

The quality of the interface system set up will impact the quality of information and knowledge sharing between stakeholders and for our thesis between the central research team and the design offices.

In the literature review, we can find methods to diagnose an interface and the flow of intermediary objects. The method for diagnosing an interface proposed by the literature review has proven its effectiveness in work published by Laurène Surbier (Surbier L., Alpan G. et al. 2009) who has carried out her 4 years of research within the company Siemens.

According to Koike (Koike., Blanco. et al. 2005) five fundamental elements compose an interface: the interface actors (“stakeholders”), the intermediary objects (“artefacts or object”), the tools, the rules and procedures, the interface space and time (see figure 23).

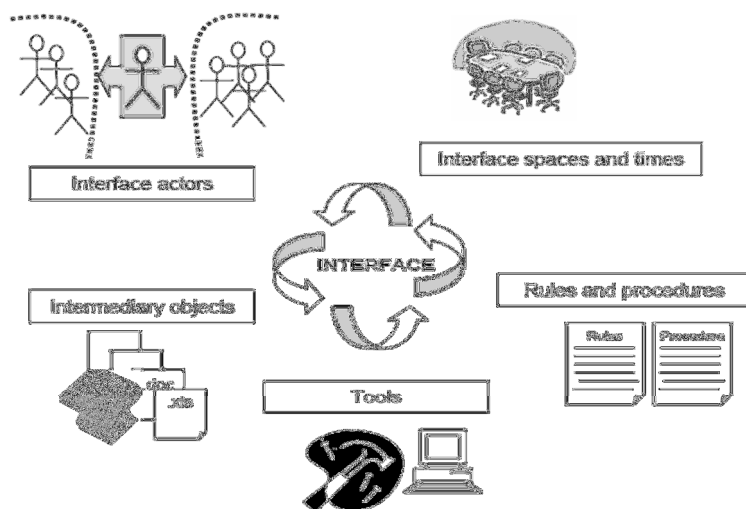


Figure 23: The five fundamental elements of an interface (koike, 2005)

The Interface actors are persons or groups involved in the design activity.

Interface spaces and times are moments and places where stakeholders can interact during the project. They are dedicated moments and places to create or use intermediary objects. The interface times could be either synchronous (such as project status meetings) or asynchronous (such as e-mail exchanges). In this paper, only synchronous interface times will be considered. The interface space and time is related to the “ba” essential for the co-construction and the articulation of knowledge from the individual to the group.

The rules and procedures are guidelines that will define how to coordinate and perform in the activity execution.

The tools are supposed to support the information and object exchange. Database, PLM (Product Lifecycle Management), ERP (Enterprise Resource Planning), and MS Office software are for example tools supposed to serve the design information sharing.

The Intermediary Object: The concept of intermediary object was first presented by Jeantet and Vinck (Jeantet. and Vinck. 1995; Vinck D. 1999). Intermediary objects include almost all the objects handled by designers to fulfil their objectives.

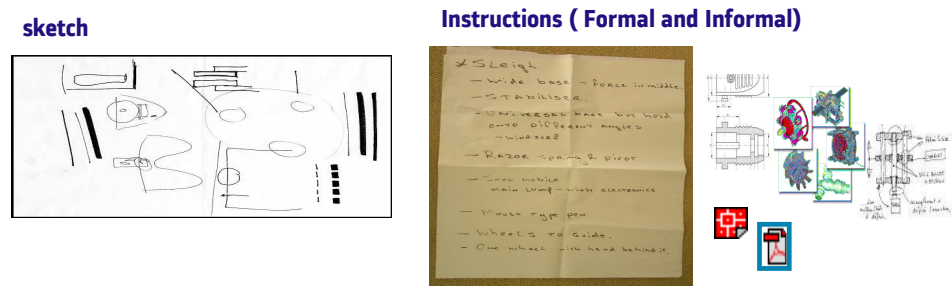


Figure 24: Illustration of an Intermediary Object

Listing the main intermediary objects (IOs) produced by R&D central teams and used by designers and then understand if this IOs reach the characteristics of boundary objects will help us to create a picture of the interface system which could give us a good idea of the KM practices deployed within Hydro.

In our research, we focus particularly on intermediary object that has to fulfill the characteristics of boundary objects.

2.2.2 Boundary object concept

The concept of boundary object was introduced by Susan Leigh Star and James R. Griesemer in a 1989 publication (Star. and Griesemer. 1989) : “Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds”.

The boundary objects are supposed to cross the technical functions and allow actors to understand each other. Star precises that “Boundary objects” are those “(...) that both inhabit several communities of practice and satisfy the informational requirements of each of them”. The concept of boundary object has been extended with the notion “intermediary object”, first presented by Jeantet and Vinck (Vinck D., Jeantet et al. 1996; Jeantet 1998).The authors call “intermediary objects” (IO) items that are used or created during the design process. Intermediary objects include almost all the objects handled by designers to fulfill their objectives and to mediate the product or service designed.

Subrahmanian (Subrahmanian., Granger. et al. 1999) describes how boundary objects act as links to the “interface” enabling communities of different point of view to interact with each other.

2.3 Interface assessment method

2.3.1 Intermediary object assessment method

In order to obtain a dynamic picture of the information flow, it is interesting to use the grids developed by Surbier. Her model has been done to qualify the intermediary object and the Interface space and time, crucial elements that reflect in a way the knowledge management approach of the company.

Intermediary object	Description	General description			Information dynamic			Information Impact		
		Support	Person in charge	Users	Update frequency	Evolution	Modification	Sensitivity	Update duration	Information structure

Table 4: Intermediary objects Grid from the work of Surbier L

In this IO grid, an intermediary object is characterized by different observable and measurable attributes.

After a general description of the object, its three main dimensions are qualified.

The first one is related to the information dynamic. It includes the “update frequency determination” that shows how often the information might change. It also specifies the information evolution concerning the velocity with which the information will reach its final value. Finally, the notion of modification is proposed and refers to the possibility of the receiver to include comments.

Moreover, the author analyzes the “information impact” using the characterisation of “the information sensitivity”, “the information update duration” and “the information structure”. Concerning the information sensitivity, the aim is to evaluate the impact of the information changes on information users (downstream tasks). The criteria given are the following ones:

- High sensitivity of IO information means that a change in IO information will have a direct impact in the final delivery of the product.
- Average sensitivity of IO information means that an information change implies rework on some activities and thus, an additional cost but no lead-time for the final delivery of the product.
- Low sensitivity means that the global impact (in the project duration or project cost) was not significant.

The update duration refers to the workload for the person in charge of releasing updated information.

For the information structure, the following rules are established:

- If the IO was an official object, the IO information was considered as “Structured Information”

- If the IO information was referenced (for example, Excel-sheet columns with titles broadly known by the plant's actors) and if the document was shared by various actors without the need to be further explained or translated, the IO information was considered as "Semi-Structured Information"
- If the IO information was almost raw information (raw data) with no special layout and the person in charge of the IO is almost the only one to understand the information, then it was considered "Non-Structured Information"

All these information characteristics allow a precise picture of the nature of the information exchanged between stakeholders through the interface. Some criteria such as "modification" in the information dynamic characteristic and "the information structure" in the information impact characteristic help us to determine whether the objects are more a support to information and knowledge sharing or to support prescription.

2.3.2 Synchronous Interface Time (SIT) assessment grid

The second grid is called the Synchronous Interface Time Grid. It consists of listing the synchronous interface times occurring during the design activity. Indeed, these times ensure information exchange and or diffusion, intermediary object explanation and used. In the grid, we find the person responsible for the meeting, the participants and at which level the information is exchanged.

The public Workspace: meeting gathering internal and external actors. Official deliverables are shared. Participants involved do not belong to the project team.

The project workspace: meeting gathering the project team. Meeting concerns actors of the project team and in the context of a formal meeting (Officially set in the actors' schedule).

The proximity workspaces: this level corresponds to the information producer's/provider's personal network. The meeting concerns actors of the project team and is established as an informal gathering (not scheduled on the participants' calendar).

Meetings	Person in charge	Participants	Number of Meetings	<i>Public Workspace</i>	<i>Project Workspace</i>	<i>Proximity Workspace</i>
					To check	

Table 5: Synchronous interface time: The SIT grid (Surbier, 2009)

All the SIT identification methods allow a precise picture of the interaction frequency and perimeter of the actors.

To conclude, we propose to use the interface assessment method as a framework for the diagnosis. This method will give an insight into the collaboration and knowledge management practices that support the work division with Hydro

In the next chapter, we present the diagnosis methodology and findings.

CHAPTER 3 –Diagnosis methodology and findings

3.1 Method to collect data

3.1.1 Direct involvement

To understand how members of the central research team and design office work and what type of information designers generally require to progress during the design phase, we have carried out an exploratory study over 12 months with the help of operational involvement from each department for six months:

- Central >Research Team - Mechanical Department
- Design Office (DO).

The particularity of this first exploratory study is that the central research team and the design office are both located in the same place. Many communication problems between the central and local teams could be attenuated because of this co-localization. Actors might know each other and share the same language...

Also and in order to facilitate our involvement in the company, Hydro management asked us the following questions:

- How the common designs produced by the mechanical team of the Grenoble technology center are used by Grenoble design office designers?
- Do Grenoble Design Office designers feel well supported by the mechanical team of the Grenoble technology center?
- How are carried out the communication and information exchange about the common designs between the mechanical team of the Grenoble technology and the Grenoble design office designers?

3.1.2 Techniques adopted

The data have been collected as follows: The central research team and especially its mechanical department were involved for six months. We focused our interest on their history, activities and interface. We started to collect statistical information from the IS & T department about the main technical database managed by the central research team. Our objectives were to find out the number of users, consultations, etc.

We interviewed members from the central research team and the Design Office and the HR partners. The Rogers technique (Rogers. and Kinget. 1971) was used. The principle of this

method is to let the interviewee speak about a topic of their choice. In order to avoid deadlock situations, interviews were introduced by the presentation of our operational mission. Each interview was recorded, reported and then forwarded for review by the interviewees. Interviewees sometimes wanted to clarify some part of the interview or add information. These exploratory interviews were followed by closer meetings with the entire central research team.

The open mindedness and support from the involved protagonists of the unit greatly facilitated these first months of research.

Methodology	Central Research Team	Local Team / Design Office
<ul style="list-style-type: none"> 10 Open exploratory interviews >2 hours 	<ul style="list-style-type: none"> 6 people composed of : : 2 experts, 1 principal engineers, 3 Product engineers 	<ul style="list-style-type: none"> 4 people composed of : : 3 Product designers, 1 Technical Product Managers
<ul style="list-style-type: none"> Formal interviews <2hours 	<ul style="list-style-type: none"> The entire mechanical technological center (except the calculation team) 1 product manager 1 HR partner 	<ul style="list-style-type: none"> 4 Product designers

Table 6: List of actors interviewed

To double check our outcomes, we moved to the design office of Grenoble where we carried out eight focused interviews. We launched and animated workshops in order to collect the opinion of the actors of the central research team and understand how successfully they access information and learn using the development of events. This event development consisted in projecting the actors into an imaginary situation and asking them to describe how they would manage the problem or act when facing different situations. Those workshops allowed us to understand how product designers work in reality and what kind of information they need to progress during the design activity. Six workshops were done in 2 months, involving five product designers, four technicians, three calculators and one Principal Engineer (Engineers who follow the Expert career path).

Methodology	Local team / Design office
2 Workshops (scenario methodology)	1 Principal engineers 5 Product designers 4 Technicians
4 Workshops (scenario methodology)	5 Product designers 3 Calculators 1 Principal engineers
8 Formal interviews >2 hours	3 Experts 1 Principal engineers 3 Product designers 1 Technical product Managers

Table 7: List of workshops and Participants involved and interviewed

3.1.3 Intermediary object model improvement proposals

To classify the data collected, we have adapted the grid of “Intermediary Object”(IO) by Koike and Surbier.

We have made several adaptations to the Intermediary Object grid;

In the General description, we have added criteria entitled Pedagogical Effort.

The "Pedagogical Effort (PE)" criteria can be high, average or low.

When the PE is high, it means that the document has been written respecting the rational thinking of the receiver as a learner. The document is structured and organised through questions and helps the reader to understand the way in which results were obtained. It also provides many practical illustrations. It could also indicate certain specifications about the level of understanding requested in relation to the content of the document or even content qualification, meaning that there exists as well a colour code for at least some of the given information to simplify user reading.

When the PE is low: It means that the document does not include any effort to help the reader to understand the way results are obtained. The information is explained but not organised through questions. A document that explains a process will have a low “PE” because it lists only a series of actions to be performed in order to accomplish a task. It is of no critical importance to inform the reader why the task has to be performed as written in the process.

Intermediary Object- Short title	Description	General description			Information dynamic			Information Impact			Object Collaborative abilities
		Support, Person In Charge (PIC)	Users	Pedagogical Effort	Update frequency	Evolution	Modifica-tion	Sensitivity	Update duration	Information Structure	Interaction dynamic

Table 8: Intermediary Object grid improvement proposal

We have also added a characteristic to qualify the Object entitled: Object Collaborative abilities.

The first criterion is the interaction dynamic (ID). It could be prescriptive, communicative, or collaborative.

- When the ID is prescriptive, it means that the users cannot comment on the document or ask questions related to a particular point. The document is closed and does not allow any interaction through the document.
- When the ID is communicative, it means that user needs and commentary can be taken into account. A comment can be posted in the document or sent by e mail to the Person In Charge (PIC). The PIC is supposed to answer the user and correct, if needed the document.
- When the ID is collaborative, it means that a link from the document to a collaborative space is available to let users discuss the object with the PIC, and post comments and/or question to co-produce the document upstream throughout the life cycle of the information.

Also in the Synchronous Interface Time (SIT) grid, we have added the community workspace.

- The Community workspace means meeting gathering community members (Officially set in the actors' schedule).

Based on these theoretical grids, we define in the next section the interface system.

3.2 Findings: Interface qualification

3.2.1 Interface actors

- Grenoble technology center actors
- Grenoble Design office actors

3.2.2 Main Intermediary objects observed at the interface between central teams and the design office

During our observation, we have gathered 48 technical documents used by designers but following the Hydro management request, we have focused our attention on the main intermediary objects that compose the interface. These main intermediary objects exchanged between the central teams and designers are:

- The common design.
- The central technical instruction and business standards, which is information on how design activity has to be carried-out.

Globally, these 2 intermediary objects listed here are supposed to bring coherence to the design activity and to rationalize the design practices anywhere in the world. They are supposed to fulfill the characteristics of the boundary objects. There are representative of the whole of technical documentation and the remarks that will follow concerning these common design could be generalized to the others technical documentation.

These main intermediary objects are stored in two different technical databases.

Intermediary Object- Short title	Description	General description					Information dynamic			Information Impact			Object Collaborative abilities
		Support Format	PIC	Users	P.E.	Update frequency	Evolu-tion	Modifi-cation	Sensitivity	Update duration	Information Structure	Interaction dynamic	
Common design	Design guides	PDF	Central Research team	Designers	low	low	Slow	closed	High	Several months	SI	Prescriptive	
Technical instruction	Standards to be used	PDF	Central Engineering team	Designers	low	low	slow	closed	High	Several months	SI	Prescriptive	

Table 9: Extract List of main intermediary objects

3.3.3 Focus on Common Design Characterization

3.3.3.1 General description

The common designs are knowledge codified by experts working for the central research team, sent via mail by the central research team to product designers in PDF form. They are under the responsibility of the central research team and are stored in a technical database. The target of the common design is to aid the designers in charge of the basic and detailed design working in the design offices.

Designer testimonials, Grenoble Design office, 2009

The lack of granularity of transmitted information as well as reactivity on the part of the central teams... The common designs are scholarly instructions on the machines that we design. However, on our side, most questions that which we face are minor, yet one loses lots of time on minor issues.

For example, the technical notes will say: "need to measure temperature" without saying what measuring device to use. We'll have to test many probes, spending an amount of time on this search and not enough time on more fundamental and rewarding operation issues.

One of the questions to ask: To what extent do we want to manage risks when giving details?

It is true that a probe to change compared to a hub that burned has nothing to do with each other but all aspects must be paid attention to in order to create a good machine. How does one manage this technical granularity?

There are aberrant things also. In designing my pivot, I order a pressure sensor to be used on case x. It is the provider in question explaining we had lot of problems with this sensor on case x.

When reviewing the design, at no time is this problem mentioned. I call the supervisor to warn him and say that there actually should be another type of flexi... This information was not notified in the instruction.

These experiences need to be highlighted and diffused, why not flyers of corrective action?

3.3.3.2 Pedagogical Effort

There is no pedagogical effort observed in the structure of the document. There is no way to qualify the content. There is also no effort to pinpoint the level of requested understanding or

prioritise the information. All the content of common design is supposed to be mastered by the designers.

3.3.3.3 Information dynamic

The update frequency is supposed to be “low” because the know-how to design a product such as a turbine is not supposed to change quickly.

However, we have noticed that the correction or revision process of a common design takes months (update duration=several months) and leads to critical issues with how the feedback on experience is taken into account.

Technical Project Manager Testimonial, Grenoble Design office 2009

As reported by an engineer working for the commissioning department “In location B, we have discovered a problem with one of our products. We sent an email to the central research teams to inform them that there are some design problems with the component A. Normally, all units should have been informed about it. We need to improve our reactivity so as to be able to diffuse more efficiently that type of feedback in order to avoid similar mistakes in the future”.

Engineer Testimonial, Grenoble Technology Center, 2009

One of those more surprising testimonies was about the dimensioning of a shaft. I found super high allowable stressed. I said to myself ‘this is crazy,’ I never thought it would be tolerated. Afterwards, I went to see the expert for another reason and while doing so I brought up the shaft and he said: whoa, where did you get that? Wait a minute, this is nonsense.

Afterwards he said, ha, it’s true that this note is no longer valid, but the new version hasn’t been validated yet so it’s not visible. And he gave me the updated note.

I told him that he had to update the note as soon as possible.

In this situation the problem is of little consequence but how can we guarantee the pertinence and integrity of the information transmitted by the technology center if they’re not on top of updates. Such a problem can generate a lack of confidence in all written documents.

To finish, there is no possibility to modify a common design and no clear possibility to insert information or comments into the document (PDF version). The object is closed and does not support negotiation. This is a top down rationality if we observe just the document. However, in Grenoble, usually when designers want to obtain explanations or comments about a part of the document, they send an e mail to the common design producer or ask their supervisor or an expert.

These problems are related to the lack of information status. Are available only validated information without any rooms for information with other status such as, under revision...

3.3.3.4 Information impact

The content of the common design is crucial (High sensitivity) and needs to be strictly respected by product designers in order to avoid any risks. As mentioned by a product designer: "We use the Common design to avoid risks. They include formulas and methods that must be followed."

A rectification or change within a common design always has a direct impact on the final design. More specifically, the product designer may need to change the way he makes his design.

Because of the high sensitivity of the common design, the person in charge must update it whenever it is needed. However, the update duration is very long and insert an annexe to a common design with several points updated after issues has been reported on the project takes too much time. The Feedback on Experience (FOE) process needs to be improved and several actions have been managed by the central team to improve this FOE process.

3.3.3.5 Object collaborative abilities / Degree of prescription

All the common designs are considered confidential by the central research team. The confidentiality of all common designs reveals the high stakes faced by the central research team to protect the Knowledge. However, this makes it difficult for users to know to what extent they can share the common design even with their own colleagues and, of course, with suppliers involved in the design.

The Common designs clearly support a process of prescription. They are highly structured with official information. They are stored through in technical database and therefore shared in a semi-public space with varying limits on access rights. Common design does not share the characteristics of boundary objects which are supposed to cross the technical functions and allow actors to understand each other.

3.3.3.6 Tools

The common designs are stored in a database that presents issues as outlined in "lean information management" (Houy 2008) and Marcus Works (2000). Until today and because the technical database was not efficient enough in spite of huge progress made in the last two years, finding the right information was extremely difficult for designers who are confused by such a large database. The system is static instead of being dynamic and supportive of global interaction between actors.

Designer Testimonial, Grenoble Design Office, 2009

Even if serious efforts have been made, "navigating the database still remains difficult. There are many different storage schemes, many different technical databases. We often ask our expert and sometimes our colleagues in order to understand how to find the requested document. This practice is more efficient."

Until 2012, there was no comprehensive and shared data management in Hydro. The setting up of a data management system is very new.

3.3.3.7 Other communication tools

To federate the transfer of the other instructions other databases are deployed. For instance HEM has created in 2006 its own database named IDB for the storing of its technical instructions and processes. Even if serious efforts have been made, "navigating the database still remains difficult too."

During the workshops managed with designers, we have realized that the designers ignored the existence of the crucial common design information. The designers were aware of having a multitude of information provided by the central research team that could have been useful in solving daily problems. However, they did not know where to find them.

In the Grenoble units, there are 248 databases and around 30 databases covering technical documentations. Worldwide, we can account more than 11000.

3.3.3.8 Focus on the Technical Document Database: Statistical Data

The TC technical document database was created in 2000 to store this technical documentation produced by HRD. Even if serious efforts have been made, "navigating the

database still remains difficult. Until today, and because the technical database was not efficient enough in spite of huge progress made in the last two years, finding the right information has been extremely difficult for designers who are confused by such a large database. The system is static instead of being dynamic and supportive of global interaction between actors.

In this research, we have conducted a study on the activity registered in the CT technical document. We have registered the rate of consultation. We have chosen not to go deeper in this analysis but have proposed some specifications to improve the global database interface and its user interface.

3.3.3.9 Technology Center database statistics

The statistics that will follow have been made from the records of the consultations on the CT technical document done during the period from January to April 2009. The figures provided by ALSTOM Informatics and technology center (ITC) would not allow us to perform a detailed analysis. For instance, more detailed information on the time spent per database consultation by user could be asked to ITC and a detailed with the actions performed during the consultation... This data could help us understand the motivation of the user, whether it is for reading a document already found or just time spent on navigating or researching...

Legend:

We have identified in these statistics, the number of "potential" and * actual * users.

The number of potential users is the number of users with access to the database:

-The grey color code is a full color.

-The number of actual users is the number of users connecting to the CT technical document.

-The color code is a gradient color from the center

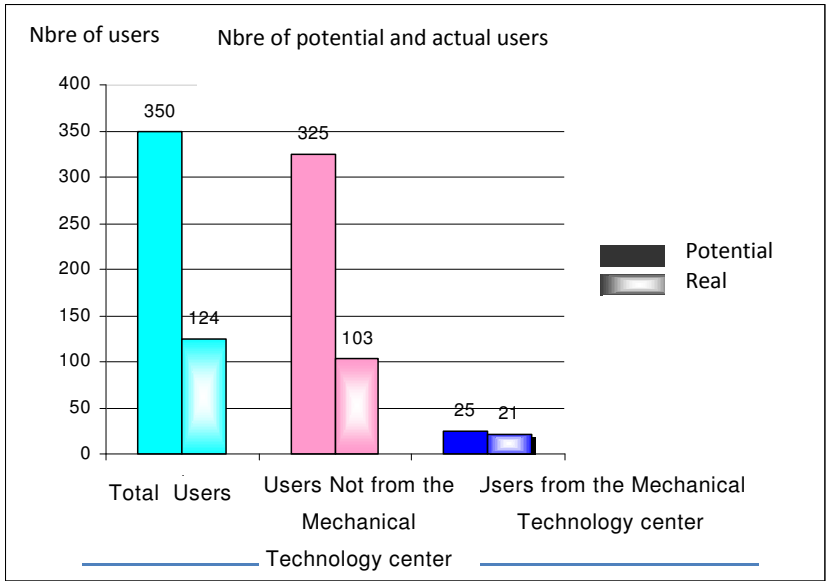


Figure 25: Number of potential and actual users

We have wondered about the number of potential users. Who were these potential 325 users? When and by which criteria the distribution list has been created? Is there any kind of uPDting process to update this list?

We have seen, however, that within the TC (technology center), 84% of the actors who have access to the database use it. However, only 32% of the actors not from the TC used the TC database. Why that almost 70% of the potential actors did not use the database?

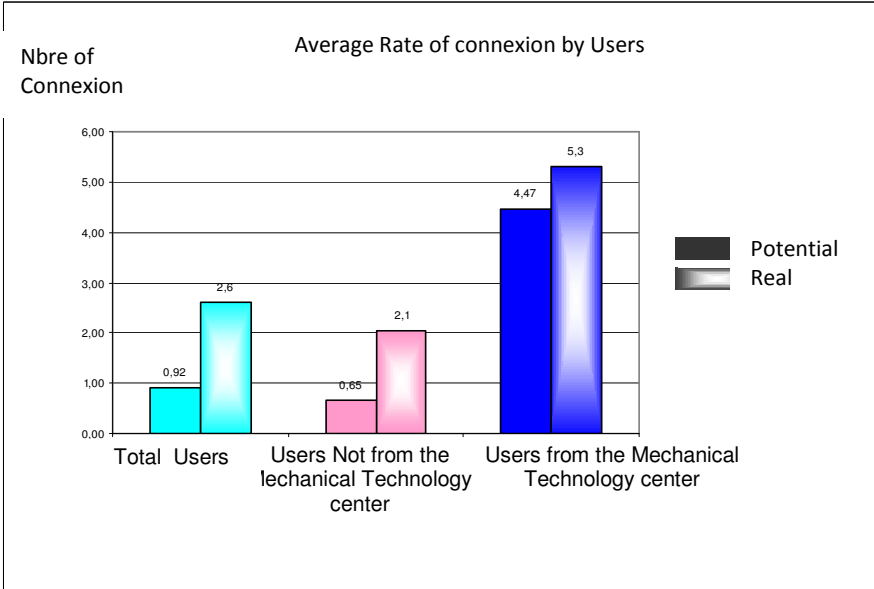


Figure 26: Average rate of connection by user

TC users were the biggest users of the “CT technical document” database. Unfortunately, the analysis did not distinguish the type of activity carried out by user on the database: Do they read or correct or publish documents? We do not even know what documents are opened?

Information related to the opened documents, time spent per connexion... would allow us to have indicators about the most consulted document, the most common activity on this database... Unfortunately, these metrics were not available.

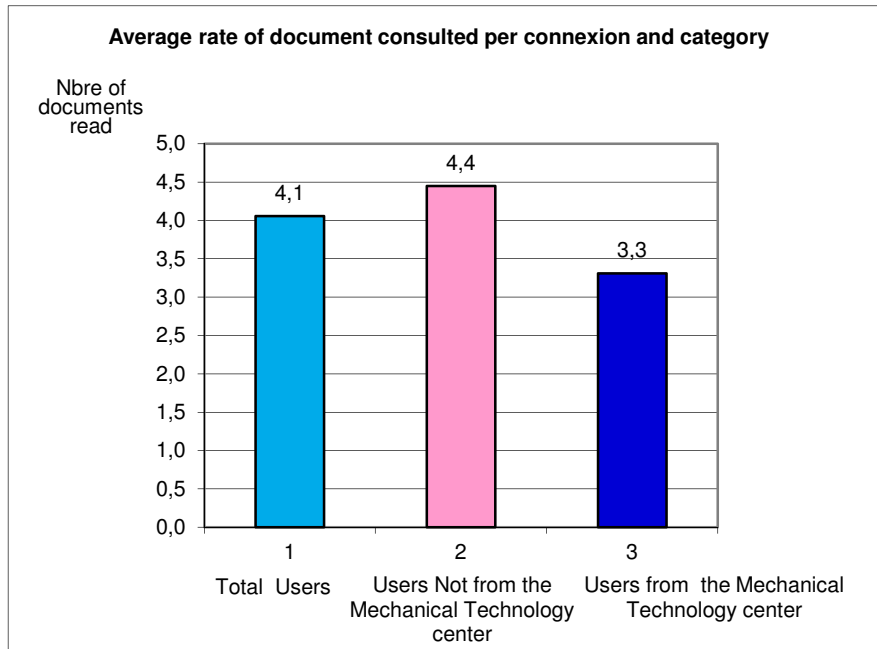


Figure 27: Average rate of documents consulted per connexion and category

3.3.4 Rules and Procedures

There exists a process to federate the collaboration and information sharing between central teams and product development actors. This process includes the stage that has to be followed to reach the final basic and detailed product design maps. To control the roll out of the design process worldwide, a technology audit and some design reviews are done and supervised by the central research teams.

3.3.5 Synchronous Interface Time Grid Results

Because intermediary objects are prescriptive and the system used to store them is static, engineers generally gain access to the requested information from the expert community or their colleagues as opposed to the database. The members of the expert community have to, according to different degrees of responsibility, ensure the quality of product design and product manufacturing due to their operational involvement in the projects.

Here above are listed the main meetings set up based on the “Nant de Drance Project” (For example)

Meetings	Person in charge	Participants	Number of meetings	Public Work-space	Project Work-space	Proximity Work-space	Community Workspace
Mechanical technical committee	Central Research Team	Experts all design offices	2/years				X
Technological Audit	Central teams and TPM and the main product Designers	Experts form central teams and TPM and/or the main product Designers	1/year		x		
Design Review	Supervisor or Expert	The main product Designers and his assistant, the Technical project Managers, the calculators, Supervisor or Expert, an assembly manufacturing representing and the industrial project leader	12 et 18 per project		X		
Technical committee	TPM	All the supervisors and experts of the design offices concerned and a senior expert + are invited The main product Designers and his assistant, the Technical project Managers, the calculators, Supervisor or Expert, an assembly manufacturing representative and the industrial project leader	1/project		x		
Customer review	Project Managers	The project management and experts. According to the problem, a specialist could be invited (calculators, designers...)	1 / project(in case of problem)	x			
Calculation meetings	Main designers	The main product Designers the calculator	3 / week		X	X (75%)	
Calculation meetings	Technical Project Designers	The TPM and the calculator	2 / week		X	X (50%)	
Daily issue Meeting	Technical Project Designers	The TPM and the experts	1/week			X	
Daily issue Meeting	Main designers	The main product Designers and the experts or supervisor or the CAD champion	1/day			X	
Daily issue Meeting	Calculators	Calculators and the experts or supervisor	1/day			X	
Daily issue Meeting	Main Designers	Main product Designers with assistant	Several times/day			x	

Table 10: Listed the main meetings set up based on the “Nant de Drance Project”

We see that almost 50% of exchanges are conducted in the proximity space.

The Technical Mechanical Committee consisted of 5-day-workshops 2 times per year. During this meeting, the experts worldwide can share problems they are facing in their own units.

The Technological Audit is organised by the central teams to ensure that the design reviews are well managed in each design office worldwide and if the methods and procedures are well applied on a project.

There are two or three design reviews per partial assembly. The first is called the “preliminary review”, the second is the “engaged” review (revue aboutie) and the last one is the final review (revue de cloture).

The technical committees are organized by HRD and HEM managers 2 times per year and consist of 5-day-workshops. The experts are gathering to share problems and Feed-back on experiences. There is no official feed-back meeting to report the discussions engaged during the technical mechanical meeting to designers.

The customer reviews are organized only when the project faces huge difficulties and can lead to modifications of the project planning and in fine cause changes in the objectives of product commissioning.

During the calculation meetings, the project actors share the results obtained by the calculators to test for instance the resistance of the material.

This data collection shows that the interaction dynamic is strong within the design office. The work of a designer is not reduced to the application of methods but really to the co-production of a solution with different technical partners.

The interviews show also that product designers access and understand common designs mainly through the support of their social network, especially their expert or supervisor. The learning of product designers is thus very dependent on their colleagues and their experts who explain to them how to handle common designs according to the context, and how to handle their design project. Indeed, Product designers ask the expert to find or understand information every day.

The experts have a key role on the information acquisition by engineers. In the next section, we present the role of the expert community to complete the diagnosis.

3.3 Focus on the Expert and Principal Engineers Community

3.3.1 Background

In 2008, a global Expert community was launched at Power level by the technology and Human resources departments with a clear strategic orientation.

As mentioned in the official Expert community presentation (2008), “the Technical Expert Community is a key community for the Power Sector, as this community participates in the sector’s performance and is an integral part of defining the sector strategy together with Senior Management...

Identifying, recognizing, developing and keeping critical global technical expertise for the Power Sector places expertise career paths alongside those of traditional management career paths”.

The objective of this Expert and Principal Engineer (PE) community was to create technical career paths as well recognized the traditional management career paths and consequently to allow ALSTOM employees who are attracted by technical fields to have new perspectives in terms of career ascension.

See below, the whole Expert and PE Community at a Glance in 2011

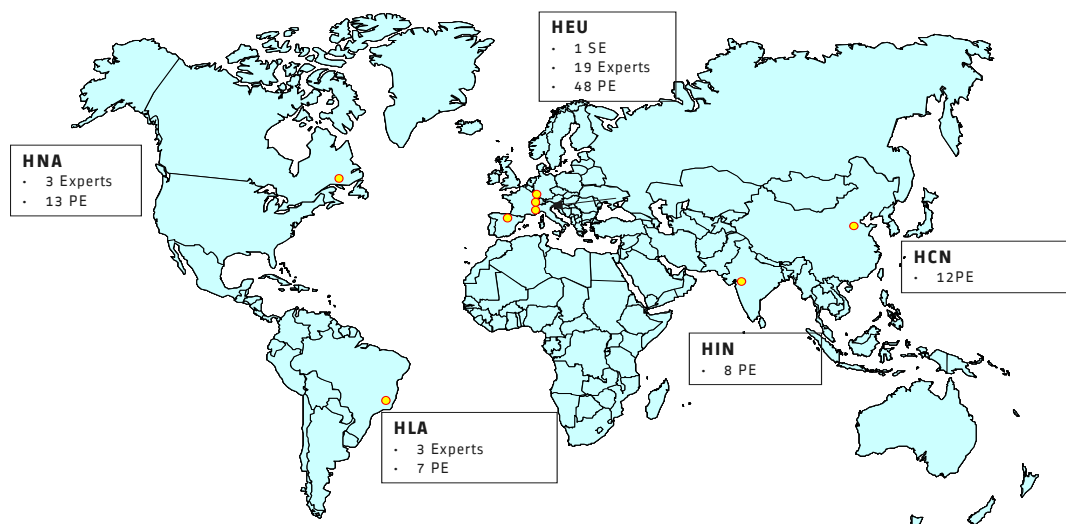


Figure 28: Expert & PE community at a glance in 2011

114 specialists have been nominated (88 Principal Engineers, 25 Experts, 1 Senior Expert), representing more than 10 % of the total Hydro R&D and Engineering population.

3.3.2 Technical expert levels

Three levels of Technical Expert Community members have been identified:

Principal Engineer, Expert, Senior Expert

The selection process of Experts and PE is performed by the Human Resources department (HR) according to pre-defined criteria.

3.3.3 Role and objectives of Experts and Principal Engineers

The members of the Expert and PE community have to, according to different degrees of responsibility, ensure the quality of product design and product manufacturing through an operational involvement in the projects. (For example: participation or leading of design reviews according to the technical review process in the location in relation with the central R&D department, checking that the R&D and the engineering processes are correctly applied, giving feedback on knowledge development based on design reviews, communication of the critical technical issues within the Expert community (high impact, high risk, lead-times), participation in the defining of the R&D program based on the needs of the different locations so as to address local markets...)

The community members also have objectives in terms of knowledge transfer, for instance, keeping and continuously improving the level of their own technical knowledge and experience, documenting their own know-how through design directives, patents, presentations, lectures, internal technical reports and external publications, sharing advice and training other colleagues locally through specific training programs on specific subjects and/or through design reviews or technology audits.

The community members also have objectives in terms of communication, they should:

- Promote in priority the interests and image of the company by writing technical articles and / or participating in external events
- Behave according to the ALSTOM Code of Ethics and Values

For Experts and Senior Experts only, community members should additionally:

- Write and publish at least one article every two years.

Twice a year, these community members are gathering together. They then have to ensure the cascade of information obtained during the global meeting to the local designer teams.

This community is a good instrument to encourage knowledge sharing across the globe and plays a key role in the engineering performance.

However, if we come back to our diagnosis, we wonder if the different units of Hydro, the designers have the possibility to interact with experts to find the analogy or rules they sought. Does the communication between designers and expert is a common practice in each site of Hydro?

In the next section we will explain the conclusion of our diagnosis.

3.3 Diagnosis synthesis

The interface diagnosis was done in Grenoble. However, we have collected internal documents from Barcelona, Baroda and Tianjin units (Technology Audit 2010, 2011) that prove that our observations done in Grenoble was generalizable in other units. The diagnosis has thus revealed a common trend of knowledge management practices within Hydro Company.

3.3.1 Outcomes

Let's going back to the questions asked in the conclusion of the first chapter:

- Are the design guides published by the technology center well implemented and used by the designers of the design office of Grenoble?
- Are the exchanges between the central teams and the designers of the design Office of Grenoble efficient?
- What are the main Knowledge management practices in R&D Hydro business?

We can say that the exchange of information and knowledge among Hydro between central teams and local operating mostly through the network and the support of the experts. The experts are guarantors of the success of the exchange between central research teams and designers.

On one hand, it reveals a good performance of the socialization process within the business studied but on the other hand, it reveals a weakness of the instrumental practices which failed compared to the social practices.

Paradoxically, the management of R & D at ALSTOM intensifying dissemination procedures, standards. The goal is to be able to align and homogenize the practices at the global level.

In Hydro, there is thus a gap between the formalized process and the actual practices of employees. There is especially a gap between the tools available that do not meet the expectations set by the management. There is a conflict between the means and intentions.

Indeed, on one hand, the central research team is engaged in an "codification approach" of knowledge. The central research team formalizes technical knowledge of structured objects which are stored in databases. These objects called common designs are supposed to frame the design activity.

The Common designs and more generally the whole technical document transferred by central teams clearly support a process of prescription. They are highly structured with

official information. They are stored through the CT technical database and therefore shared in a semi-public space with varying limits on access rights.

Common designs do not share the characteristics of a boundary objects. The common design digitalization makes more available the formal expertise of the company. These codification practices are limited to deal with the cooperation needs of multiple parties inherent in the design process.

There is no way to qualify the content and to identify if any revision is ongoing. There is also no effort to specify the level of requested understanding and prioritize the information. All the content of common designs is supposed to be mastered by the designers.

The designers receive global team's (HEM and HRD) work results. The content of the methods (common design or technical instruction) are based on the choice rationale of the central actors according to a given context. The methods diffused by the global teams often expose the result of reasoning. However, this rationality must be questioned and adapted in different contexts. Concretely, to ensure an adaptation or the actualization of the design guides and apply the rules diffused by the central research team, it is crucial to understand design rational. It is appropriate then to master this intellectual process in order to ensure the adaptability and up-to-dateness of its conclusions.

Finally, the amount of data and the way they are structured also causes access problems. The common designs are stored in a database that presents issues as outlined in "lean information management (Hick,2007).

Until today, and because the TC Technical document and the other technical database was not efficient enough in spite of huge progress made in the last five years, finding the right information was extremely difficult for designers who are confused by such a large database.

On the other hand, the knowledge sharing practices are inscribed in the "personalization approach". Engineers generally gain access to the requested information from the expert community as opposed to the database. We emphasize that product designers access and understand common designs mainly through the support of their social network and especially their expert attached to HRD and HEM. The learning of product designers is thus very dependent on their Colleagues and their experts who explain to them how to handle common designs according to the context.

The diagnosis allows us to deduce therefore an imbalance in the interface system.

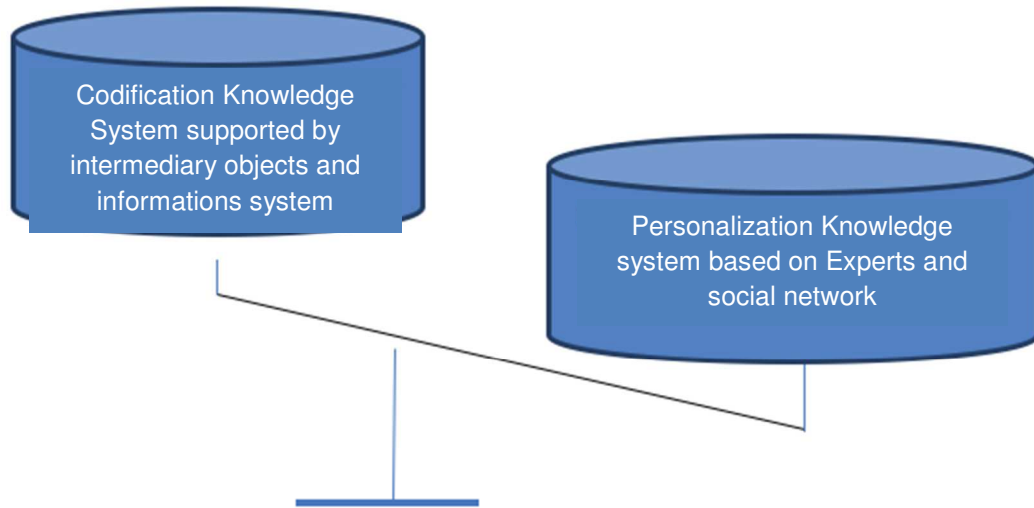


Figure 29: An imbalanced Knowledge management System

Also, we reported that the labor division between those in charge of the basic design in Grenoble and those in charge of the detail design in India was not easy to implement. The boundaries between basic and detailed activity formalized within the engineering process explaining the responsibilities of each party, was not so easy to implement in practice.

A negotiation about the division of labor was actually important. A discussion and a negotiation among players to reach a shared understanding of their respective mission were necessary. Activities that overlapped had to be clarified in order to have a common understanding of the input and output data of each party.

Moreover, we realized that in several years, the Asian engineers had acquired relevant knowledge and skills, particularly in manufacturing activity that has become necessary for Europeans. The relocation of the machine factory has created on one hand an imbalance and a mounting in competence of Asian actors, and on the other hand the loss of competence in manufacturing for the European staff.

Collaboration among Asian and European Designers, and actors in general, is critical to continue to demonstrate the relevancy of such work division.

The challenge of Hydro was thus to pass from a global model to an international model.

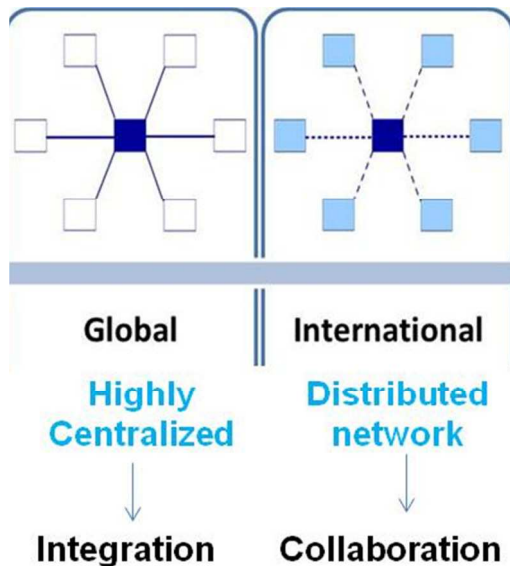


Figure 30: From the integration Model to the international one

The international model is focused on collaboration. The main objectives are to consider the different units as equal and be aware that central teams *have a lot of things to learn from the peripheries* (Doz, Y and Whilson K, 2012) and that design offices have to work and share together experiences as well. New mechanisms of collaboration have thus to be implemented to enable engineers to switch from local knowledge sharing and collaboration perimeter to global one.

3.3.2 Short-term industrial improvement proposal

According to the results of the exploratory study, we defined short terms actions to try to improve the interface system and in fine enhance the designers satisfaction of central support. Because these actions are not necessary to defend our thesis, we are going to present very briefly these operational outcomes. We will later place more focus on the presentation of the experiment and outcomes.

Summary of the Key operational Short-term improvements

One of the key outcome, was the improvement of the main technical databases (CT technical document and IDB) and their content (common designs) respectfully managed by HRD and HEM.

Our main objectives were to facilitate the access to information for the following professionals:

- Tendering professionals involved in the design

- Engineering professionals involved in the design

We proposed thus to reorganize the two databases according to the logic of the receivers.

The key objectives of the databases' restructuration proposal were summarized as follows:

- Capture and transfer knowledge (Know How and Know Why) through the common design
- Ensure a lean strategy by ensuring that the right person has access to the right information/ common design without losing time (No waste/efficiency)
- Improve employee efficiency and motivation by providing some space to let them comment and share their experience and ideas
- Ensure user interaction through a dynamic system

We then set up an action plan including 4 stages:

1. We initiated a data management project to standardize the vocabulary of the technical documents. For instance, they have plenty vocabulary to speak about instructions. There are technical notes, technical documents, technical instructions, a technical guide, technical specifications, technical directives, a methodology guide, standards, tolerances ... We thus initiated the standardization of this vocabulary.
2. We then worked with the central functions to reorganize the databases, review the storage of the information according to receiver rational thinking and remove all the common designs that were not up to date.
3. We also proposed a new way to organize the access to the content of the common designs' structuring using questions that the targeted population would ask during their work. Ref Appendix 4.3
4. We encouraged :
 - The database content qualification in order to allow a user to see, at a glance, and thanks a "flag" if some information were "not up-to-date".
 - Not up-to-date: Means that the content of the document has not been updated but is still useful for designers.
 - The setting up of a space allocated to allow user comments

Because, all user comments allow HRD to progress, we have proposed the creation of a space for comments allowing users to submit any comments* or proposals to improve a

common design. In order to qualify the comment, a color code has been proposed (ref table 11).




	Status = Request analysis
	Status = Intermediary comments
	Status = Expert's Answer. It can lead to an update of the common design or technical instructions

Table 11: Color code proposed to qualify the comments

Simultaneously, we pushed for implementing a dynamic system, encouraging people to share comments and encourage each user to share directly through the system his/her own experiences.

The second major action was the formalization of the knowledge of an expert. Different methods are presented in the literature to ensure knowledge formalization and capitalization. For example, we can take the example of the experiments set up to formalize the knowledge of an expert. We know the experience of "expert systems". The idea was to replicate the cognitive mechanisms of an expert in a particular field. Experimentation such as the sniffer aircraft was supposed to enable the detection of oil deposits, performing reasoning from facts and preprogrammed rules. The experience of the sniffer aircraft was a failure, but it's the principle more than the result that is interesting. Our objective was nearly similar in that sense that we have to extract from an expert what he knows without knowing it and eventually help him to sort, and explain it.

For our work, we have applied the "MASK method" developed by Jean-Louis Ermine. A detailed report is proposed in Appendix 4.4;

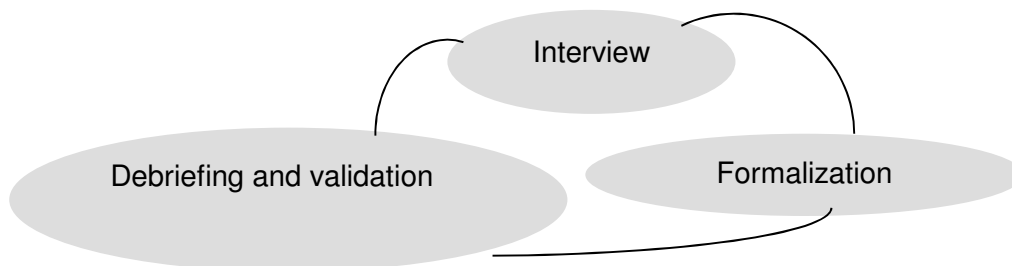


Figure 31: Knowledge Capture and Formalization cycle according to Jean-Louis Ermine MASK Method

In this dissertation, we would like to report the difficulties of formalizing Knowledge.

First, writing is too limited to express all the tacit knowledge. To illustrate our point: in the manufacturing process, we refer to rational data such as “control the oven temperature to reach maximum 180 C ...”. Oven temperature is a guard in order to ensure that the material will be heated enough to be easily deformed without being broken. However, the crucial knowledge of the expert surrounds the oven temperature. These are all details of the layout of the workshop, the knowledge of "noise from the oven".... These are all details that make an expert a resource that no process can ever replace.

How a process can mediate the intelligence of a situation? How can a process transfer the ability to quickly identify the risks, errors, and anticipated problems that we include under the term of the intelligence of a situation?

Formalizing the working steps to comply may allow workers to avoid going too fast. However, all tacit knowledge can not be formalized and put in writing.

Thus, "knowledge sharing» through the set up and diffusion of process is limited, as it is difficult to reduce into words that which must be understood by the perception gained through experience.

In conclusion, the objective of knowledge retention through formalization must be balanced by more human systems. The aim of standardizing practices may make sense but what is really relevant is to learn to understand a situation in order to be able to react to any kind of event. A formal writing can't show a worker how to behave or react in different situation. A procedure can be mapped out to explain what to do but only in a certain context, it is limited in its usefulness for dealing with with various contexts. It is for these reasons that we proposed/suggested to Hydro management to experiment tool such the “flash operator¹¹” and more human practices, which will be presented in the following section.

Here-below, a summary of the operational outcomes.

Operational outcomes	
Runner Manufacturing Guideline	completed
Common Design Interface improvement	Implemented on « Hooped Pelton»
Specifications proposal for the « CT technical document » // « IDB »	•Implemented For IDB •Agreed for R&D
Integration Plan for Design Office new comers	Agreed for HEU DO but not implemented

Figure 32: Operational Outcomes

¹¹ Interactive Movie that explains what has to be done and understood.

Conclusion

The diagnosis concluded that:

-An effective local social network existed, in the sense that designers always ended up finding the analogy or rules they sought,

-All discussions related to the design guides and how to apply them were local not capitalized and shared within a global network.

The linear top-down rationality of information transfer was completed by the current interactive practices where information was shared among local networks.

That is why we have imagined solutions to set up a global network. The stakes/aim was to globalize the local network, while sharing globally current discussions about rules, in order to switch from a local rationality to global network rationality.

We have seen an opportunity offered by the collaborative platform. The information that circulates is co-constructed by communities of players. With this new system, the flow of information won in fluidity and breaks with prescribed information, top-down management system and controlled by management.

In the next part of this thesis, we have conducted a second literature review on online interaction on platform collaborative of virtual communities of practices.

Our idea was not to remove all processes and methods that have been enacted in the 20 previous years because they were absolutely necessary, but rather to generate discussions around these rules or instructions by using the recent opportunities offered by information technology from 2.0. The rationality of the hierarchical transmission of information stored in databases was progressively changed for an area where knowledge was co-constructed in a global network.

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Introduction

If we consider the increasing success of forum applications (McKinsey. 2009), and the development of forums in the professional sphere to facilitate the communication and collaboration of an existing distributed community, what do we know? Could a collaborative platform such as a forum :

- balance the current interface system and help Hydro to balance its current KM practices ?
- enable engineers to be involved upstream in the production of the method?
- enable actors to pass from local rationality of knowledge sharing to global rationality of knowledge mediation?

These questions lead us to the formalization of three main questions:

- What kind of activities of a Virtual Community of Practice (Vcops) can be supported by a collaborative platform?
- How does one model these activities?
- How does one detect or implement a favourable Virtual Community of Practice configuration that will ensure online collaboration and Knowledge sharing?

Cycle 3	
Diagnosis	<ul style="list-style-type: none"> - Literature Review that led to the problematic : In a global context, how does a collaborative platform improve the collaboration and knowledge sharing among virtual Communities of practice in the domain of Product development? .
Planning Action	<ul style="list-style-type: none"> - Propose a methodology to conduct the experiments
Taking Action	<ul style="list-style-type: none"> • Setting up of a scientific model and grids to test a forum as a means to leverage global Collaboration (Interaction model, Community Configuration Table, Interaction modeling grid) • Set up of an European Engineering Community and its forum (Colleague)- Launch of the mutual Understanding Project
Evaluation	<ul style="list-style-type: none"> - Validation of the industrial partners to test the a scientific model and grids to test a forum (results found in the third part of this document) - Validation of the industrial partners to set up colleague Community and Forum

Table 12: Part 2 as the cycles of our action research

CHAPTER 4 – Interaction Clarification Concept

4.1 Interaction a key element for knowledge sharing and collaboration

Kerbrat-Orecchioni identifies interaction when " discourse is caught in an exchange circuit: it is for a specific targeted population (whether individual or collective), endowed with the ability to speak in turn " (Kerbrat-Orecchioni C. 2005). Only the dialogue is equivalent to interaction. Indeed, interaction "implies that the recipient is able to influence and alter the behavior of the speaker unexpectedly while he is engaged in the construction of his speech, in other words, in order for interaction to exist certain phenomena of immediate feedback must be observed "(Kerbrat Orecchioni C., 2005, p. 17). According to Goffman (Goffman E. 1973): The interaction (that is to say, the face-to-face interaction) means roughly the reciprocal influence that participants have on their respective activities with a physical proximity to each other (p. 23).

Professor Shigehisa Tsuchiya (Shigehisa T. 1993) explains that dialogue is what permits the exchange and mediation of knowledge. He also concludes that to reach an exchange it is necessary that the interpretation schemes of each of the members of the organization possess a minimum of common representation which he calls 'commensurability'(shared mental model). The 'commensurability' of organization members' schemas of interpretation is indispensable in the sharing of individual knowledge.' We translate from a French initial version and paraphrase his thoughts here: *"Individual knowledge is shared by way of dialogue. As knowledge is above all tacit, it has to first be articulated, and expressed in language in a general sense... It is important to clearly distinguish the sharing of information and the sharing of knowledge. Information does not become knowledge except for when it is understood by the schema of interpretation of the receiver who in turn gives it meaning. In most cases, any information inconsistent with this schema of interpretation goes unregarded."*

Following this idea, Osterman and Kottkamp (Osterman K. and Kottkamp R. 2004) explain that the information progressively becomes knowledge for the receivers when they start to « ask questions, challenge ideas, and process learning verbally, they clarify their thinking and deepen understanding » (p. 20). However, it is now understood that for being able to ask a question, the interlocutor has to share commensurability', that means that the topic under discussion makes sense in his mind. Jung and Latchem (Jung Insung . and Latchem Colin. 2011) underline that « dialogue in the form of teacher-student and student-student interaction tests and negotiates ideas, verifies learning, provides feedback, and constructs and expands knowledge and understanding » (p. 10).

The idea is that conversation allows « the deconstruction of those experiences and the reconstruction of a shared meaning in a way that transforms understandings and changes practice » p. 491 (Crow J. and Smith L. 2005). Christian Brassac claims that the co-construction of meaning is done thanks to interaction: « The interaction is not a message transfer exercise even implicit; the conversation is a meeting between cognitions involved (Brassac C. 2000; Brassac C. and Grégori N. 2000). This is inscribed in the cognitive approach and its sense-making perspective with the assumption that the meaning creation come from the interaction between a man and its environment. Knowledge is situated in a contingent context in which human action and interaction takes place (Patriotta G. 2003). Karl E. Weick (Weick K. 1995) explores for instance the mechanisms by which a man, a group or a company gives a meaning to a situation. The knowledge assimilation will be done based on the environment in which the individual evolves. Knowledge acquisition is a combination of experiences, meanings, affects and representations that people will combine with other people or situations. The knowledge sharing will allow for instance to change the mental maps of the individuals by a convergence of interpretations. Within the organization, the process of collective construction of meaning allows the setting up of a collective structure (Koenig G. 1996).

In design (Engineering) sciences, Guy Prudhomme, Franck Pourroy and Kristin Lund (Prudhomme G., Pourroy F. et al. 2009), inspired by teaching research (current teachings), explains that knowledge emerges thanks to the personal connection that will build the individual with "the object of knowledge" in a given context. The object can be both tangible (a component, a machine) and symbolic (a formula of words, a graph). The meaning of the information that the individual will build will depend on a given context and individual intrinsic factors. This meaning is dynamic and will evolve to climb or not to the level of new knowledge in the heads of the individual. Learning will be measurable by the changes in the link that the person will meet with the object of knowledge manipulated.

According to Guy Prudhomme and Franck Pourroy observing a collaborative design situation that regroups designers with different and complementary expertise can allow the researcher to observe knowledge sharing phenomena and learning phenomena. For them, a collaborative design situation leads to the confrontation of viewpoints and is thus a favourable ground for argumentation. They define argumentation between designers during the collaborative design of an industrial product as the cognitive and interactive operations by which the designers strive to convince both themselves and their peers of the sense and validity of a particular solution, or of the necessity to respect a particular constraint in relation to the problem.

As Prudhomme says an argumentative situation dealing with the collaborative design of industrial products is a series of defences or attacks on a single or multiple propositions for a solution during evaluation. Guy Prudhomme and Franck Pourroy hypothesize that an argumentative situation is typical of product design. This type of situation allows a team of designers to converge towards a solution, and requires them to negotiate, and so to render explicit their knowledge. Argumentative interactions are typical of design situations where designers must make choices between possible solutions, in order to respond to needs defined by expected performances.

They also say that argumentation is generally understood as proposing written or oral elements, either to support or attack a proposition or an affirmation that has been put forth.

The negotiation is a key element of the argumentation process.

Negotiation Moeschler (Moeschler J. 1985) can be seen as constitutive of verbal interaction: « without negotiation, the dialogue is transformed into monologue, the function of the interlocutor being reduced to that of a simple receptor of the message » (p. 176).

Negotiation is also interesting from the perspective of co-construction of knowledge in interaction. This concept, particularly valued by the Vygotsky and Piaget researches, is central in the situated approach wherein « negotiation is both a means for coordinating perception, action and the environment [...] and mechanism for social construction of knowledge by conversation, within 'communities of practice'» (Baker M. 1994).

According to Baker, Negotiations consist basically of sequences of offers that may be accepted or/and rejected; and two possible strategies are to refine original offers towards agreement, or to keep an offer fixed and to attempt to persuade the other to accept it by argumentation (p. 200). The negotiation is thus the final outcome of the argumentation process.

Two conditions are however crucial to the negotiation : (1) prior to any negotiation, the interlocutors must have a common intention as to reach a consensus, otherwise there is, strictly speaking, "nothing" to negotiate, (2) both partners must be able to contribute to the exchange of a relatively symmetrical, otherwise it's not anymore a meaning negotiation but a message transmission. To sum up, in interaction, the exchange and setting up of common representations is only possible through the phenomenon of negotiation thanks to the argumentation.

To conclude, the interaction between two people is fundamental for knowledge sharing. As soon as actors communicate: ask questions, challenge ideas, they start a process of learning

in the sense that they will change their initial mental representation. Through the dialogue and the communication actors progressively clarify their thinking. As soon as they start to negotiate, they combine their experiences, meanings, affects and representations with their interlocutor. They can defend or attack the idea exposed by their interlocutor, propose a single or multiple argument to try to convince their interlocutor. During this dialogue, the actor mediates his knowledge and can change his understanding of the situation leading to the change of the mental maps of the individuals by a convergence of these interpretations. Within the organization, the interaction process allows a collective construction of meaning. These main characteristics of the dialogue remind us of the clover design model inspired by the work of Ellis and Wainer (Ellis C. and Wainer J. 1994) (Figure 33). The authors propose a way to model a collaborative situation into three main activities: communication, coordination and production

Three main activities involved in the Collaboration clover



Figure 33 : Collaboration Clover (Ellis and Wainer, 1994)

The link between the observable of the interaction and collaborative activity can be explained as follow. In a dialogue, the following activities can be found: communication, coordination and production.

Communication as a message sending, and message receiving process : Communication appears when the receiver sends back a message that could be an idea, a question... in response to the first message received. Coordination means effort of negotiation that should take form of production of argument to attack or defend a proposition.

The Production is the outcome of the two first activities led to a new understanding of the situation. Actors may change their respective mental map through a convergence of the interpretations toward a new vision and representation of the “world”.

Thus, within a face to face interaction, knowledge sharing can be observed if we quote communication, coordination and Production. However, could we observe the same dynamics in online interaction?

4.2 New doors open by “Generalist collaborative platform” or “Forum” and theoretical gap

In efforts to develop better systems of global collaboration, many companies are leveraging collaborative platforms with usually forum functionalities.

A generalist collaborative platform allows the instrumentation of relationships within a community whose members are scattered across the globe. For our research, we are particularly interested on "collaborative platforms" hosted in the internal Information System of the company and allow both the sharing of contact and information between users.

The main principle of a collaborative platform is to allow members to discuss and exchange ideas informally. The idea is to encourage members to bring up problems and create debate through sound argumentation and in fine collaborate.

Besides proving attractive to corporations, forums also provide researchers with the opportunity to record and analyze the complex and nuanced interactions of global virtual collaborations (Iorio J., Peschiera G. et al. 2011).

Many speeches advocate the introduction of these new collaborative platforms. These new tools are considered "essential as the e-mail was 15 years ago." Some consultants even bet on "a winning combination of Generation Y who masters these tools combined with the experience of Generation X who understands the levers of productivity and performance." (Source blog Duperrin)¹².

These new forms of mediation between employees may allow the creation of global digital collectives to facilitate the information acquisition, exchange, argumentation (Cross R., Parker A. et al. 2001; Cross R., Laseter T. et al. 2006). They are an alternative to mail in

¹² Duperrin is Bertrand Duperrin is Consulting Director at Nextmodernity, a leading consultancy company in the field of business and management transformation through Social Business Design. He's considered as one of the first pioneers on this industry in France. Bertrand has been named as one of the 100 people count in the digital industry in France in by the leading french magazine "01 business & Technologie" in its 2013 ranking.

which communication is too sequenced and the databases that suffer from inertia. They are mostly a solution to the growing needs for collaboration.

A collaborative platform could indeed address several problems of information and knowledge management. These tools are based on the newer approaches to knowledge modeling from research in cognitive sciences. Users can "tag" information or photos posted, post comments, share features such as drawings and information, and manage their contact lists. In the field of educational science, using the typology of Bonk and al (Bonk C.J., Hansen E.J. et al. 1998), it has been found that the forums develop what is known as reflective practice not only do the interactants expose their professional practice but respondents as well. Reflective practice, as laid out by Schön (Schön D. 1983), is defined as a reflection-in-action and a reflection-on-action that lead to learning phenomena.

Bernard Coneins (Coneins B. and Bouvier A. 2007) has studied the forums of discussions animated by francophone users with an editor using open software : Linux. He tries to characterize the exchanges of knowledge that take place over extended periods and follows the temporal evolution of the behaviors of cooperation as well as the dynamics of coordination that accompany them. It is noted that the internet based technologies and the Open Source architectures provide great support to cooperation because they are both tools of social coordination and information creation and diffusion.

He defends a concept of knowledge acquisition based on a dynamic model of collective action where knowledge is constructed in the context of coordination. The mobilized tools act as supports to the argument process.

Other researches show that asynchronous online interaction is likely to give more time to participants to reflect (Zhao Y. and Rop S. 2001; Joiner R. and Jones S. 2003; Guiller J., Durndell A. et al. 2008).

For Gunawardena et al. (Gunawardena C., Lowe C. et al. 1997) online interaction becomes *"the essential process of putting together the [contribution of participants] in the co-creation of knowledge"*.

Hixon and So (Hixon E. and So H.-J. 2009) conclude, from their literature studies that « *incorporating technologies that promote communication and interaction between peers and/or supervisors can enhance reflectivity in all types of experiences* » (p. 297). Wade and al.(Wade S., Fauske J. et al. 2008) say « computer-mediated communication (CMC) promises to enhance critically reflective thinking»(p. 400).

Drawing on that type of studies, some trends seem to emerge. First, it seems generally accepted in literature that temporal flexibility (especially for asynchronous communication) and spatial interaction online is an advantage in terms of learning.

Most of the identified studies on online interactions concern education. Few empirical studies exist to show the use of a collaborative platform, a forum in the field of a company. The study of Di Micco (DiMicco J-M. and Millen D-R. 2008, April 5-10 ; DiMicco J-M., Millen D-R. et al. 2008, November 8–12; Dimicco J-M., Millen DR. et al. 2008, November 8–12,; DiMicco J-M., Geyer W. et al. 2009; DiMicco J-M., Geyer W. et al. 2009; DiMicco J-M., Millen D-R. et al. Nov. 2008) at IBM is certainly the most publicized. Di micco sets up a PC which she named Beehave hosted by the internal network of the company. Users use Beehave mainly to exchange information and very rarely to build social ties with people they don't know. The exchange of personal information is being made only in spaces of proximity to the users and is limited. In addition, and according to the findings of Di micco, we know that in the beginning, there may be some confusion between private life and public life. Western cultures are not ready to integrate (Ascencio C. and Rey D. 2010) into this mixture. In short, when Asians are going to be very successful at exchanging personal data, photos... the westerners will clearly be resistant and controlling what they want to expose within the business.

Another study concerns the effect of these platforms on the productivity of the employees. Although, the Ferreira (Ferreira A. 2009) study reveals that these technologies can be used to increase the collaboration between individuals who share a common interest or identical objectives.

To finish, another body of research explains, that steps must be taken to ensure the survival "of living together". Do not lock the employees into platforms under the pretext that they share common interests. The company must also allow debate between teams not necessarily working on same topics. This is therefore to find a balance between the use of these new tools for virtual communication and the actual communication between employees (Mercier P-A. 2008). All of these tips can be helpful in due time.

4.3 Assumption and theoretical gap

Our assumption is that a collaborative platform can offer opportunities for Knowledge management practices. For us, no matter are conducted the interaction on line or face to face, they have the potential to generate collaboration and knowledge exchange. Some studies tried to model the forms of online interactions in Virtual Community of Practice (Stempfle J. and Badke-Schaub P. 2002; Xu Wen., Kreijns K. et al. 2006; Barcellini F., D tienne F. et al. 2008; Riverin S. and Stacey E. 2008; Scherngell T. and Barber M. 2009; Walthall CJ., Devanathan S. et al. 2011). This studies demonstrate that collaboration activity and knowledge sharing occur among participants. However, we have found that there are only few studies that has been performed on a virtual community of engineers working in product development (D tienne F. 2006). We also note that there is no study on the link between the configuration of a virtual community and its level of online interaction.

Thus, if we consider the increasing success of collaborative platforms (McKinsey. 2009), and the development of forums in the professional sphere to facilitate the communication and collaboration of existing distributed community, little is known about the influence of the tools and communities structure on online types of interaction. Is it a question of tool configuration or of community characterization that will lead the community to successfully collaborate? What are the main factors that play a key role in fostering online collaboration and knowledge sharing between Community members?

CHAPTER 5 - Methods used to track online activity

We know that online forums provide potential for new forms of collaborative work, study, and community that reduce barriers of time and distance. Yet the types of interaction and means by which individuals create new knowledge in online environments are not well understood. Junio Cesar de Lima (De Lima., Júnio César. et al. 2010)) explains the challenge. We paraphrase here what he wrote (Page 107).

As an example of what can be done, suppose a forum for the discussion of hardware installation. If a member has problems installing any hardware, he may post a message explaining his problem, and other members may give him solution ideas. He may test these ideas and give feedback to the forum, saying what worked and what didn't. If the problem is not solved, other iterations occur. The process continues until the user is satisfied. Eventually there may be problems that continue unsolved even after a long discussion. A big challenge is to capture the implicit knowledge contained in these communication processes. The procedure to solve the original problem may be inferred from the sequence of messages exchanged in that specific topic of the forum. If this is possible, the problem and its solution may be stored in the community's knowledge base, making it accessible. If other members have the same or similar problems, they will be able to use this knowledge without having to post a new message to the forum and pass through the same process as the first user. As in forums, messages sent by email or Wiki annotations may also contain embedded knowledge.

Online interaction, as a form of discourse, is thus a complex and discursive phenomenon. Researchers in this field generally agree that mixed method multidimensional analysis is necessary to provide in-depth understanding (Wegerif R. and Mercer N. 1997; Hmelo-Silver C-E. 2003). Thus in order to understand and identify the nature of the interaction of the VcoP studied and demonstrate that a collaborative space such a forum can generate collaboration and knowledge sharing, we have selected different modeling grids available in the literature to make our own grid.

5.1 Modeling grids of the online interactions proposed in the literature

We have attempted to identify the modeling grids of the online interactions proposed in the literature in order to be able to understand how the online interactions are framed and to detect how to justify that they allow for the exchange and co-construction of knowledge, and that it also facilitates international collaboration.

5.1.1 Henri model to understand learning process that occur online for educators

To date, several researchers had attempted to develop coding schemes to account for the different aspects of online interactions.

One of the earlier attempts to analyze content is the model proposed by Henri (Henri F. 1992) that includes five dimensions and their categories as shown in Table 13.

Dimension	Categories
1. Participation	Levels of participation; Types of participation
2. Social	Statement or part of statement not related to subject matter
3. Interactivity	Explicit interaction: Direct response, Direct commentary Implicit interaction: Indirect response, Indirect commentary Independent statement
4. Cognitive Skills	Elementary clarification; In-depth clarification; Inference; Judgment; Application of strategies
5. Metacognitive Knowledge and Skills	Personal; Task; Strategies; Evaluation; Planning; Regulation; Self awareness

Table 13: Henri's (1992) Model of Content Analysis

Henri believed that her model would help educators to understand the learning processes that occur online comprehensively. Although the model is lacking in clear criteria and detailed descriptions (Howell-Richardson. and Mellar H. 1996), it is a useful tool in terms of laying the groundwork.

However, Henri's model is based on a teacher-centered instructional paradigm, and as Gunawardena Lowe and Anderson (Gunawardena C., Lowe C. et al. 1997) note, such a paradigm is inappropriate in a constructivist environment where learning is based on the shared construction of knowledge.

5.1.2 Gunawardena, Lowe and Anderson model to understand the meaning negotiation and co-construction of knowledge online

Gunawardena, Lowe and Anderson developed an interaction analysis model (see Table 14) to examine meaning negotiation and co-construction of knowledge. Their study explored the dynamics of learning community creation and support through a text-based mediated form of interaction occurring asynchronously over a limited time span. The model describes co-construction of knowledge as five progressive phases. They are sharing, comparing of information; discovery of dissonance; negotiation of meaning/ co-construction of knowledge; testing and modification of proposed synthesis; agreement/ application of newly constructed meaning. Each phase consists of a number of operations such as stating an observation or asking questions. Every constructed knowledge may not progress linearly through each successive phase.

Phase	Operation
1 Sharing / comparing of information	Statement of observation or <u>opinion</u> ; <u>statement of agreement</u> between participants
2 Discovery and exploration of dissonance or inconsistency among participants	Identifying <u>areas of disagreement</u> , <u>asking and answering questions</u> to clarify disagreement
3 Negotiation of meaning/co-construction of knowledge	<u>Negotiating meaning of terms and negotiation</u> of the relative weight to be used for various agreement
4 Testing and modification of proposed synthesis or co-construction	<u>Testing the proposed</u> new knowledge against existing cognitive schema, personal experience or other sources
5 Agreement statement(s)/application of newly constructed meaning	<u>Summarizing agreement and metacognitive statements</u> that show new knowledge construction

Table 14: Gunawardena, Lowe & Anderson's (1997) Interaction Analysis Model

This model is interesting and we have pay a lot of attention on the different operation described to code the message. However, for us, the operation are to wide to show with accuracy the argumentation process for instance that lead to knowledge sharing. For instance, argumentation could appear in the phases three to negotiate the weight to be used for various agreements but also in phase four, while testing the new knowledge. It is for us critical to be able to detect argumentation process with precision because we argue that the

exchange of knowledge is done through the phenomenon of negotiation and argumentation. The operations presented in this model are too wide.

5.1.3 D tienne Model to highlight the different dimensions of collaborative design activity

A Study in the field of Open Source Software proposed some refined analysis of online design collaboration (Barcellini F., Detienne F. et al. 2008). This study of a community of developers highlights some characteristics of design dynamics within the exchanges based on a systematic coding of the messages. They highlight different dimensions of collaborative design activities in the interactions: (i) generation evaluation activities (elaboration of the problem, proposition...), (ii) Clarification activity appearing with question-answer turns (also called cognitive synchronization), (iii) group management activities. This work is consistent with the types of activity identified by(Stempfle J. and Badke-Schaub P. 2002) and(Prudhomme G., Pourroy F. et al. 2009) who also point out argumentation as a key point of design interaction. We should find also coordinated effort on problem/question sharing, idea (solution proposal) sharing, and finally argument (pro and cons) sharing. These different interactions should lead to the co-production of a solution.

Dimension of Collaborative Design Activities from D�tienne
Information transfer
Clarification activity appearing with question-answer turns (also called cognitive synchronization)
Group management activities
Generation evaluation activities (elaboration of the problem, proposition...)

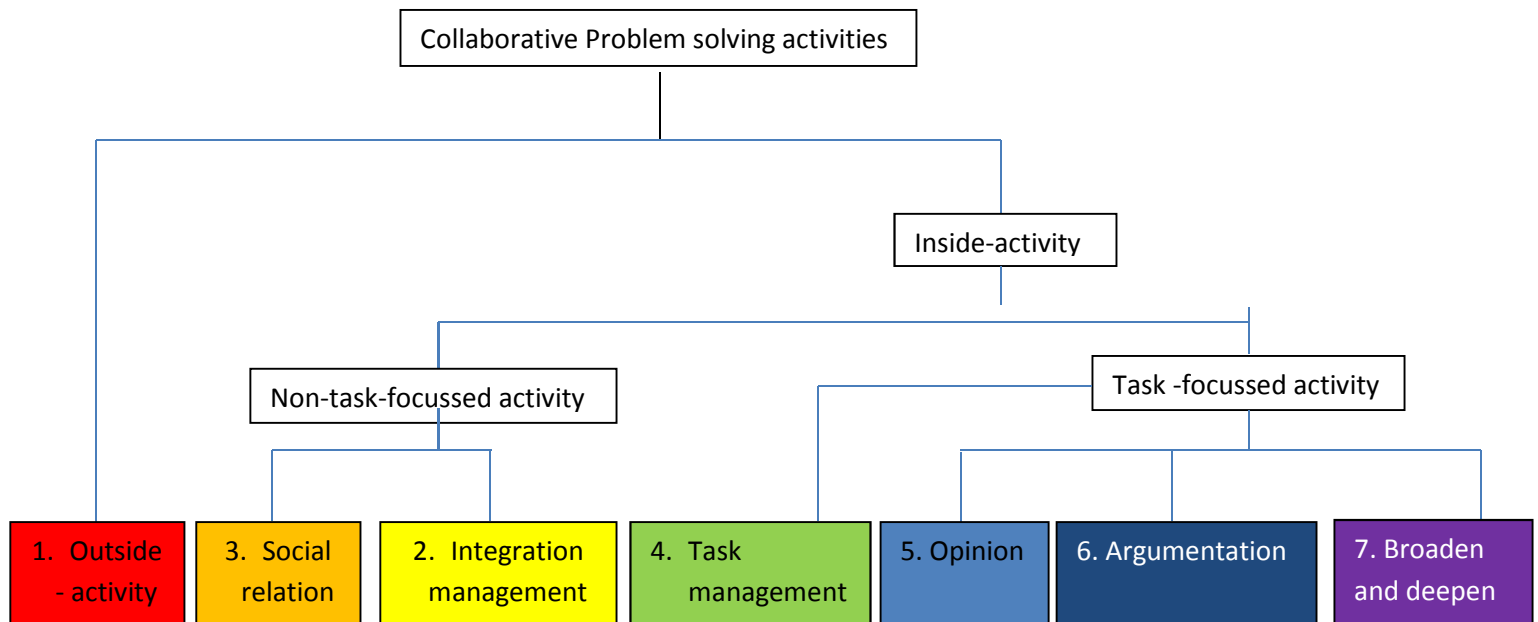
Table 15: Dimension of Collaborative Design Activities from D tienne

D tienne Model allows detecting dimension of collaborative design activities but we consider that this model is not relevant to model interaction because it is not enough precise.

5.1.4 The Rainbow Model to analyze quasi synchronous computer mediated interaction/debate

The Rainbow was developed within the EU funded “SCALE” project¹³. Rainbow was initially developed for the analysis of quasi-synchronous computer mediated interactions, produced with a conventional CHAT system, and/or a tool for collective construction of argument diagrams (with the “DREW” tool,¹(Corbel A., Jaillon P. et al. 2003)).

The Rainbow framework is a visual tool, since it comprises seven principal categories, to which different colours are assigned for ease of visualisation of each category (Ref figure 34 here below).



¹³ The research reported here was carried out within the SCALE project (Internet-based intelligent tool to Support Collaborative Argumentation-based Learning in secondary schools, project n° IST-1999–10664, March 2001 – February 2004), funded by the

Rainbow functional category	Brief definition
1. Outside activity	Any interaction that is not concerned with interacting in order to carry out the teacher/researcher-defined task, including socio-relational interaction that does not relate to interacting in order to achieve the task, e.g., talk about last night's party.
2. Social relation	Interaction that is concerned with managing the students' social relations with respect to the task (debating about X), e.g. greeting, leave-taking, politeness, expressions of frustration with the way the partner is interacting, etc.
3. Interaction management	Interaction concerned with managing the interaction itself: who will speak or not and when (coordination), establishing contact, perception, understanding, attitudes (communication management), topic shifting, time management, ...
4. Task management	Management of the progression of the task itself: planning what is to be discussed, establishing whether problem solved or not, ...
5. Opinions	Interaction concerned with expressing opinions (beliefs, acceptances, ...) with respect to the topic debated; expression of opinions at opening and closing of phases of argumentative discussion.
6. Argumentation	Expression of (counter-)arguments directly related to a thesis (e.g. GMOs increase famine because farmers become dependant on seed companies), theses themselves, requests for justification
7. Broaden and deepen	Interaction concerned with (counter-)arguments linked to (counter-)arguments, argumentative relations, and meaning of arguments themselves (elaboration of them, definition, extension, contraction, i.e. any discursive or conceptual operation performed on content of arguments themselves).

Figure 34: Rainbow Study Categories (From the Article p 326 "Rainbow: A framework for analysing computer-mediated pedagogical debates (Baker M., Andriessen J. et al. 2007)")

This framework has already been reused for modeling design situations by Prudhomme and Pourroy (Prudhomme G., Pourroy F. et al. 2009). The relevance of the model has been shown in their study as far as argumentation appears to be a critical element in the design activity.

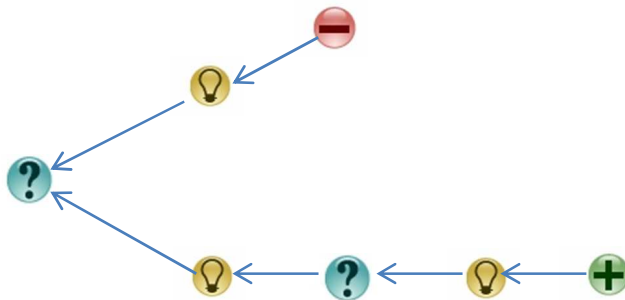
The authors have however pointed out some limitations of the model and had to adapt it to describe design situations. Rainbow framework is thus relevant to code a debate such as a knowledge-based argumentative interaction (Baker M., Andriessen J. et al. 2007), in which argumentation in interaction is engaged in order to answer a specific question by purely writing means. We see argumentative interaction as a process that is oriented towards deciding what statement(s) should be jointly accepted, or not, by linking those statements to others [called (counter-) arguments], and thereby transforming the degrees of acceptability of the statements under discussion. Whilst argumentative interactions may arise in any cooperative problem-solving situation, in debates, argumentation is the *raison d'être* of the verbal interaction itself, as a means and medium for solving a problem.

5.1.5 The IBIS model to highlight the problem solving dynamic and idea generation in design situation

The Issue-Based Information System (IBIS) is a concept-mapping tool, which supports informal and exploratory conversation and facilitation, with a structured modeling approach (Selvin., Sierhuis. et al. 2001, March 4-7)

The Issue-Based Information Systems (IBIS) was developing to support coordination and planning of decision processes. IBIS guides the identification, structuring, and settling of issues raised by problem-solving groups, and provides information pertinent to the discourse. Elements of the system are questions, ideas and arguments.

For example, the history of a discussion taking place during the design of a product can be represented by an IBIS model as follows:





Symbol				
Meaning	Question	Idea	Negative argumentation	Positive argumentation

Figure 35: IBIS model Representation

The question on the left represents the problem to be solved (design of a product) and the little bulbs represent the ideas suggested for the design. As we can see, there are also arguments for or against some ideas or the rise of other questions. The ibis model is a strong visual tool to enable at a glance to see a team interaction dynamic.

By crossing the model, we propose a synthesis of the different elements.

5.2 Synthesis

5.2.1 Synthesis table of the modeling grids of the online interactions proposed in the literature

Model	Henri Dimension (Henri F. 1992)	Gunawardena, Love and Underson Operations (Gunawardena, Lowe & Anderson's 1997)	Detienne Dimension (Barcellini F., Detienne F. et al. 2008)	Rainbow Interaction model (Corbel A., Jaillon P. et al. 2003)).	Ibis Observable (Selvin., Sierhuis. et al. 2001, March 4-7)
Objectives of the Model	Understand learning process that occur online for educators	Understand the meaning negotiation and co-construction of knowledge online	Highlight the different dimensions of collaborative design activity	Analyze quasi synchronous computer mediated interaction/debate	Highlight the design Rational Process
Coding scheme proposed	<ul style="list-style-type: none"> • Participation • Interactivity • Social • Cognitive Skills • Metacognitive Skills 	<ul style="list-style-type: none"> • Statement of observation or <u>opinion</u>; <u>statement of agreement</u> between participants • Identifying <u>areas of disagreement</u>, <u>asking and answering questions</u> to clarify disagreement • <u>Negotiating meaning of terms and negotiation</u> of the relative weight to be used for various agreement • <u>Testing the proposed</u> new knowledge against existing cognitive schema, personal experience or other sources • <u>Summarizing agreement and metacognitive statements</u> that show new knowledge construction 	<ul style="list-style-type: none"> • Clarification activity appearing with question-answer turns (also called cognitive synchronization) • Group management activities • generation evaluation activities (elaboration of the problem, proposition...) 	<ul style="list-style-type: none"> • Outside-Activity • Social Relation • Interaction Management • Task Management Opinion • Argumentation • Broaden and Deepen 	<ul style="list-style-type: none"> • Question • Idea • Negative argumentation • Positive argumentation

Table 16: Synthesis table of the Modeling grids of the online interactions proposed in the literature

5.2.2 Comparison of the coding scheme

Model	Henri Dimension (Henri F. 1992)	Gunawardena, Love and Underson Operations (Gunawardena, Lowe & Anderson's 1997)	Detienne Dimension (Barcellini F., Detienne F. et al. 2008)	Rainbow Interaction model (Corbel A., Jaillon P. et al. 2003)).	Ibis Observable (Selvin., Sierhuis. et al. 2001, March 4-7)
Comments	The dimensions of Henri are too wide to allow a precise interaction storage	The operation of Gunawardena are too wide to allow a precise interaction storage	The activities shown by Detienne correspond to a set of observables that are not explicit in her model	The observables are clear but for design activity question and idea items are missing	The observables are clear but it misses a lot of items to characterize a "post"
Classification within the proposed interaction activities					
Communication	<ul style="list-style-type: none"> • Participation • Interactivity • Social • Cognitive Skills • Metacognitive Skills 	<ul style="list-style-type: none"> • Statement of observation or opinion; statement of agreement between participants • Identifying areas of disagreement, asking and answering questions to clarify disagreement 	<ul style="list-style-type: none"> • Clarification activity appearing with question-answer turns 	<ul style="list-style-type: none"> • Outside-Activity • Social Relation • Interaction Management • Opinion 	<ul style="list-style-type: none"> • Question • Idea
Coordination		<ul style="list-style-type: none"> • Summarizing agreement and metacognitive statements that show new knowledge construction • Negotiating meaning of terms and negotiation of the relative weight to be used for various agreements 	<ul style="list-style-type: none"> • Group management activities 	<ul style="list-style-type: none"> • Task Management 	
Production		<ul style="list-style-type: none"> • Testing the proposed new knowledge against existing cognitive schema, personal experience or other sources 	<ul style="list-style-type: none"> • generation evaluation activities (elaboration of the problem, proposition...) 	<ul style="list-style-type: none"> • Argumentation • Broaden and Deepen 	<ul style="list-style-type: none"> • Negative argumentation • Positive argumentation

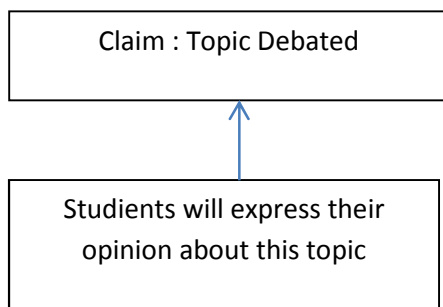
Table 17: Storage of each model' observed in the proposed interaction activity

These different models have different objectives. They highlight respectfully activity, dimension, operation, interaction. Even the semantic is different. However, the shared point of these models is that they try to model online discussion or debate and try to remind the characteristic of each dialogue.

After having done this comparison between models, we consider that the most complete model is the rainbow model.

However, we found two main limitations of this model in its original form: there were neither proposition or idea items nor question items to describe the actual interactions we were facing. Indeed, in the initial model of rainbow, the debate was initiated by a “claim” asked by a teacher. Also, the objective of rainbow was to model the interaction dynamic between the teacher and the student and the student themselves. Opinion was exchanged and things were explained to student but the answer to their questions already existed.

Rainbow Model Context



In the rainbow model, there is only a topic debated and the answer exists in that sense that knowledge on that topic has been already validated. For instance, the topic could be the life of a famous engineer. A debate around this topic will be map thanks to the rainbow model. The objective is not to propose another possibility of life for this famous engineer. The objective is more to learn about his life, debate about his main achievements and so on.

In design, the Designers have to generate new solution to solve a problem. There could have plenty topics of debate.

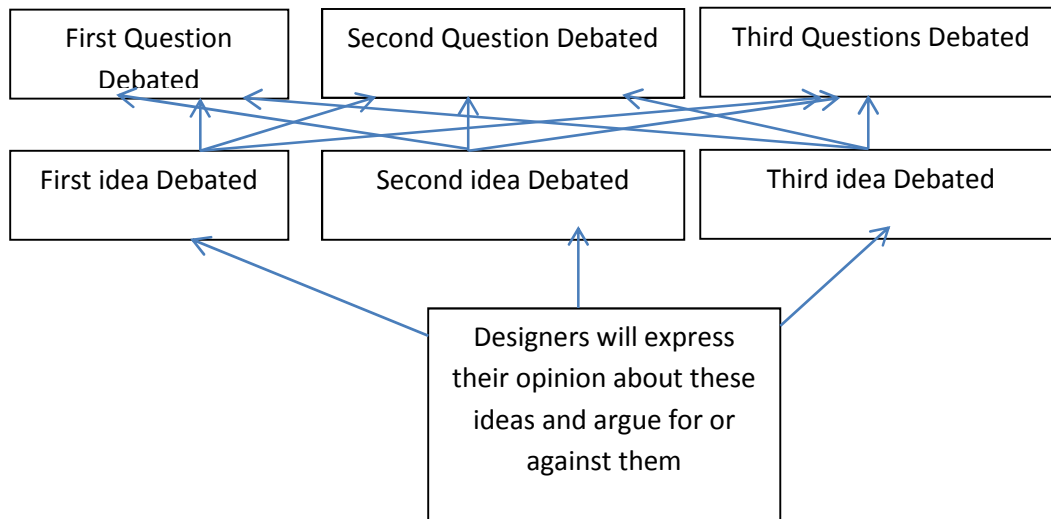


Figure 36: Design typical debate

In a discussion, designers have to co-design the appropriate answer to a question which is similar as a problem. We may have several ideas to solve this problem, debated at the same time which corresponds to the generation of proposed solutions. That is why, items such as question and idea have been added.

In design rationale, the models IBIS (Issue Based Information System) (Conklin J. and Burgess Yakemovic K. 1991) or DRED (Bracewell R-H. and Wallace K. 2003) have these items.

Also within Rainbow, we do not know the topic of the interaction. We can't enter in the content of the discussion. However for our analysis, we do not need to reach the content and the sense of the online discussion.

In the table 17 we have crossed the interaction that we can code from corpus analysis and activity required for collaboration and knowledge sharing viewed in the previous chapter.

Activities integrate different types of elementary interactions coded from an enriched rainbow corpus.

Collaboration component		Knowledge sharing Component	Elementary interactions coded
Ellis and Wainer (1994)	Détienne (2008)	From sense Making theory.	Rainbow enriched model
Communication	Information transfer	Question-answer	Idea, Opinions
	Clarification activity appearing with question-answer turns (also called cognitive synchronization)		Idea, Opinions, Question, Interaction Management
Coordination	Group management activities	Debate coordination	Task Management, social relation, Interaction Management
Production	Generation evaluation activities (elaboration of the problem, proposition...)	Negotiation, Argumentation	Idea, Opinions, Question, Argumentation, Broaden and Deepen

Table 18: From Interactions coded to collaboration activity

Analysing the interaction will enable us to illustrate the type of collaborative activity mediated in the forum and demonstrate if there is Knowledge sharing or not.

Just to clarify the purpose :

- An Action is a post of a person on the forum
- An Inter-action is an exchange of posts between at least two persons,
- A set of interactions refer to an activity and correspond to an interaction dynamic.

When we reach Argumentation and Broaden and Deepen interaction, we could say that a forum allow the knowledge sharing according to the sense making theory.

5.3 A Mixed method proposed to identify interaction patterns in the VcoP

In a collaborative platforms such a forum, each member of the community can express his or her ideas, opinions, arguments, by editing a comment within a topic. Thus, in each topic, there is a succession of comments and our challenge is to demonstrate if within a discussion, can be quoted knowledge exchange.

Our coding scheme is thus a mixed method mainly based on the Rainbow model (Baker M., Andriessen J. et al. 2007).

Thus we proposed an enriched rainbow model adding “Question” and “Idea” interactions within the “task focus activity” of the rainbow-coding scheme. The coding scheme presented in the figure 37 had been used in this study.

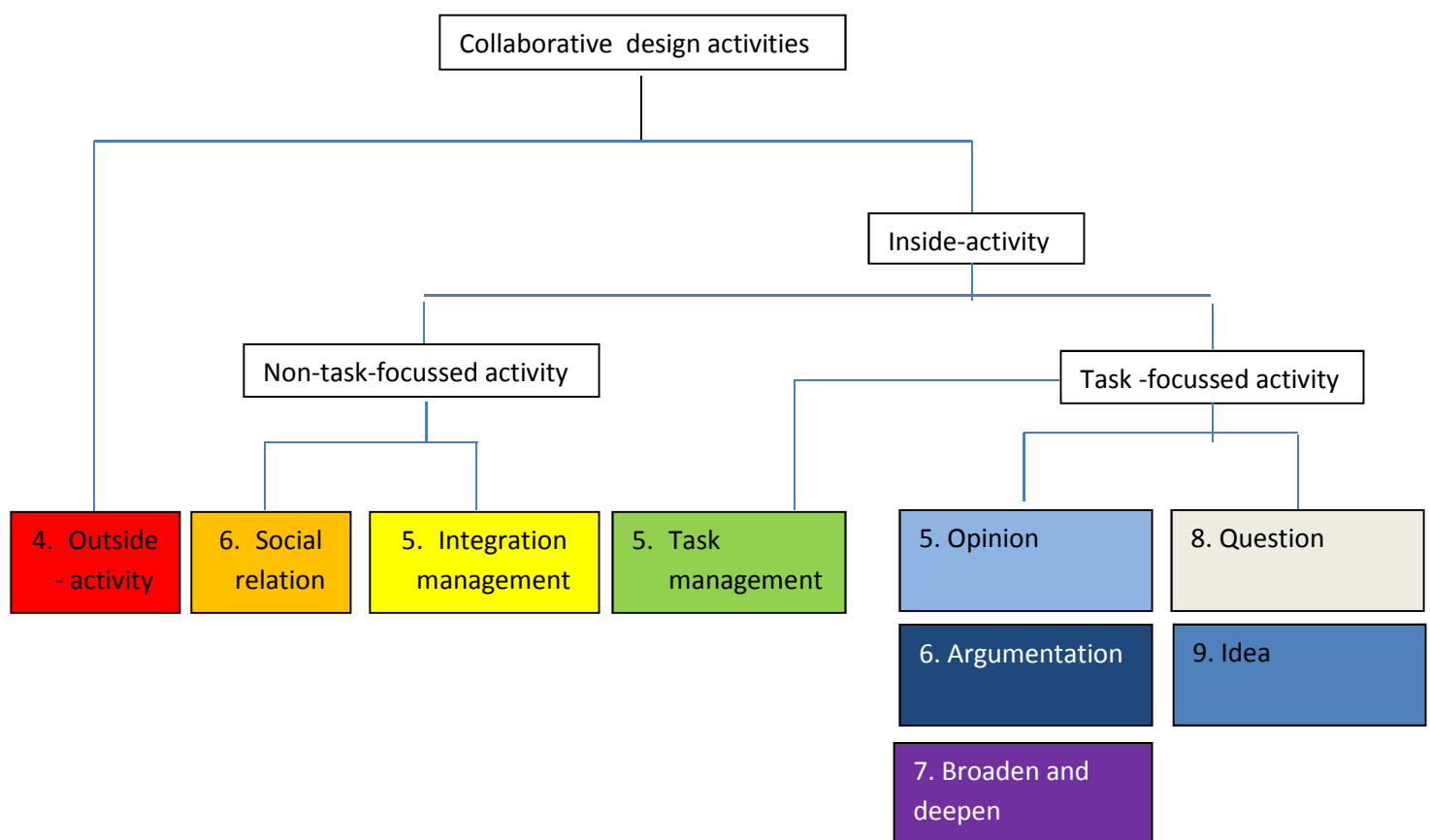


Figure 37: Coding scheme proposed adapted from (Baker, Andriessen et al. 2007)

A question is an interaction concerned with expressing a problem with respect to a daily work

An idea is an interaction concerned with expressing a proposition of solution with respect to the question raised.

5.3.1 Graphical representation of an argumentative situation

The IBIS model combined with the enriched Rainbow categories will help us to make a graphic representation of an argumentative situation.

Our graphic representations follow the rationality of IBIS models and they intend to represent the development of a conversation about a subject.

To identify collaboration within a collaborative platform, it is necessary to characterize each comment according to the enriched Rainbow analysis categories given above and then search for signs of argumentation. Here is an example of a comment posted in a collaborative platform of CAD community:

B	As PLM Solution is not forecast within 1 year , we are now facing big issue regarding automatic transfer of pro_E drawings in AUTOCAD version	Question
	We use the manual action "save_as" , sheet after sheet	Broaden & deepen of Question 1
	We would like to have a macro to launch on a specific drawing CAD "drw" file, the automatic conversion of each and all sheets in AUTOCAD version "dwg".	Idea
	Can you explore the possibility to make this requested transfer in an automatic way (1 macro for all sheets)	Question

Table 19: Example of coding

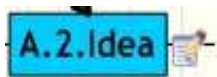
The left column represents the user posting the comment, represented here by a letter to remain anonymous. In the middle column there are the comments made by the user and in the right column each comment is classified according to the enriched Rainbow analysis categories.

Once we have classified all comments in a conversation we can construct the graphic representation.

The graphs are composed of rectangles. Each rectangle represents a comment (idea, argument, opinion ...). The color of each rectangle matches the color of the kind of comment that represents, following the color code of the enriched Rainbow analysis categories. Within the rectangle there are:

- A letter: represents the user that posts the comment.
- A number: represents the order of the comment within the conversation to keep track of the time evolution of the conversation.
- Category of the comment: represents what type of comment it is, according to the enriched Rainbow analysis categories.

For example:



It means that user **A** on line **2** has expressed an idea.

Each rectangle is connected to other rectangles. The lines that connect each rectangle represent a relationship between them. The continuous lines connect ideas, arguments, broad and deep, opinions and questions. While the dashed lines connect Interaction and Task Management comments with other comments to which they relate.

Here is an example of our graphic representation:

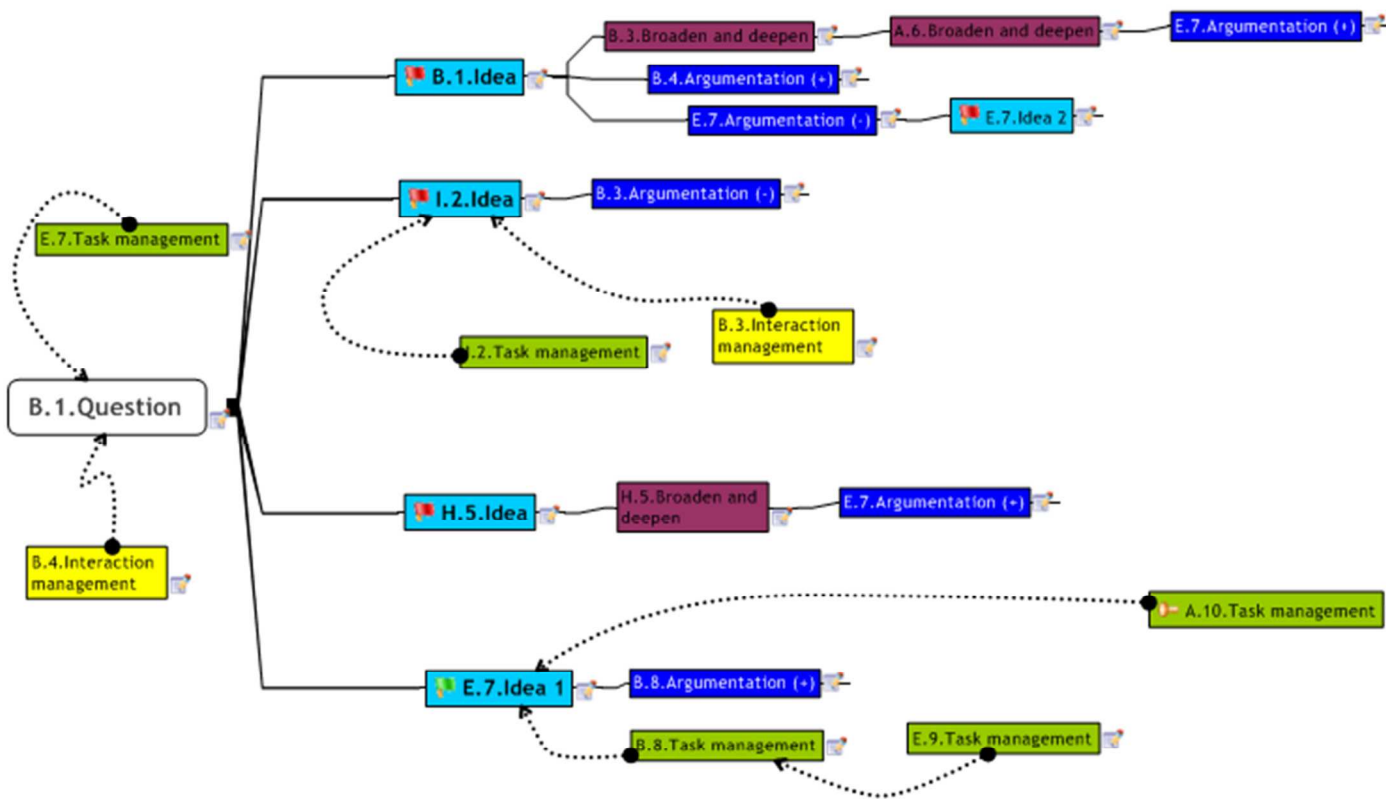


Figure 38: Topics with signs of argumentation and final solution

The graph runs from left to right. Each branch represents the development of an argumentation about an idea or question, so to read the graph you just have to start reading each branch. In addition, you can know at what point in the conversation each comment is being said checking the line number showed within each rectangle.

We have classified the topics into three different types:

- **Type 1:** topics with signs of argumentation and final solution.
- **Type 2:** topics with signs of argumentation and no final solution.
- **Type 3:** topics without signs of argumentation.

5.3.2 Conclusion

In the previous sections, we have proposed a coding scheme to identify what type of activity can be supported by a forum. Let's propose now theoretical grids that allow characterizing Virtual Communities of Practice. Indeed, for our study, the concept of virtual Community of Practice seems to be the best framework to structure the analysis of the designer distributed team. They share a same practice: The design of turbine.

CHAPTER 6 - Method for anticipating the capacity of a virtual Community of Practice to go online

6.1 Method to characterize VCoP

To know how to evaluate the potential of a Community of Practice to go online, we propose to present the work of Line Dubé (Dubé L., Bourhis A. et al. 2006). The method she proposed is the more completed method that we could find in the literature. In her study, she denounced the “one size fits all” advices for organizations interesting in forming developing and sustaining CoPs and VCoP. That is why, she has developed a grid that characterizes existing Virtual Communities of Practice and allows one to build a deep understanding of the communities, from the context of their creation down to various details such as membership profiles. Her typology includes structuring characteristics, stable elements that could be used to describe a VCoP if one wanted to take a picture at a given point in time on which many communities may vary and be compared. The grid is separated according to 4 main characteristics: Demographics, Organizational context, membership and technological environment.

Within each characteristic, criteria are related and can be evaluated to analyze the weaknesses and strength of the communities' configuration for further collaboration.

Each criterion is evaluated with a value scale that is more or less favourable to the collaboration success of the virtual Community of Practice studied. This scale is easy to understand but not really used in the work of Dubé. We explain quickly the main principals of this value scale. For instance, for the First Characteristic (Orientation), if the first criterion (community orientation) is strategic, this means that the collaboration between the community members will not lead to a direct gain for the community members. This configuration is thus not optimum for the online interaction among members. On the contrary, if the community orientation is operational, this means that it will serve the community member's objective. This is an excellent point of the configuration because we can forecast that community members will interact online with the objective to produce solution in order to fit their respective goals.

The following table shows the main characteristics and the related criteria.

Community Structuring Characteristics		Description
Demographic	Community Orientation	A VCoP can be <u>operational</u> , set up to support a project with a concrete operational or <u>strategic</u> goal or created to support an organizational orientation
	Life Span	A VCoP can be assembled on a <u>temporary</u> basis to serve a specific purpose (Specific project, mission), but can also be created on a <u>permanent</u> basis with no definitive time frame.
	Age	The age defines the experimental period of time where the VCoP have to improve and grow from <u>young</u> (less than a year) to <u>old</u> (more than 5 years) experimental as in try new things until you get it right.
	Level of maturity	A VCoP may go through different phases throughout their life. Five Stages are identified : (1) potential, (2) coalescing, (3) maturing, (4) stewardship, and (5) transformation
Organizational context	Creation Process	A CoP can be <u>intentional</u> , (i.e. deliberately established by the management who will define its purpose and select key members) or <u>spontaneously</u> emerge from the organization and created by a group of motivated members
	Boundary Crossing	Boundary crossing can be considered <u>low</u> if only members from similar work groups are involved, <u>medium</u> if different groups or units from the same organization are part of the community, and <u>high</u> if members of different organizations are involved
	Environment	The environment is related to the context (economical environment, management style and process, political context etc.) that is <u>facilitating, neutral, or obstructive</u> to the creation and development of the CoP.
	Organizational Slack	The organizational slack is the general ability of the organization to promote learning, exchange between people and accept phases inherent to the learning curve (time consuming). When organizational slack is <u>low</u> , VCoP may receive less support and resources than when it is <u>high</u>
	Degree of institutionalized Formalism	The degree of institutionalized formalism relates to the degree to which a CoP has been integrated into the formal structure of an organization. The CoP could be <u>unrecognized</u> (invisible to organization), <u>bootlegged</u> (visible only to a group), <u>legitimized</u> (officially sanctioned), <u>supported</u> (receiving direct resources) or <u>institutionalized</u> (official status and functions)
	Leadership	An organization can either create a <u>formal CoP governance structure</u> where individuals are appointed to specific roles or <u>leave roles and authority relationships to emerge</u> through interaction around expertise (Continuously negotiated)
Membership Characteristics	Size	Size refers to the number of members involved in a VCoP. This number may <u>be small and intimate</u> (i.e. only a few people) to <u>very large</u> (i.e. more than a thousand people)

	Geographic Dispersion	Geographic dispersion refers to the physical location of the participants. Members of a VCoP may <u>all be physically located in the same building</u> (low dispersion) or <u>scattered around the world</u> (high dispersion)
	Member selection Process	A VCoP with an <u>open membership</u> means that anyone in the organization who is interested can become a member. A VCoP may also choose to have a <u>closed membership</u> and only admit people who meet a predetermined list of criteria.
	Member enrolment	Members' enrolment can take many forms, from <u>voluntary to strongly encouraged, to compulsory</u> .
	Member prior community Experience	Prior community experience may vary from extensive (when the community is based on an existing network), to medium (when members of the community have worked in groups, although those groups may not be identical to the VCoP), to low and none
	Membership Stability	A VCoP may have permanent members (<u>stable membership</u>), ranging from <u>moderately stable to fluid</u> according to the turn over within the community, but can also have <u>temporary membership</u> .
	Member ICT literacy	It refers to the level of comfort members have using ICT, either <u>high or low</u>
	Cultural Diversity	Three levels of cultural influence must be considered: national, organizational, and professional. Given the three levels of cultural influence, cultural diversity is evaluated on a continuum, whereby " <u>homogeneous</u> " describes a community in which members come either from the same organization or from organizations with similar cultures, are located in culturally close countries, and have similar professional backgrounds. On the other hand, it can be <u>heterogeneous</u> when members who have various professional backgrounds, come from disparate organizations, and are located in dissimilar national cultures.
	Topics Relevance to members	VcoP are usually launched by organizations with a defined objective. This topic may be close to the daily work of its members (<u>high relevance</u>) or, on the opposite, it can be far from the members' day-to-day preoccupations (<u>low relevance</u>), while still being important to the organization.
Technological Environment	Degree of reliance on ICT	VcoP may be <u>familiar</u> with technology to <u>different degrees depending on their needs</u> .
	ITC Availability	The technology available may also shape the objectives of the VCoP and its adopted processes. <u>A low variety of technologies would mean a CoP that only has access to simple media. The variety would be qualified as medium</u> in the case of a CoP using both a document management capacity and a discussion forum; on the other hand, a CoP with access to a <u>wide variety</u> of ICT such as synchronous and asynchronous discussions and document management, would be an example of a VCoP with a wide variety of available ICT.

Table 20 : Community structuring Characteristics definitions and evaluation From Dubé Work

Globally, one of the limitations of Dubé's grid was that it was not clear enough and operational for an industrial partner. A lot of criteria's titles could be improved to be easily understood.

The criterion "level of maturity" was also really difficult to evaluate. Finally, the grid was too long and we wonder if a management team will take time to read the entire completed table. We have thus proposed a way to simplify the lecture of the table 20 and make it more pragmatic and visual to become a really usefull tool for management team.

We are going to present our modifications in the next section.

6.2 A mixed method proposed to evaluate the capacity of a virtual Community to go online

6.2.1 Dubé method's adaptation proposed

To use the Dubé grid, we have made few adaptations. We have tried to simplify the grid with the industrial partners and reformulated some of its criteria to fit with the vocabulary of the company:

We have replaced Demographics by Community Orientation and within this structuring characteristic, we have replaced:

- Orientation by Objectives
- Level of maturity by Mutual Commitment that was for us a criterion more explicit and possible to evaluate. We will expose just after the way to evaluate this criterion.

In Organizational Context,

We have put:

- “Member level of commensurability” (Ref to the definition in the table) instead of “boundary crossing”.
- “Context” instead of “Environment”
- “Level of sponsorship” instead of “Organization Slack”
- “Corporate recognition Degree” instead of “Degree of institutionalized formalism”.
- “Consensus on Leadership” instead of “leadership”.

In membership characteristics,

We have put:

- “ICT skills” instead of “Member ICT literacy” and have deleted all the “member” before the criteria name.

The table 21 shows the main characteristics and the related criteria adapted grid. This table is explained in details and a definition of each criterion has been presented to the industrial partners (ref. table 20).

Community Structuring Characteristics	Criteria			
I. Community Orientation	1. Objectives	2. Life Span	3. Age	4. Mutual Commitment
II. Organizational Context	5. Creation Process	6. Member level of commensurability	7. Context	8. Level of sponsorship
	9. Corporate recognition Degree	10. Consensus on Leadership		11. Size
III. Membership Characteristics	12. Geographic Dispersion	13. Selection Process	14. Enrolment	15. Prior Community Experience
	16. Stability	17. ICT skills	18. Cultural Diversity	19. Topic Relevance
IV. Technological Environment (ICT)	20. Degree of Reliance		21. Availability	

Table 21: Community configuration table: Structure Characteristics, related criteria

Mutual Commitment Characteristics	Evaluation criteria	Evaluation Grid		
		Low	Median (Average)	high
Common Enterprise	Voluntary Action	Several individuals would like to initiate a joint action	Several persons are involved in joint actions	There is a network / group which is already engaged in a joint action
Mutual Engagement	Mutual Support	Several individuals would like to receive help or support from others and provide help and support to others	Several persons are punctually (at least 1/month) helping or supporting each other	There is a network / group where people are already helping and supporting each other
	Mutual apprehension	Several individuals express a common understanding and vision of their activity	Several persons are aware that they share a common understanding and vision of their activity	There is a network / group which has already set up and developed a common vision of their activity
	Mutual Knowledge	Several individuals would like to inform people of what they know and determine who knows what in order to enable people to share with the right person	Several persons are informed and aware of their respective knowledge	There is a network / group that has already mapped their respective knowledge to enable the group to share a common vision of who knows what
	Management tool	Several individuals will be interested in developing common management tools	Several persons have designed and set up at least once a common management tool (example includes an excel file)	There is a network / group that has already set up or has an on going project to set up common management tool
Shared Repertoire	Routines	Several individuals are developing common routines	Several persons have adopted at least once a common routine	There is a network / group of persons who have already adopted common routines
	History	Several individuals find interest in sharing their experience	Several persons discuss punctually (at least 1/month) their activity and experience	There is a network / group that discusses and shares its activity and experiences
	Common Knowledge Need	Several individuals express a common knowledge need	Several persons have tried together at least once to find some common knowledge	There is a network /group that tries on a regular basis (more than 2/month) to find some common knowledge

Table 22: Cappe's translated Evaluation grid

To facilitate the evaluation of each criterion, we have set up questionnaires (refer appendix 4.9)

6.2.2 How did we measure the mutual commitment (criterion 4)?

Emmanuelle Cappe proposes a tool with several grids that allow management to detect seeds of Communities of Practice and evaluate their respective maturity level. We focus our attention on the grid she proposed to evaluate the mutual commitment of a community. The Mutual Commitment is one of the most important components of a community because it forecast the level of involvement of members. She proposes 10 criteria based on Wenger’s definitions and key dimensions(Cappe E. 2008).

The level of maturity of the community commitment ranges from low to high. If it is low, the management will have to set up a strong action plan to address each criterion to pass from a low level of mutual commitment to a medium near to a high level of mutual commitment.

Mutual Commitment characteristics	Evaluation criteria	Evaluation Grid (Presented in Appendix)		
		Low	Medium	High
Common Enterprise	1. Voluntary Action			
	Mutual Engagement			
Mutual Engagement	2. Mutual Support			
	3. Mutual apprehension			
	4. Mutual Knowledge			
Shared Repertoire	5. Management tool			
	6. Routines			
	7. History			
	8. Common knowledge Need			

Table 23: Extract of Cappe’s Translated and Adapted Evaluation grid

Completing Dubé’s adapted Configuration table and evaluating each criterion will enable us to have a deep analysis of the community and to highlight criteria missing that play a key role in the online activity.

6.3 Improvement proposal: A Visual Management tool

6.3.1 Visualize the Community Network

Because the lecture of the table was not easy, we have first proposed to visualize the shape of networks of the community under study. To do that, we use the “Ucinet” and “Netdraw” software. Both are software of “Social network analysis” which we received training in at a seminar on social networking. However, in this thesis, we do not want to refer to “social networks” because it refers to a specific theory and research wave that we do not want to put in the heart of our own research. Moreover, we will not use vocabulary inherent to the social networking science.

The software has been specifically deployed to reach non-specialists in the analysis of social networks. Ucinet and Netdraw were both developed by Borgatti

Everett and Freeman and are very easy to use (Borgatti S. P., Everett M. G. et al. 1992). They can quickly produce effective and clear analyzes.

To use Ucinet or Netdraw, it is necessary to have a matrix. In our case, we created a questionnaire in an excel spreadsheet (Ref Working tie Questionnaire, Appendix 4.7). The responses to our questionnaire were binary, that is to say, if there is a link between two nodes, the response is (1) or if the link is absent the response is (0). Then, once the questionnaire is filled in, we copy and paste it into Ucinet

The visualization of the network enables us to immediately, even before starting the qualitative study of the communities studied, to have an overview of the network and data such as the density of the graph, the number of ties existing or not between actors, the geodesic distance between two actors, ie the number of people to cross between two actors ... This also allowed us to identify the actors who had the highest number of ties between actors which served as the basis for recognizing certain key players in the sense that they could play a key role in the animation of the community.

6.3.2 Visualize the Community Configuration at a glance

We have secondly proposed to facilitate the lecture of the configuration table. To do that, we have proposed to examine the idea of the value scale initially proposed by Dubé. Dubé’s initial idea was to give a scale value to the criterion corresponding to the VCOP’s chances of success. Success means that the VcoP collaborates and interacts online. However, we have considered that this value scale should be more explicit in order to become a real management tool. To go further, we have thus proposed to assign a numerical value scale representing the type of interaction forecast online according to the criterion analysis. Our objective was to allow the management to see at a glance the gap between the VcoP

observed and the ideal one that will lead to online knowledge sharing. We have thus proposed to give a weight for each criterion. We have then proposed to generate a graph that is a result of the evaluation done of the whole criteria in each characteristic with the perspective to go online.

How have we created the value scale?

As mentioned in the literature review of this document, knowledge sharing includes three main activities: communication, coordination and production. We have mentioned that we are able to identify a knowledge sharing dynamic within a community, when during their virtual or real interaction, we find a coordinated effort on problem/question sharing, idea (solution proposal) sharing, and finally argument (for or against) sharing leading to the co-production of a solution.

We thus intend to forecast four levels of interaction. These interactions could be stored in different collaborative activities: communication, coordination and production.

- Information as message sending that does not lead to an answer from another person.
- Communication as the message sending and message receiving process. Communication appears when the receiver sends back a message that could be an idea, a question etc. in response to the first message received.
- Coordination means argument (for or against) sharing leading to the co-production of a solution.
- Production means creation of a new understanding of a situation with a solution being proposed.

The “interaction dynamics” have a value from (1-4).

Scale	Interaction Dynamics
1	Information
2	Communication
3	Coordination
4	Production

Table 24: Scale corresponding to the interaction dynamic forecasted online.

The information transfer is the easiest interaction dynamic that can occur within a Vcop. The production dynamic is the most difficult to obtain.

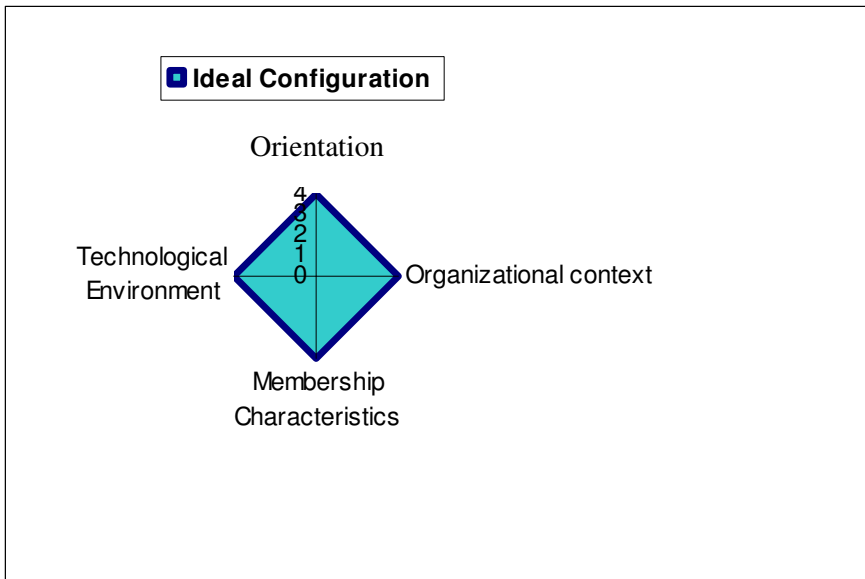


Figure 39: Ideal Configuration

Example of Evaluation:

For the first characteristic (orientation), if the first criterion (community objective) is strategic, this means that the collaboration between the community members will not lead to a direct gain for the community members, the evaluation result will be 1 meaning that we forecast that the interaction dynamic will be limited to information posted by members with no communication forecast.

On the contrary, if the community objective is operational, this means that it will serve the community member's objective, the evaluation will be 3 to 4 because we can forecast an interaction dynamic that extends to coordination (Argument sharing on ideas) and to the co-production of a solution.

You will measure as well the Life span and Age of the community and all the criteria.

To finish, we know that considering setting up a platform to facilitate the community's interactions and knowledge sharing, seven criteria are among the most important. [1-4]

These following criteria will play a key role in the online interaction dynamic.

Objectives

Context

Corporate recognition Degree

Consensus on Leadership

Topic Relevance to members

ITC level of comfort

Because the community objective is one of the 6 crucial criteria, we will multiply its results by two in the final operation. Then, the first characteristic consists of adding all the figures obtained for each criterion and dividing the result by the number of criteria including one more because of the multiplication of the crucial criterion.

Example:

Community Structure Characteristics			
I. Objectives	4	1	1

$$(4*2+1+1)/4= 2,5$$

We will apply the same technique for each of the characteristics and we will be able to easily generate a visual representation of the community's configuration thanks to excel radar. You will see how far the current community configuration is, compared to an ideal one that has reached level 4 for each characteristic.

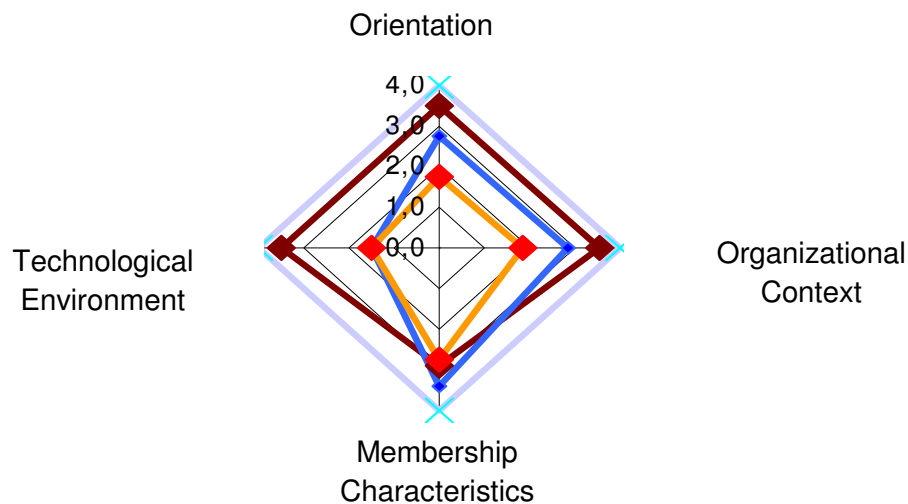


Figure 40: Radar Example to visualize a community Configuration

Note that, the radar shown below in the example demonstrates that a serious amount of work has to be carried out before considering setting up a collaborative platform.

This value scale affixed to the community configuration table enables the management team, after having assessed and evaluated each criterion, to generate a radar and see at a glance the chance of the community to succeed or the amount of work that has to be done to the community a chance to succeed.

This is a global approach that allows only seeing a tendency of the success of the community in terms of capacity to go online. However, the industry has then to come back to the criteria to understand and define what types of actions have to be set up.

Conclusion

Our research aimed at determining a way to improve knowledge sharing among global Product Development virtual Community of Practice.

To do this, we have first investigated model to map the online interactions of virtual communities of practice. We have then proposed an an enriched Rainbow model. The enriched Rainbow model has the objectives to highlight whether or not an interaction can support a process of co-construction of knowledge within an engineering community involving in a Product Development activity. If we can identify questions, ideas, and arguments in an online discussion, then we can deduce that in the minds of participating engineers a changing framework of the initial thought and a convergence towards a shared understanding, and so a co-construction of a new understanding of the object occur.

Through our literature search, we have also read that there is a link between the communities' configuration and the nature of their online interactions. Some research even pointed out the key success factors of virtual communities.

We have paid particular attention to the work of Line Dubé. Line Dubé has developed a configuration analysis grid of virtual communities to fully understand the behavior of a virtual community of practice. This analysis can project the functioning of a community studied and can estimated its chances of success in light of online collaboration. However, her analysis grid is complicated and some criteria are really complex to evaluate. That is why we have proposed to simplify her grid and affix a radar. The radar shows at a glance the configuration of the community studied in relation to an ideal configuration for online collaboration.

Our goal was to allow the management team to see at a glance the configuration of the virtual community studied and the remaining work to do to set up online collaboration and knowledge sharing.

In the following of this thesis, we present the proposed experimentations to test:

- Our coding model,

- Our VcoP characterization model
- Our VcoP visualization tool.

Introduction

Action Research has been conducted in real time. That is why, the reality of the experimentation management is slightly different from the way we have chosen to present it. Indeed, historically speaking, we took the opportunity to create and instrument a community before having demonstrated anything about the potential of a forum to support knowledge sharing and collaboration.

Let's explain the context. In Europe, design offices are specialized either in small Hydro or Large Hydro. Small Hydro machines are assigned to short design cycles and require skills such as: pragmatism, agility, and use of standardization. The small-hydro market is managed by the Barcelona design office.

Large Hydro machines are created with a make to order mode and customization rationality. This market is managed by the Grenoble design office. In this configuration, Barcelona and Grenoble do not encounter similar problems. However, Barcelona was involved in designing machines in medium-sized and correcting technical problems that occurred.

To correct the problems and ensure the performance of the on-going projects of Barcelona design office, Spanish designers had to be trained on the process using large hydro machines.

Hydro management had assigned an expert from Grenoble in order to give assistance during the Design reviews of the Barcelona unit. Some technical project managers from Grenoble were also offered to support the Spanish teams.

In this context, we took the opportunity to propose to test a forum as a tool to leverage the interaction efficiency within a community gathering French and Spanish designers. Our assumption was that a collaborative platform could improve collaboration and allow knowledge sharing in a design community. However, at this stage of our thesis, we have no evidence of the relevancy of a forum to instrument these exchanges in an engineering community.

We thus asked the Hydro management to identify a pilot group composed of engineers from Grenoble and Barcelona that were sharing the same practice. We wanted to have a working group sharing the same design perimeter (turbine designers). Our objective was to demonstrate that the French engineers could increase their interaction across the current

boundaries, giving them the opportunity to share with other European sites through a forum. This experimentation was called “ColLeague” corresponding to the name of this community. In appendix 4.6.2, we report our work related to the ColLeague forum deployment.

The objective of this ColLeague community was to improve the feedback on experience and knowledge sharing among engineers in Europe.

Before starting, we have established the mutual understanding project (presented above) without having in mind the configuration community table that we discovered later on in the project.

In parallel to the management of the Mutual Understanding project and the deployment of the forum, we have codified the existing two forums identified during the diagnosis.

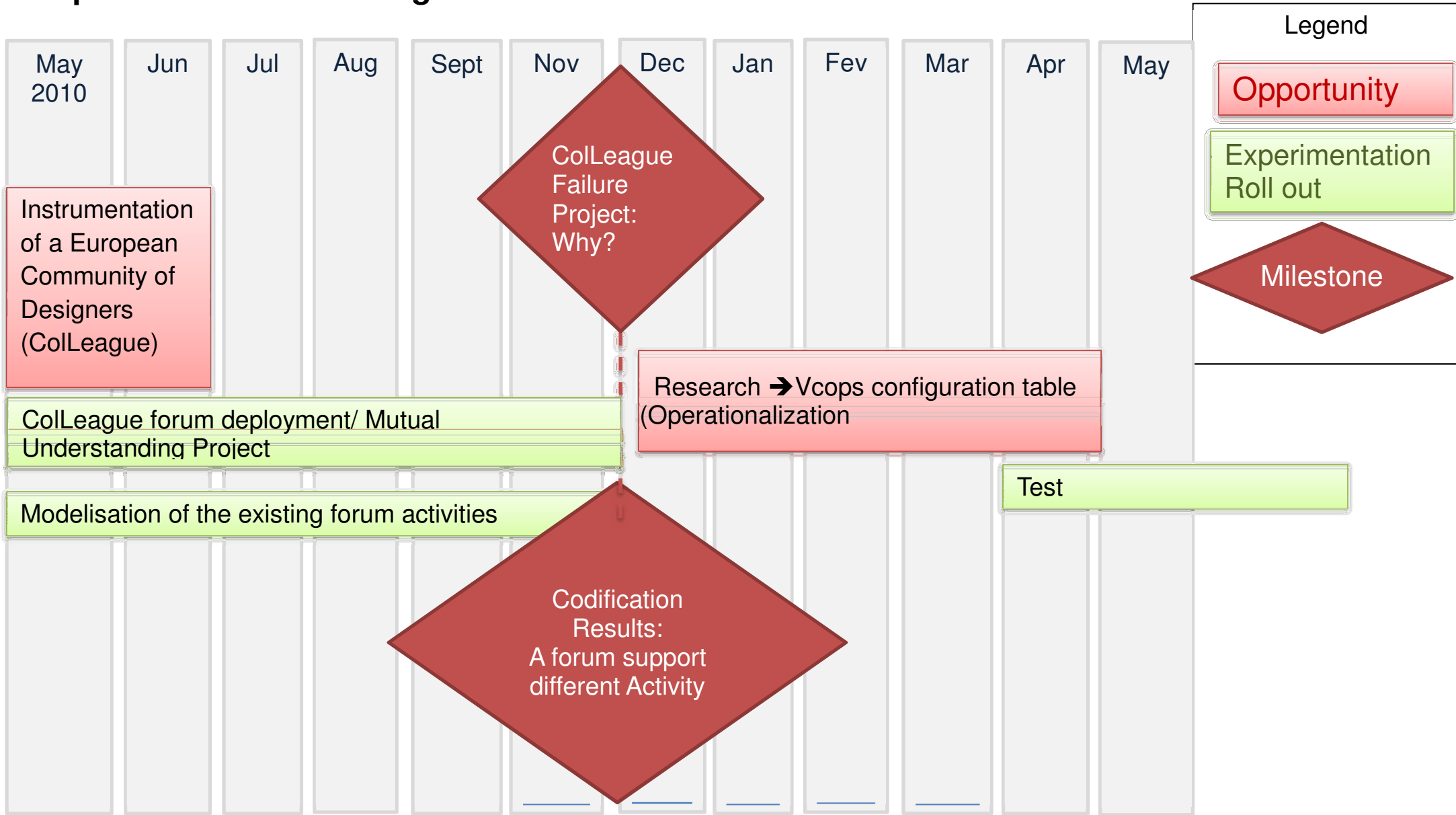
These two forums were based on the same wiki technology. They had a similar objective which was to improve the way engineers share technical information and knowledge.

One of the forums is referred to here as the CAD forum focusing on CAD tool experience sharing. This community is involving key users of CAD systems, who are in charge of sharing experiences, questions and continuous improvement of CAD tool configurations and methods.

The second forum supports specialists of mechanical engineering and simulation analysis in the R&D teams – we refer to this community as CAE. This community is located throughout different services but in the same plant which gives a special configuration to the community.

We obtained the results of the ColLeague experimentation and the forum codification nearly in the same time. On one hand, we had evidence that a forum could support collaboration and knowledge sharing activities, and on the other hand, we had the failure of the ColLeague project. The three communities were using the same technology with completely different results. We wondered thus, what were the criteria inside the community that justified the engagement of members. We wanted to clearly demonstrate the roots of failure for the design community. We started to search the table to gain an in-depth understanding of community behavior and found the one of Dubé that we have applied and tested on all the communities studied. It allowed us to explain the reasons for the failure of the ColLeague forum. We are going to present in this part the results.

Experimentation Planning



Action Research Cycles

Cycle 4 and 5 have been managed in parallel.

Cycle 4	
Diagnosis	Based on cycle 3 and the failure of ColLeague community
Planning Action	<ul style="list-style-type: none"> • Test the VcoP characterization grid on ColLeague to explain its failure
Taking Action	<ul style="list-style-type: none"> • VcoP characterization grid Method applied on the ColLeague Community • Presentation of the analysis to the participant and to the steering community • Corrective action plan proposal
Evaluation	<ul style="list-style-type: none"> • Corrective action plan validation by the management and ColLeague participants

Cycle 5	
Diagnosis	Based on Cycle 3
Planning Action	<ul style="list-style-type: none"> • Model of forum activity of existing VcoP (CAD, CAE)
Taking Action	<ul style="list-style-type: none"> • Modeling of the CAD platform + collective characterization • Modeling of the CAE platform + collective characterization <p><i>Findings:</i> Demonstration that a collaborative platform can support different types of interactions from information transfer to the co-construction of knowledge.</p> <ul style="list-style-type: none"> • VcoP characterization grid Method applied on the Expert Community
Evaluation	<ul style="list-style-type: none"> • Validation of the Steering Committees of the different results and Publication in the “global management System of Hydro” of a method to characterize a collective to help management to decide whether a forum is the best leverage to improve the level of collaboration and in fine knowledge sharing within a community. • Publication of article for Iced 13

Table 25: Part 3 as the two last cycles of our action research

CHAPTER 7 – Experimentations

7.1 Pragmatic application of the assessment tool on existing communities

7.1.1 Pragmatic application of the assessment tool on the CAD Community

Method used to collect data for characterizing the Community of practice

For this community, called the “CAD community”, we spent 3 months in the office of the CAD champion which gave the opportunity to perform an ethnographic observation with extensive discussions about the mission and the status of the community. We ended up with a questionnaire (Refer to Appendix 4.7, 4.8, 4.9) and 4 hours of formal interview. The interview was recorded, transcribed and reported to the interviewee for clarification and comments.

We have also use UCINET program to map the connections between community members.

CAD Presentation

The CAD Community is a small group, composed of 14 CAD Key Users (low boundary crossing) spread all over the world leading to a high level of cultural diversity. This community has been intentionally pushed in 2008 by the global engineering management in order to globally disseminate a common methodology to ensure that the different design offices were using the CAD Software models in the same way and provide daily support to CAD Software users and improve the CAD Software interface.

This community has a clear Operational Orientation and a temporary life span.

Community objectives

Objectives	Description of the objective
Deploy a common methodology	The community had come to ensure that the design office uses in the same way the model of CAD.
To be CAD users support on a daily basis and improve the interface CAD.	Answer questions from users. Facilitate the use of CAD taking into account the difficulties and improving the user interface

Table 26: Objectives of the Community

All members are engineers or high level technicians and are generally attracted to software tools (high level of comfort in the use of ITC).

They all have nearly the same level of understanding (except for the CAD champion), and experience with the CAD Software. The environment appears to be facilitating because the management is willing to provide all the necessary resources to lead the community to the road of success. All members have a full English proficiency and the community is institutionalized i.e., recognized formally within the organization.

All members of this community had met each other in 2008 during a 3 day workshop in Grenoble and they volunteered to be part of this global community. The main outcomes of this first meeting were:

First, the election of the community “delegate” called today the “CAD Software Champion” (in the following analysis, this person is named user B). User B is the more experienced person of the group, he received through this democratic election recognition and legitimacy as group delegate with 100% of the popular vote. The leadership this community was thus negotiated.

Secondly, a chart regarding how to collectively proceed in order to fulfill their objectives (Priority, communications rules and principals...). They have reached a Maturity level where members have developed trust and strong sense of engagement.

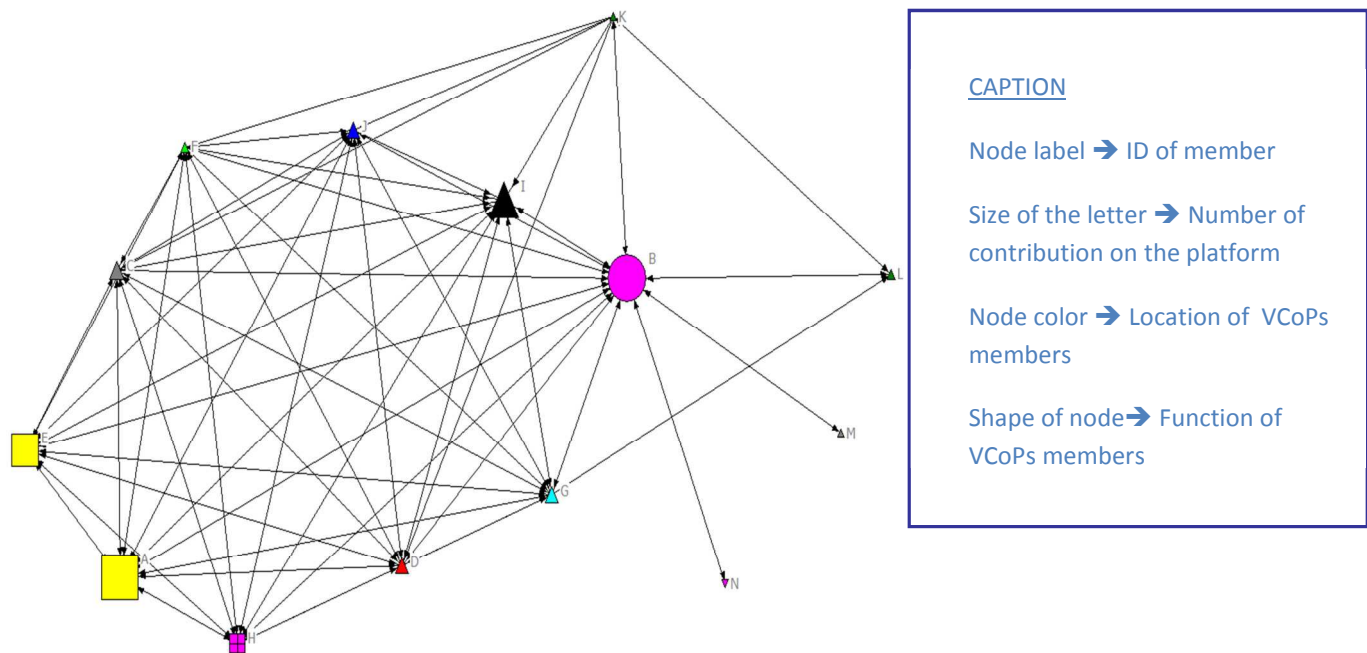


Figure 41: Representation of the CAD community

The network representation of the community presented in figure 41 highlights some characteristics of the community. The Ties are representing an existing working relation (A statement meaning to be in regular contact and more than 2 times/month about CAD problems faced). Additionally, each year, the community has a weeklong workshop in order to intensify their exchange and tighten their relationship. The CAD topics have a high degree

of relevance for the community members. The appropriate roll out of the CAD software in their respective units is part of their respective yearly target evaluated by the hierarchy.

The figure 41 highlights the fact that this community is globalised, each color representing a location (10 different locations for 14 members), with the maximum number of members per location being three. The community members have homogeneous roles (represented by the shape of the nodes) as they are key users of the CAD tool. Only three different roles are present: key users (Up triangle), Champions (Circle) and Information Communication Technology tool (ICT) support (square). Finally the size of the node indicates the number of contributions within the forum. The central role of user B is clearly visible as a major contributor in the community; he is the coordinator of the community. We also see that user A has a central role as the ICT expert of this tool. The low level contribution of users M and N is consistent with their low level of connection to the network They are only linked with the Champion.

The degree of engagement of this community is high according to Cappe’s criteria :

Mutual Support/Help	High: It exists a formal group of persons who are already supporting each other
Mutual apprehension	High: It exists a formal group of persons which is already set up and that develops a common vision of the activity
Mutual knowledge	Average: Several persons are informed and aware of their respective knowledge

Table 27: Degree of engagement of the CAD community

Forum objectives

Prior to 2007, to solve a problem, each user could contact the CAD provider. This generates several problems:

The weight of a user was too low and PTC does not necessarily seek to offer a solution to the need expressed by the user.

The need expressed by the user was not necessarily clear.

The circumstances that led to the CAD Software Forum creation were due to external converging factors an opportunistic behavior of the CAD group. In that sense we can speak of emergence. These circumstances led the CAD users to obtain a proposal from the IT

support. Initially, in Poland an ITC engineering support team was established to support the deployment of a PDM link. But the vendor’s project had a two year lead-time at that time and resulting in the ICT computer experts being underload. The management therefore suggested that the ITC team during their wait for the launch of the PDM Link be allocated to support the CAD community. At their second annual meeting in October 2009, the Polish ITC team was presented to the entire CAD group. During this meeting one of the computer experts suggested the deployment of a collaborative tool more suitable than e-mails for intense knowledge based exchanges. The idea of the CAD forum was born.

Users’ perception

The forum was conceived as a “private garden” space. No desire to extend the exchange to "followers". No observer of what is happening. According to B, this intimacy ensures that everyone has confidence and dares to ask questions.

The forum is organized by topics according to the supports PTC textbook terminology. The subjects and structure have been proposed by one of the ITC support computer expert from Poland and approved by the entire community. The most important subjects are those related to methodology and support.

Subjects	Description
Change Management	Operate and discuss possible improvements to the tool by responding to the daily problems of users
Methodology Management	Talk about how to use methodology on CAD
Enhancement process	These are software problems of writing where it may be necessary to modify the source code, opening an enhancement with PTC is required
Incident Management	Everyday problem that can generate a discussion shift to "enhancement process"

Table 28: CAD Forum structuration and content description

There is not opacity between subjects. However, according to CAD Champion, the topics covered by "Change Management" were the one that brought more to the community.

CAD Software Key user, 2010

"...This wiki proposal by A was considered as the end of our long list of e mails and CC's to the manager. For us, it was just for a tool more convenient than the lotus note mailbox. You know, previously for involving all our colleagues in a discussion, we had to send e-mails to the champion (A) and CC the whole community. Usually, if one of the groups had already faced the problem, he replied to all of us and a discussion through e-mail started. This way to communicate led to manage a huge amount of e-mails and attachment history. Really, when A proposed to set up a forum only dedicated to our community, we have been immediately enthusiastic just thinking we could stop to manage our mail box..."

CAD Software Champion, 2010

According to the Champion (A), it was a good answer to their communication needs: *"When the IT explained to us what was the principals of a forum and how easy it was to post a comment and/or an answer, I was really impressed. My children often use forums to find good mountain tricks and exchange opinions about what they have done etc. but I have never really paid attention to this new technology. However, as soon as I have started to navigate on the allocated space I realize that it was not a change but just a useful evolution of our old mail box (Laugh)"*

The first perception was very positive because this new technology was really adapted to the users needs and was seen as a means to reduce the workload and the complexity of the exchanges. The adoption/adaptation was therefore very easy.

The degree of reliance on ITC is high. Today 90% of the exchange is through the forum and as Key user of CAD tool, members are very used to ICT.

7.1.2 Construction of a graphic representation of an online discussion

Method used to collect data for Characterizing online Interactions

We proceeded to the characterization of the online interactions of the two communities. A systematic platform monitoring based on available indicators of collaborative activity (Gendron E., Pourroy F. et al. 2011), allows for accessing some quantitative data from which collaboration indicators can be derived. Number of posts, number of answers, and number of pages viewed. This quantitative approach has provided a global vision of the platform

activity. From there, we were able to identify and characterize the contribution and the role of the different participants in the groups.

The second step of the characterization of online interactions was to select some excerpts of the discussed topics on the platform and to perform a systematic coding of the interactions. The rationale behind the choices of the Coded sections was based on the intensity of the posts, on the topics and also based on advises of the community moderator. The subjects « Hydro Change management » and « Methodology Management » were the spaces the most used. We decided to model the subjects « Hydro Change management » because in it there were lots of interactions and according to CAD Champions it was the most important subject for the community. In the subjects « Hydro Change management » there another subdivision of topics:

Approved Solution: topics that have been discussed and a solution have been found.
 Proposition to discuss: topics that don't have a clear solution. These topics haven't been validated by CAD Champion.
 Each message has been manually double coded by two distinct coders following our coding scheme. The coding was refined until we reached 80% similarity.

	CAD	CAE
Automatic Data collection	x	x
Interviews > 2 hours	x	x
Coding	x	x

Table 29: Data collection summary for online interaction coding

We have chosen three different conversations (one of each: type 1, type 2, and type 3) to put into practice the model. We tried to choose the most representatives topics to give clear examples easy to understand.

7.2.3.1 Type 1: topics with signs of argumentation and final solution.

The topic chosen to apply the model for conversation of type 1 have been the one entitled “Macro for Autocad Transfer”.

After doing the first step, it was clear that there were signs of argumentation, so it was possible that there was collaboration in it. Besides it was classify as an approved Solution in « Hydro Change management » section. Then, the topic was a type 1 conversation. Most of

the comments along the conversation were ideas, arguments for or against them and broaden and deepen of ideas and arguments.

Then it was necessary to construct and analyze the graphic representation in order to show that there was an argumentative situation thus collaboration.

Here below the graphic representation of the topic selected is shown:

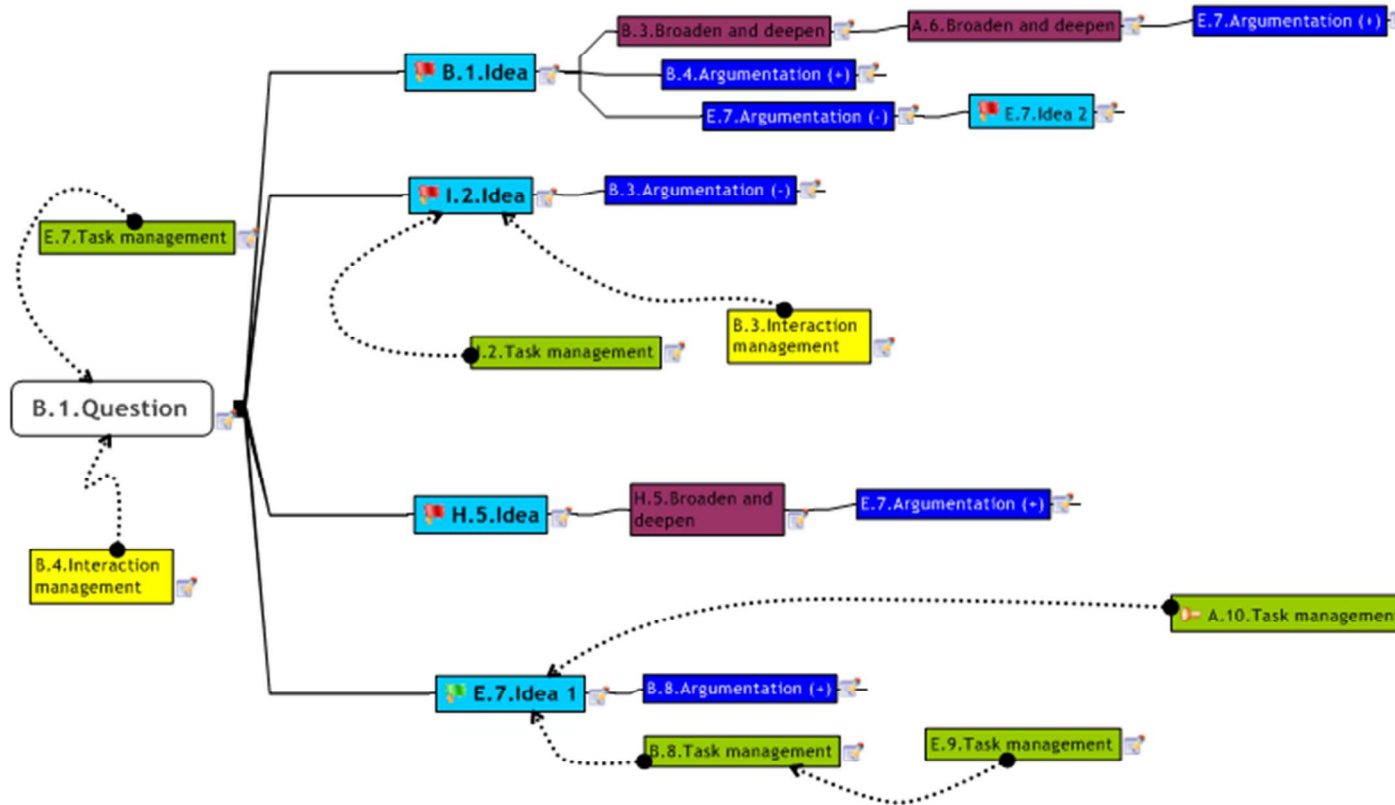


Figure 42: Topics with signs of argumentation and final solution

In the figure 42, we can see that the conversation begins with a question from user "B". This question raises several ideas. The first one (first branch) it is proposed by the user who has posed the question. A "Broaden and Deepen" comment deepens in the idea and an explanation is given. On the contrary, there is a negative argument from the user "E" on the idea proposed by "B". After the negative argumentation "E" gives a new idea. We see that in this branch there is an argumentative process. In the end, this initial idea has been discarded as a solution.

In the second branch the user "I" proposes another idea. The user "B" gives negative arguments for this idea and the idea was eventually discarded.

User "H" proposes an idea in the third branch and makes a "Broaden and Deepen" comment, explaining more in depth the idea. Although the user "E" argues in favor of this idea, it is not considered as a solution to the question.

In the fourth branch user "E" gives the last idea and "B" agrees with it. We must clarify that the user "B" is the CAD Champion and that he makes the final decision. Around the idea of user "E", a series of task management are made to report the status of development of the idea.

As we can see, in this conversation there have been different users who have given different ideas to solve a question. The users have given their opinions and arguments to support or attack one idea or the other. Thus, we can observe an argumentative process between users which means that a collaborative situation has happened.

Because there has been a collaborative process that involved several users who have given different ideas, the moderator of the forum has been able to choose the most appropriate idea to solve the question.

In this conversation we cannot observe all users explicitly agree with the solution taken. However, the fact that there has been no negative argumentation may indicate that all of them, to a lesser or greater extent, agree.

I consider that there is collaboration in this specific topic.

7.2.3.2 Type 2: topics with signs of argumentation and no final solution.

After doing the step 1) it was clear that there were signs of argumentation, so it was possible that there was collaboration in it. Besides it was classified as Proposition to discuss in « Hydro Change management » section. Then, the topic was a type 2 conversation.

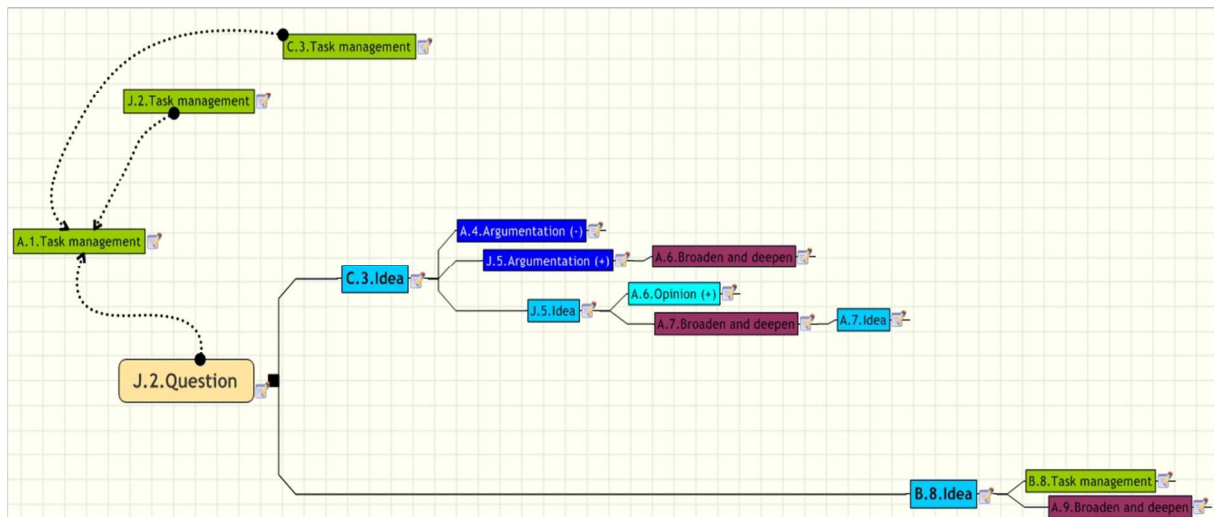


Figure 43: Topics with signs of argumentation and no final solution

In this conversation the user « A » gives an actualisation of a situation in the comment “A.1 Task management”. There is a feedback of the situation from the users “J” and “C” with the comments “J.2.Task management” and “C.3.Task management”. Besides, “J” proposes a question regarding the information given by “A”.

This question is answered by “C” who gives an idea. “A” gives a negative argument to this idea but “J” gives a positive argument and also proposes an idea in “J.5.Idea” to develop the idea proposed by “C”. Finally “A” agrees with “J” and also he tries to deepen in “J.5.Idea”.

After that “B” proposes another idea in “B.8.idea” and “A” deepens in this idea.

As we can see, there are two ideas for the same question, but in this conversation there is not a decision making even when an argumentative process, thus collaboration, has taken place.

In this conversation there is an argumentative process and thus collaboration even if there is not a clear decision on the topic visible in the forum. Interview allowed knowing that the decision has been taken by phone outside this forum.

7.2.3.3 Type 3: topics without signs of argumentation.

The topic chosen to apply the model for conversation of type 3 has been the one entitled “How to know Intralink data”.

After doing the step 1) it was clear that there weren't signs of argumentation, so it was possible that there wasn't collaboration in it. Then, the topic was a type 3 conversation.

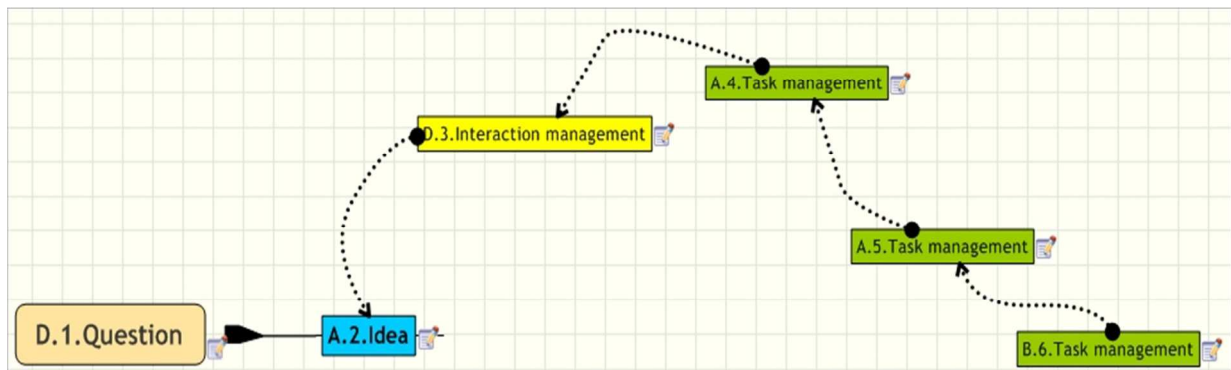


Figure 44: Topics without signs of argumentation

In this conversation, user « D » asks a question and user « A » gives an idea to solve the question. After that there is a comment made by “D” to ask for a conference call with “A” and a series of “Task management” to give a feedback of the development of the situation.

In this conversation there is no argumentation or other different ideas to solve the question, thus there is not collaboration.

This may happen because the question demands a methodology to do things rather than demanding for ideas to solve a problem. There is no space for argumentation because the solution is unique and it can only be made in one way. We could say that it is like an exchange of information or a feedback of experience.

Besides, there are only two users who exchange comments, so the collaboration within the community doesn't exist for this topic.

7.1.3 Pragmatic Application of the assessment tool on the CAE Community

Method used to collect data for characterizing the Community of practice

For the second community, the “CAE community”, we focused on the structuring characteristics proposed by Dubé et al (Dubé L., Bourhis A. et al. 2006), presented above, and investigated each criterion through questionnaires and interviews. For that purpose we carried out semi structured interviews. We asked each member to fill in a questionnaire which was slightly different from the one done for the CAD community because of the maturity differences.

We have also use UCINET program to visualize the connections between community members.

CAE Presentation

The CAE is a small group represented by 15 persons. Each member is a mechanical engineer of the Central research team of Grenoble and a CAE Software user (low boundary crossing-low level of cultural diversity). This community has been intentionally pushed by the mechanical research department Director with an operational orientation to encourage members to share ideas about CAE software problems. However, despite their co-localization, the management proposed a forum to share on the software. The forum composed of two sections: one for the Mechanical engineering community and one for the Hydraulic engineering community. Both of them use the same CAE Software. All members are allowed to visualize the exchanges in each section. According to our field observations, this forum was one of the only places where mechanical hydraulic researchers could exchange ideas. In that sense we can consider that this community has a strategic orientation. The management tries to foster dialogue between the mechanical and hydraulic research departments. But the forum is organized in two separate spaces, and very few cross exchanges are observed.

This confusion regarding the aims of the forum created some misunderstandings even if at the end the participants perceived the strategic objective. As reported and shared by 3 other members.

Extract of interview, 2011

“... To be honest, when I have a CAE software problem, I go directly to see C or D. I do not know if they know that we have a forum dedicated to that type of question by the way... But, the hydraulic sections of the forum are really useful for me. As a mechanical engineer, I have tried for a long time to understand why sometimes, our hydraulic colleagues were so aggressive when I refused a hydraulic shape proposal. However, I start to understand now the implication of our work in their work and how complex it is to ensure hydraulic calculations. This is such a small factor within an equation that could make a performance fall dawn.”

This interview reveals also that there is a lack of clear leadership within the community. There is no leader to federate this group. People have been designated and some of them are not aware that they are part of this group exchange in an online forum.

Online Discussion quoted

Regarding the communication dynamic, most of them are regularly in contact. Some of them often meet informally during coffee breaks or at lunch time. Some of them discuss punctually (at least 1/month) their activity and experience through e-mail or face to face. The structure of the network representation figure 41 displays these links. They solicit each other when they need to and in that sense they constitute a community because they are willing to help each other, know the type of expertise of one another and can find the right person for a given problem. Figure 45 uses similar representation codes as figure 41. The same color of nodes shows that the community has a single location. The shape of the nodes highlights that only users are part of the community.

The size of the nodes is representing the number of connections of each node, and the size of the label (letter) relates to the number of posts and comments on the platform. Users A and F are the most active participants.

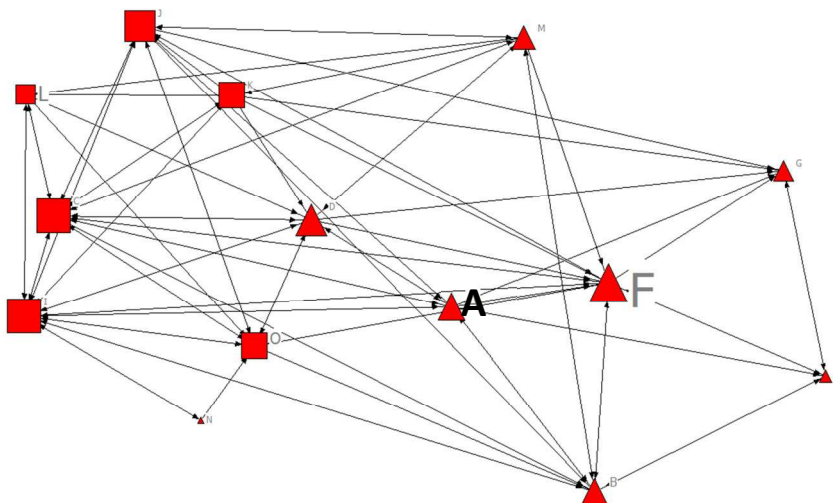


Figure 45: Network model of the CAE community

We observed that despite a good connectivity the forum was not the main support of communication and a lot of members were not contributing. This is shown in the degree of engagement of this community which is defined as average according to Cappe's criteria. Community perimeter could be improved.

Mutual apprehension	Low: Several persons express in isolated incidents a common understanding and vision of their activity
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Mutual knowledge	Average: Several persons are informed and rewarded for their respective knowledge
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Table 30: Degree of the CAE community engagement

7.2 Findings and proposal analysis

7.2.1 The CAD community: a mature CoP with deep collaboration and knowledge sharing

The forum is structured on general Topics. Subjects are created by members inside topics as questions or Problems to discuss. Posts are contributions of each member within a subject. A first observation based on automatic monitoring of the forum highlights the intensity of communication through the forum. 447 posts structured on 54 subjects. 87% of the posts are in the 3 main topics that covered 62% of the subjects. The average reply rate for each open subject is 6.3, but reaches 11.9 and 11 respectively in the two main topics. In the CAD Forum we have coded all the interactions related to the topic called: "Change management". This topic represents 72% of the posts. Additionally this topic was also presented as the most representative by the CAD champion.

In this topic, there were 27 discussions on which 10 had been closed by an approval from the CAD Champion.

Figure 42 illustrates the type diagram we obtain after coding the exchanges. We have displayed a model of each topic evolution considering the sequence of the interactions among the group. A graphical model of a topic is proposed including the contributor (denoted by a letter) and the place of the post into the sequential chain of contributions. Each rectangle represents a class of interaction (idea, argument, opinion...). The color of each rectangle matches the color of the extended Rainbow categories (figure 37). Within each rectangle there is:

A letter: which denotes the user that posted the contribution.

A number: which represents the order of the comment within the sequence of the conversation.

A class of interaction: which represents the type of comment

Each rectangle is connected to other rectangles by links that represent the relationship(s) between them. The continuous lines connect ideas, arguments, broad and deep, opinions and questions. While the dotted lines connect Task Management Interactions

This representation highlights a strong level of collaboration where users cooperate to construct solutions or to raise problems. A question is systematically followed by ideas and arguments denoting an important activity of the forum. This argumentation through online interactions refers to collaboration dynamics of the community Prudhomme G. et al., 2009. This scheme of interaction relies on problem solving and often leads to proposition of implementation by the CAD Champion.

Only 26% of the interactions do not develop argumentative situations. Most of these conversations are subjects where users transfer or exchange information such as feedback on past experiences that do not call for argumentation.

If we pay attention to users, two of them (A and B) are the most active in the discussions within the forum. User A is one of the two IT experts that help the community to solve their technical problems. He gives lots of ideas, arguments and explanations (broadens and deepens category). He is a really important user. User B is the CAD Champion. He encourages people to argue/debate and sets the rubric for these debates. He has a hand in the decision of closing or opening a topic and he posts task management comments too. The full community members except 2 new participants were active on the forum. On each sub-topic, at least 35% of the community was reacting, and if we don't consider the 3 that are not interacting within the forum, this average goes up to 54%. Regarding the timeline, our observations differ from Barcellini et al., 2008 who observed quasi-synchrone exchanges. In our case, the average time of a discussion is 41 days. Our observations and interviews show that emergencies or critical issues are treated with other means than the forum.

7.2.2 The CAE community: a mature CoP with communication dynamics

The interaction dynamics in the forum is very different than in the CAD community. The whole CAE forum has been coded. 17 discussions were opened, 7 were information transfer and 10 questions asked by a member to the whole community. We noticed that the 10 questions were the monopole of a same member whose comments represented 58% of all forum activity. Only 4 out of the 15 members were active on the forum. Regarding the 10 questions asked, 8 led to the exchange of at least one idea including one that resulted in argumentation/debate. The 2 other questions did not lead to discussion. In a section of the forum some images were used as comments to support explanation and presentation. Most of the subjects show very short interaction intervals. Answers were generally a question answer pattern which transmits information without elaboration of a solution. The average level of reply to a comment is 1.9 which is very low compared to the results of the CAD forum.

Member	Subject: saving configuration of visualization	Coding
F	Hi all,	Social interaction
	<p>“W” add showed me how to save configuration of visualization. I’d change the size of screen which is too small no way to find out the solution 🤔</p> <p>someone knows solution?</p> <p>Thanks in advance</p>	Question
L	Simplest is to restor config in initial state ie with a scree of same size Elsewer you can look in <i>MenuCtrls / Save Menu</i>	Idea
F	It works	Social interaction

Table 31: Extract of the CAE forum (translated from French)

Anyway the forum had a certain audience as the number of viewed pages is high compared to the level of interaction. For example the conversation showed in table 31 has been viewed 10 times. On average, the discussions are viewed 36 times. Unfortunately we cannot see who has visualized the discussion. The average time to close a discussion is 64 days. The degree of reliance on ITC is however low because, the community members have no constraints of time and space. They have the possibility to see each other and to discuss face to face if needed. ICT will never be a perfect substitute for face-to-face meetings.

During the characterization of the interactions, we have observed that the three activities were supported by a forum:

1. Communication type when members proposed direct answer to specific question.
2. Coordination type when members use the community space to organize work and tasks.
3. Production corresponding to the co-elaboration of decision and the design of a new solution to problems arguing around the proposed solutions.

The following table summarizes the characterization of the type of collaborative activities mediated by the forum for the two communities.

Collaboration component		Knowledge sharing Component	Elementary interactions coded	CAE	CAD
Ellis and Wainer (1994)	Détienne (2008)	Rainbow enriched model	From sense Making theory.	X	X
Communication	Information transfer	Idea, Opinions	Question-answer	X	X
	Clarification activity appearing with question-answer turns (also called cognitive synchronization)	Idea, Opinions, Question, Interaction Management			
Coordination	Group management activities	Task Management, social relation, Interaction Management	Debate coordination		X
Production	Generation evaluation activities (elaboration of the problem, proposition...)	Idea, Opinions, Question, Argumentation, Broaden and Deepen	Negotiation, Argumentation		X

Table 32: Type of collaborative activities observed in the two communities

7.3 Comparison of the two communities and interaction dynamic forecasted

Community Structuring Characteristics		CAD	CAE
Community Orientation	Objectives	Operational	Strategic
	Life Span	Temporary	Temporary
	Age	Medium	Medium
	Mutual Commitment	Maturing	Maturing
Organizational context	Creation Process	Intentional	Intentional
	Member level of commensurability	Low	Low
	Context	Facilitating	Facilitating
	Level of sponsorship	High	High
	Corporate recognition degree	Institutionalized	Support but not formalize such an official organization
	Consensus on Leadership	Continuously Negotiated	Non existent
	Size	Small	Small
Membership Characteristics	Geographic Dispersion	High	Low
	Selection Process	Closed	Closed
	Enrollment	Compulsory	Compulsory
	Prior Community Experience	Extensive	Extensive
	Stability	Stable	Stable
	ICT skills	High	High
	Cultural Diversity	Heterogeneous	Homogeneous
	Topics Relevance to members	High	Medium
Technological Environment	Degree of reliance	High	Low
	Availability	Medium	Medium
Type of interaction observed		Question-Idea-Argument	Question-information
Interaction dynamic		Co-operation	Communication

Table 33: Typology of VcoP Structuring Characteristics and Interaction Dynamics

The two communities described earlier differ in terms of several characteristics. The analysis of interaction points out the different levels of collaboration observed in the community. It is difficult to generalize our study; we can however build a causal relationship between CoPs characteristics and quality of exchange within the community observed.

The CAD community was created with an operational objective emphasis on facilitating the setup of a global project. The community members had common objectives to improve the CAD Software interface, deploy a common using of it, and provide daily support to CAD Software users. The community was built to fulfil these 3 objectives inducing a high level of relevancy regarding the topics exchanged among the group. The high degree of topic relevancy had a clear impact on the level of cohesiveness, feeling of belonging, and sense of engagement of their members.

Additionally, due to geographical dispersion the individuals had to communicate mostly through ICT (ICT reliance = high). This contrasted with CAE community, whose members were located in the same place (geographical dispersion = low), and therefore met face-to-face on a regular basis (ICT reliance= low). The co-localization of actors, can explain their preference to communicate directly with their colleagues. This observation shows the direct impact of the pair {localization, technology} on the knowledge elicitation dynamics of the group. Indeed, knowledge elicitation requires externalizing pieces of knowledge, which is one of the main virtues of online forums. We show here that knowledge dynamics is deeply linked to the argumentative processes (CAD community). When both happen through the electronic forum the CoP has better results (VcoP) and when argumentation occurs separately the results are less convincing (CAE community). The preference of co-located CoPs to capitalize on the oral discussions that inevitably occur among the group is a rational behavior.

However, if the geographical dispersion plays a positive impact on the members' commitment to ITC use, it also leads to difficulties related to the management of the cultural diversity among the VcoP. For the CAD community, this challenge has been overcome thanks to the leader, the CAD champion. His leadership skills along with the spirit of collaboration he instilled in the group were critical to the success of the CAD members' collaboration. In Asia for instance and in the cultural rationality of the "face, Mingze" (Ascencio C. & Rey D., 2010) it might be difficult for a Chinese CAD member to ask a question whatever the media is with regards to culture. Asking a question could be perceived as a kind of confession of weakness.

Extract of interview of the CAD champion (2011)

“It is really hard to formulate a problem. Formulate a problem is yet a way to solve it. I really encourage all the members to set up their problem. You have to respect certain rationality and it is hard to be able to express clearly a problem. This is my vision and in our forum, I really appreciate the way my colleagues set up the problem and then how we proceed to solve it.”

By this message, the CAD leader promotes a non-traditional rationality behind problem setting and problem solving. In a word, for him being able to set up a problem is yet proof of ability that requires skills. Members are considered equals on both sides of the spectrum: for both asking a question and setting up a problem, as well as for answering a question. In the CAD forum, we have given evidence on the efforts of individual members to explain, through the argumentation processes a question, an idea and so on. Bear in mind that 74% of the interaction we studied included argumentation.

We also note that the CAD champion has been elected by 100% of the community members. The legitimacy gained from this election is also an important success factor that is only found in the CAD community. To conclude, a high level of membership stability throughout the life of the community (membership = stable) has also allowed the participants to develop close relationships and build strong ties. On the contrary, the CAE community has no clear leader. There is no systematic animation of the group and the degree of relevancy of the topic chosen to federate the forum as reported in the interviews is medium. The community exists and there is evidence of information exchange but they are not really working together to fulfill common objectives. The CAE software improvement is part of their objectives but not really a priority. Moreover, when they need, they solicit each other and all are willing to help each other. However, a forum doesn't seem to be the ideal medium of collaboration for them. Thus, resulting in the forums limited use by some CAE members to transfer information and occasionally communicate and/or to have contact with hydraulic members.

7.3.1 VcoP Visual Management Tools applied to the CAD and CAE Community

	CAD	CAE
Orientation	4	1
Life Span	4	4
Age	2	2
Mutual Commitment	4	4
Creation Process	1	1
Member level of commensurability	4	4
Context	4	4
Level of Sponsorship	4	4
Corporate recognition degree	4	3
Consensus on Leadership	4	0
Size	4	4
Geographic Dispersion	1	4
Member selection Process	4	4
enrollment	1	1
Prior Community Experience	4	4
Stability	4	4
ICT skills	4	4
Cultural Diversity	1	4
Topics Relevance to members	4	2
Degree of reliance	4	0
Availability	3	3

	CAD	CAE
Demographics	3,5	2,8
Organizational context	3,6	2,9
Membership Characteristics	2,9	3,4
Technological Environment	3,5	1,5

Table 34: Criteria Evaluation Process

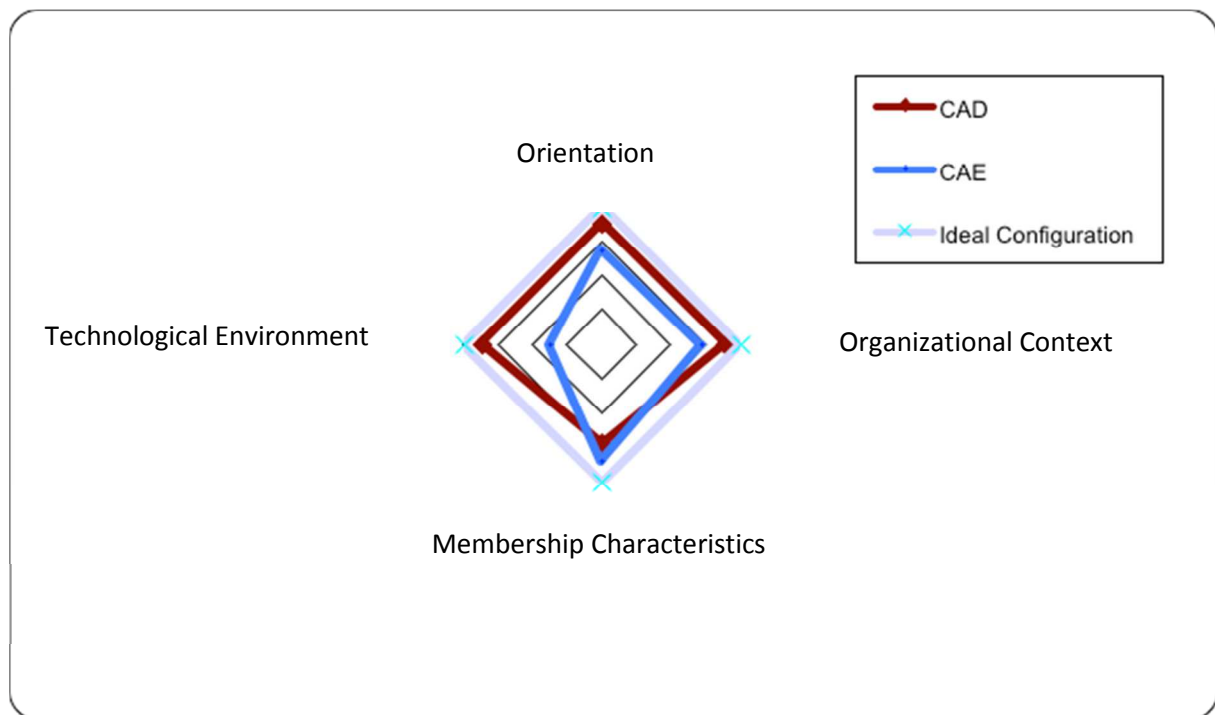


Figure 46: Configuration status of the CAD and CAE Community compare to an ideal one

In this radar, we see that CAD community configuration was extremely close to the ideal. The online interaction dynamic observed confirms the evaluation we have done thanks to the criteria analysis and evaluation.

7.3.2 Online Interaction Analysis Conclusion of the CAD and CAE community

For the CAE forum, we have mainly quoted a dynamic of the information transfer leading to few interactions of communication. Forum is not use as collaboration tool. It has to be noted also that the community members are located in the same plant even if in different building and services. They have the possibility to meet each other and to discuss face to face if required. It is widely accepted that ICT will never be a perfect substitute for face-to-face meetings.

This study shows thus that a forum is capable of supporting asynchronous argumentative activities within a remote community as shown by the CAD community and enhances global collaboration.

Besides, the two communities studied have global commonalities: all members are engineers involved in R&D activities of the same product division of the same company. However, they differ in terms of several characteristics particularly one related to the geographical dispersion. Indeed, for the CAD community, the individuals had to communicate mostly through ICT because they are split over the world. This contrasted with CAE community, whose members were located in the same place and therefore met face-to-face on a regular basis. The preference of co-located CoPs to capitalize on the oral discussions that inevitably occur among the group is not a surprising behavior. This observation shows the direct impact of the pair (localization, technology) on the “online” collaboration dynamics of the group. Thus, without over-generalizing our results, we conclude that this technology might be partly inadequate when groups have strong local collaboration dynamics. This could be a problem when new organization includes few distant members and a “historic” core community of co-localized members.

This study shows also that the analysis of the communities’ configuration and the generated radar are powerful management tool because these tools allow detecting at a glance a problem within the current behaviour of the CAE community. In the radar, at a glance, we see that there is a problem inherent to the technical environment of the CAE community. If the management wants to refer to the table, he can see that the community members are co-located and that it might be cause of failure of the forum.

CHAPTER 8 – Method tested on different communities

8.1 The Designers Community

Remind that this community has been launched in parallel of the modeling experience according to the rainbow model presented above.

The objective of this design community's was to improve the feedback on experience and knowledge sharing among engineers in Europe. The designers' community was composed initially of 21 members including 3 experts.

In appendix, we present the forum developed for this community.

8.1.1 Method to launch the community

In a participative rationality, because, we haven't got yet the community configuration table analysis, we set up a project called the "Mutual Understanding Project" The objectives were to assess:

- The relevance of the community boundaries.
- The motivation of the community to collaborate, and on what topics.
- The motivation of the community to collaborate via a platform.

The secondary objective was to characterize the mutual commitment maturity of the seed of the community identified by the management.

Before creating a collaborative platform to instrument the community, the idea was to check with identified community members to see if they were interested in collaborating with other members and if they had understood the benefits of the community.

Then, the objective was to decide with participants if a collaborative platform was the best means to improve their interactions.

The Mutual Understanding Project was consisted of 4 working sessions in France and Spain, gathering the local stakeholders, 5 interviews and a systematic questionnaire (Refer to Appendix).

Once the community was running, we summarized some of the key structuring characteristics of the Community of Practice thanks to Dubé's grid (table).

Excluding all preliminary work and IT parameterization and deployment we spent more than 30 hours with community members. The table 35 summarizes the data collection for each case study.

	CAD	CAE	Designers
Questionnaire	moderator	Whole members	Whole members
Interviews < 2 hours	2	3	5
Interviews > 2 hours	1	1	1

Table 35: Data collection, characterization of the Cops

The Mutual Understanding Project represented for the participants:

- A working session consisting of a presentation of the proposed experiment and a questionnaire.
- A restitution of the working sessions and restitution on the adjustments made accordingly.
- More than 15 phone calls to present each member and introduce the community and Build the collaborative platform gathering the topics of common interest,
- Several meetings with the management
- Training for the users

8.1.2 Method used to evaluate the candidate community configuration

During the first communication session with the community members, our objective was to reach a mutual understanding.

3 Questions was formulated:

- Is the perimeter of the "prescribed" community relevant?
- Are the members of this community interested in collaborating and working together?
- Are the members of this community interested in collaborating using a tool such as a "Collaborative Platform"?

Then we have to evaluate the mutual commitment of the community members.

8.1.3 Mutual Understanding Project Findings

8.1.3.1 Motivation to be part of the Community

To the question, “would you like to be part of this proposed community”, only half of the community was motivated. The other part was mitigated or even not at all motivate.

The 4 persons not at all motivated were thus removed from the first Perimeter configuration.

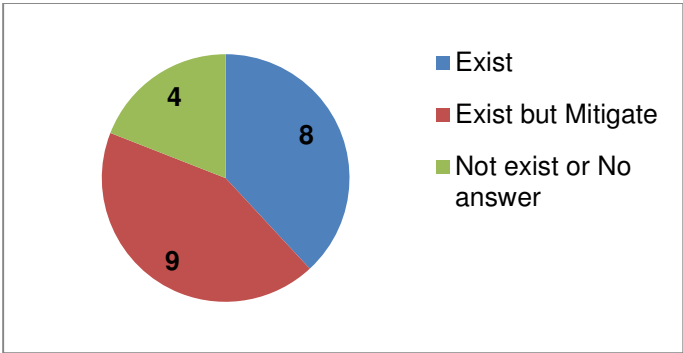


Table 36: Motivation to be part of the Proposed Community

8.1.3.2 Community boundary relevancy

To the question, “have you identified other appropriate participants to include to this community?” Participants have challenged the current community perimeter.

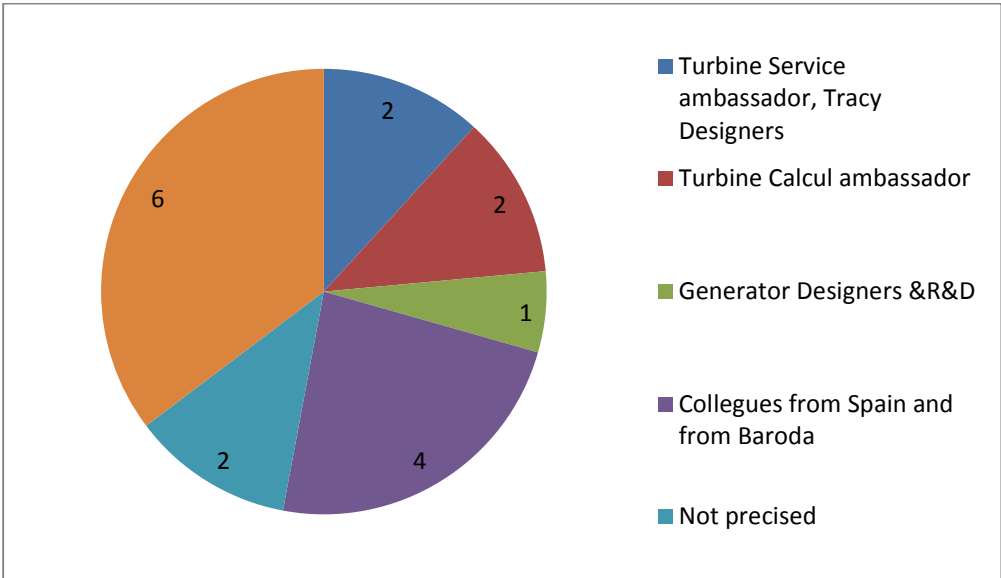


Figure 47: Proposal to Revise the Community Boundary

Members of the group challenged the boundaries identified and expressed the need to integrate the actors involved at different stages of Product development activity. The perimeter of the community was therefore revised. The concept of practice was extended to

the concept of integrated product and commissioning engineers, engineers of the service department, calculators and technician, were included (4 persons).

8.1.3.3 Are the members of this community interested in collaborating sharing knowledge?

To the question, “would you like to share your knowledge and that of others to find out how your respective education can help each other?” The Level of motivation to share knowledge was mitigated: 8 persons don’t forecast what they could gain by a global Collaboration.

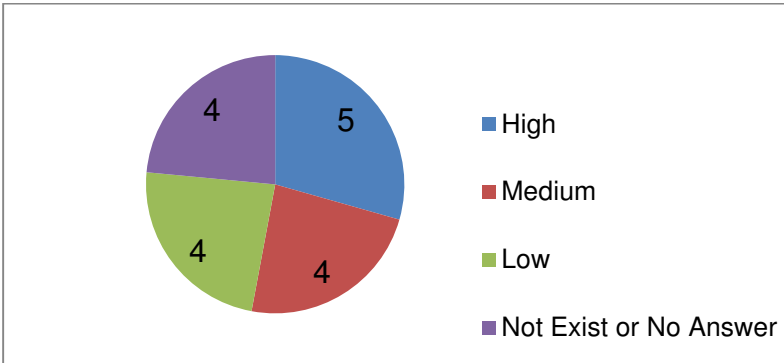


Figure 48: Level of Motivation to collaborate within the Community

8.1.3.4 Motivation of the community to collaborate and on what topics

To the question, “do you have a particular interest in a topic to share with community members?”

The members have expressed their motivation to exchange feedback of experience and unit good practices.

1	17/17	Feed-back of Experience
2	14/17	Calculation parameters
3	10/17	Problems faced during commissioning or Site erection
4	8/17	Products
5	8/17	Common Designs, Global instructions
6	5/17	Design parameters
7	5/17	Internal tools
8	4/17	Quality Requirements
9	2/17	R&D innovation project
10	1/17	Who knows what

Figure 49: Classification of the topics of interest of community members

8.1.3.5 Motivation of the community to collaborate via a platform

To the question, “Do you think a collaborative platform would be a good way to collaborate together?”

The idea to consider some form of online knowledge sharing did not seem to attract interest. Work with people you do not know already seemed preposterous, but possible. However, exchange feedback of experience via a forum was seen as a constraint. Many reasons were cited by members of the collective to justify their reluctance to use the forum.

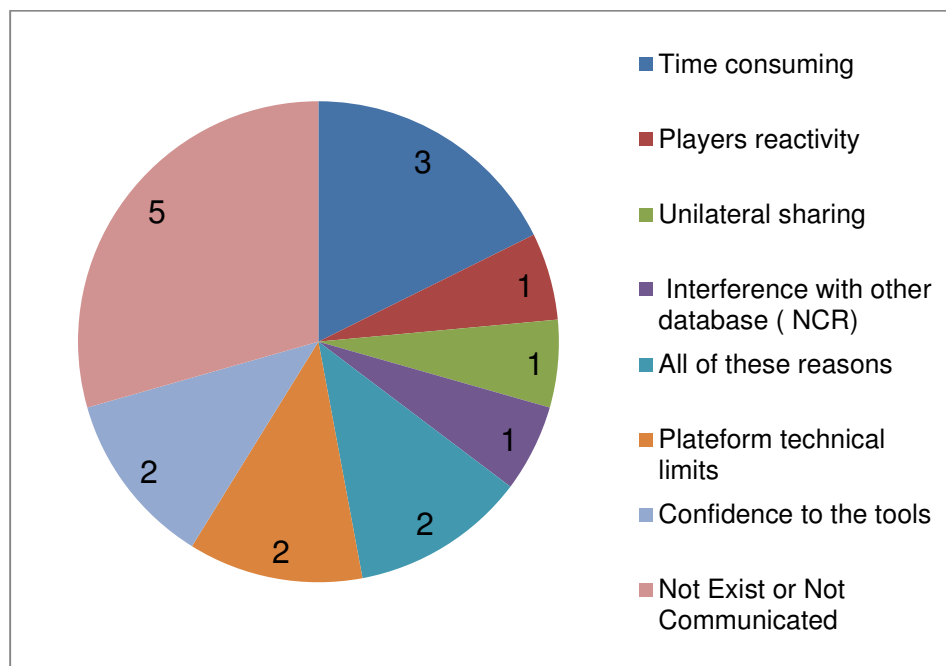


Figure 50: Identified Limits on the use of the platform

The tool was not identified such an opportunity to facilitate collaboration and knowledge sharing.

They explain during a meeting that most of their problems were urgent. An urgent topic is a topic that needs a prompt and quick solution and validation within 24hrs. For that kind of problem, they used to give a call in order to obtain the information requested. They do not imagine ask their question on a forum.

That is why, we have explained that all topics were not relevant to be discussed on a forum.

The topic relevancy corresponds to the nature of the problem formulated in the platform. If the problem is urgent, the platform is not the best medium to support the discussion because, an urgent problem has to be closed within 3 days before generate huge problem for the designer.

8.1.3.6 Mutual Understanding Project Conclusion

The designers' community was composed initially of 21 members including 3 experts. They all have complementary activities and knowledge regarding the product they are in charge of. The product is the common topic of interest to this community. Only 17 participants signed up for this community. The community is geographically dispersed and some members work in the Spanish Design office while some others are part of the French Design office.

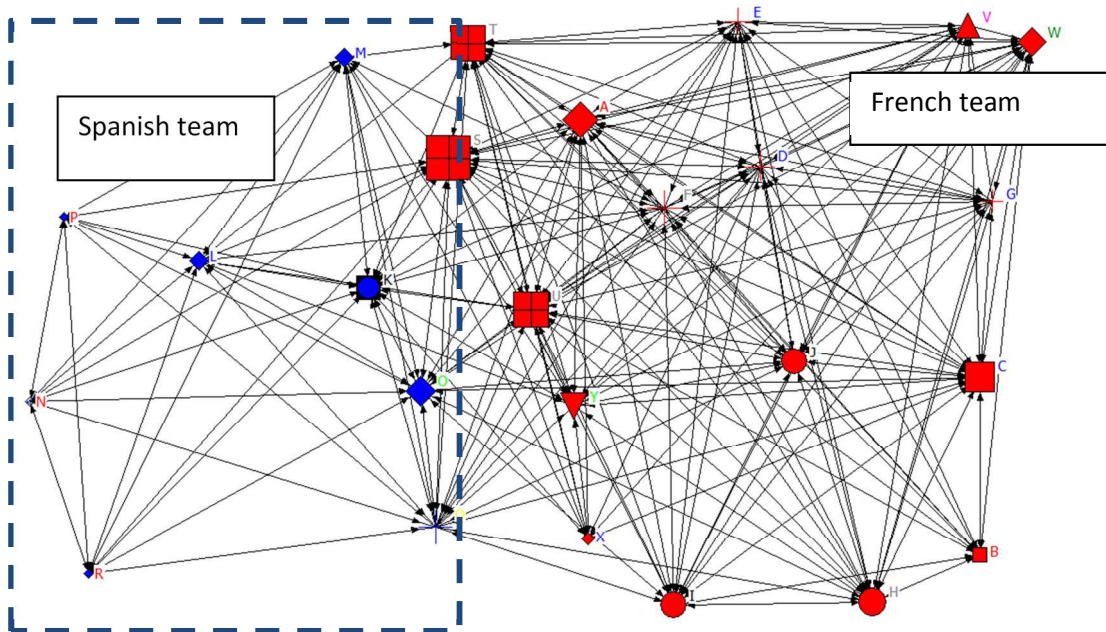


Figure 51: Network model of the Designers community

At first glance we noticed that the community is made of two groups who work and exchange on a local base. The challenge is thus to make the two cohesive groups work to build a unique community. Each group had a good understanding about who knows what in his local group. But only four persons of the whole community really work together. These four persons are punctually in contact to discuss common topics of interest because they have been involved with the same project.

In figure 51 the links refer to a declarative answer to the question: *Do you know this person?* This questionnaire was carried out at the beginning of the project.

Each group had a good understanding about who knows what in his local group. Only four persons of the whole community had previously worked together. They were punctually in contact to discuss common topics of interest because they were involved in the same projects.

We noticed that the Spanish group was more interested in receiving support from their French peers than the reverse. Even if they were all volunteers to be part of the community at the beginning, the French group was concerned with the extra work load induced by the participation in a CoP.

Extract of interview of Grenoble Designers, 2011

“You know, we have no time yet to support each other, thus even if I am ok to be a member of this community, do not expect too much from me” or “I am happy to be in contact with Spanish colleagues but really I don’t know what could I gain from their experience.”

In a word, for the French group, 80% of the members were not aware of the benefits they could draw from this global CoP. We realised that what we have called “the Mutual Member Recognition” in the sense of reciprocity was an important factor of success of the community. The “MMR” refers to the balance of qualitative and quantitative contacts between community members that allow building the “trust” among members. The mutual recognition can be high or low. A low MMR refers to a mutual recognition imbalance. This phenomenon can be identified when some members are over solicited and some other never solicited.

To conclude, the preliminary collection of data has corroborated this status; the maturity level of the mutual commitment of the community was at average to weak. Members of the group challenged the boundaries identified and expressed the need to integrate the actors involved at different stages of Product development process. The perimeter of the community was therefore revised. The criteria of practice was extended to the criteria of integrated product and commissioning engineers, engineers of the service department, as well as calculators and technicians, were included.

Criteria	Designers Community
Voluntary Action	Average: Several persons are involved in the same action
Mutual Support/Help	Low : Several isolated incidents of persons wanting to receive help or support from others and provide help and support to others
Mutual apprehension	Low: Several individuals expressed a common understanding and vision of their activity

Mutual knowledge	Low: Several individuals would like to let people know what they know and determine who knows what to maximize knowledge sharing efficacy
Management tools	Average: Several persons have designed and set up at least once a common management tool (Could be excel common file)
Routines	Average: Several persons have adopted at least once a common routine
History	Average: Several persons discuss punctually (at least 1/month) their activity and experience
Common Knowledge Need	Low: Several isolated incidents where persons express a common knowledge need

Maturity Level	Average-Low
-----------------------	--------------------

Table 37: Designers community mutual commitment maturity

The members have expressed their motivation to exchange feedback on their past experience and the unit's good practices. However, the idea to consider some forms of online collaboration did not seem to attract interest. The general consensus among participants was that working with unfamiliar members on the same team posed enough difficulty without the added strain of having to take part in an online forum. Many reasons were cited by members of the group to justify their reluctance to use the forum.

Designer of Grenoble, 2012

It is usually recommended to propose solutions as opposed to asking questions or raising an issue.

Nevertheless, it is thanks to problem sharing that team and community members will improve their knowledge. Being able to ask questions and raise issues had to be encouraged by the management as they seek to set up a collaborative spirit in a collaborative platform.

Designer of Barcelona, 2012

How a platform can help us to manage urgent problem?

The platform has to be of value to the users but does not have to manage urgent problem solving.

Also, in the design offices of Grenoble and Barcelona, the pressure induced by the “quality-cost-lead-time” objectives does not really help in the set up of a collaboration dynamic that could be perceived as time consuming. In that sense, members first have to be aware of the benefits they could draw from this global collaboration. Secondly, the topics shared have to be relevant and as much as possible, not linked with a direct urgent operational issue that is more convenient to discuss by phone or face to face with experts.

To conclude, in engineering and especially in design activity, describing the cognitive processes of designers relies on visual reasoning. We know that the information communicated and documented in engineering design includes sketches, design requirements, constraints, functions, behaviors, concepts, and ideas. Visual representations are especially important in design for sharing/conveying ideas and for documentation. Because pen and paper is a primary medium used in design, the inability to easily record sketches and other hand produced visual representations is a barrier to the first step toward collaboration between design offices. A numeric table can also be budgeted beforehand. Consider using: tablets, cameras, and touch screen tables to complement the use of the platform.

After having exposed the results of our Mutual Understanding Project and our feelings that the forum can not been an opportunity to leverage the collaboration among these participants, the global management asked us to open a forum anyway.

8.1.3.7 Characterization of the Community

Designer’s community was intentionally created by the management to improve the feedback on experience and knowledge sharing among the Engineers in Europe. The management viewed this VCoP as a pilot project intended to evaluate whether community and forum were appropriate to promote collaboration throughout Europe. It was thus a strategic objectives orientation in the sense that the collaboration within this community was not directly linked to the daily operational activities of members.

Figure 51 displays the two main locations of the group (i.e. France (red) and Spain (blue)). There is a high level of cultural diversity (the shapes of nodes show the diversity of member job titles and the label colors show the different types of departments (8)). We find a medium level of commensurability because all the members are engineers currently working for the Europe engineering department. At first glance, it consists of two groups of people who are used to work and exchange information locally. The challenge was to thus evolve from two

cohesive groups into a unique VCoP. Their complementary practices around the same product served as federators for the community.

Also, in the design office, the ratio workload/ staff has shown that in Grenoble the workload was of 200%, and 100% in Barcelona. Moreover, in Grenoble, design teams had to face to the retirement of key people, the arrival of the variable speed technology, highest requirements regarding the use of CAD software. In this context, the actors were required to prioritize their actions, attacking rationally their own project unable to focus on other activity not directly linked to their projects and daily work. They were completely absorbed by short term rationality, preventing them from realizing that they were not fully benefiting from the workforce available to them in India.

One of the central concerns of the community members was related to labor division with India.

- Why is this labor division so complex?
- How could we optimize our partnership with India?

The pressure induced by the “quality-cost-lead-time” objectives is not really helping in the setup of a collaboration dynamic that is perceived as time consuming. In that sense, the context is obstructive and the level of sponsorship has to be reviewed to evaluate the knowledge sharing capabilities of engineers. Indeed, even if orally the management expressed a strong will to support collaboration among Europeans, key performance indicators do not already include features regarding the ability to share information and knowledge.

The community has leaders, also experts (squared boxes in figure 51) but all of them have been clearly assigned by the management and only one was motivated to play the game. Additionally, figure 51 shows that they are key persons in the network. The size of the nodes shows the number of connections of each node.

The following table 38 summarizes the characterization of the Designer community

Community Structuring Characteristics		Designers
Community Orientation	Objectives	Strategic 1
	Life Span	Temporary 4
	Age	Young 1
	Mutual Commitment	Low 1
Organizational context	Creation Process	Intentional 1
	Member level of commensurability	Medium 2
	Context	Obstructive 1
	Level of sponsorship	Low1
	Corporate recognition degree	Support but not formalize such an official organization 3
	Consensus on Leadership	Clearly assigned 1
	Size	Small 4
Membership Characteristics	Geographic Dispersion	Medium 2
	selection Process	Closed 4
	enrollment	Voluntary 3
	Prior Community Experience	None 1
	Stability	Stable 4
	ICT Literacy	High 4
	Cultural Diversity	Heterogeneous 2
Technological Environment	Topics Relevance	High 2
	Degree of reliance on ITC	None 0
	ITC Availability	Medium 2

Table 38: Structuring Characteristics of Designers Community Evaluation

Community Configuration distance to the ideal one

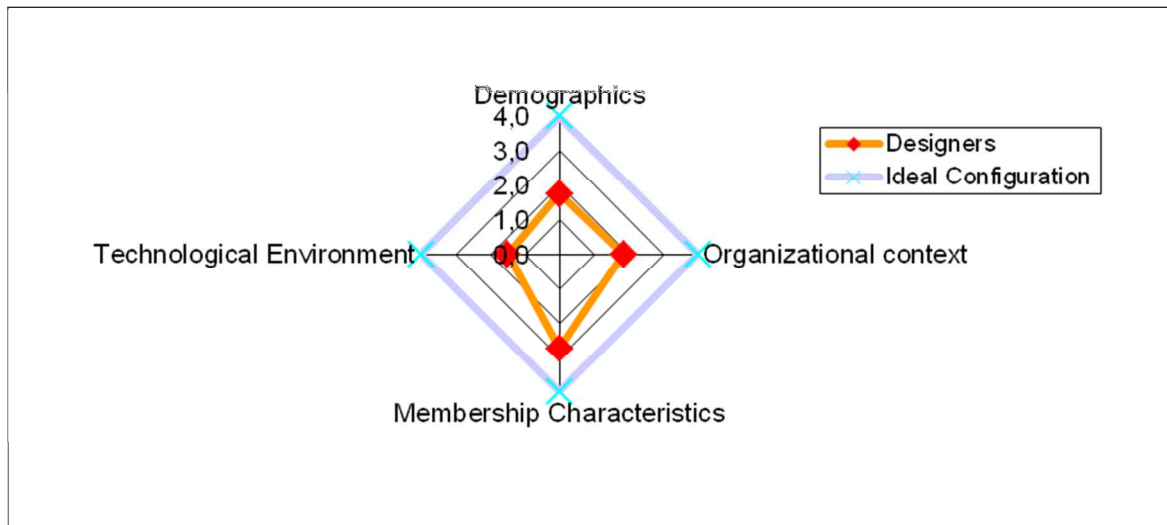


Figure 52: Community Configuration distance to the ideal one

After having done the analysis with the community configuration table, we presented our new analysis to the management. The visual tool was really helpful and the management realize the problem and they were more open to a discussion about the current configuration of the community and the reason why a forum was not, in this context, the best approach to boost the European collaboration. A corrective action plan was set up to conclude this experimentation.

8.1.3.8 Corrective action handle and new community configuration

After the failure of the Forum in that sense that after six month only 3 posts were recorded and the presentation done to the management of the explanation of its failure thanks to the adapted Dubé configuration table, we proposed an action plan to the management to revise the community configuration.

We based our action plan on 3 Operational Objectives.

1. To take advantage of both small (Standardization) and large turbine (Customization) design approaches to be stronger in medium turbine and refurbishment markets.
2. To continue to demonstrate that sharing Design activities between Europe and India is a sustainable industrial solution within the “QCD” perspectives.
3. Share Ansys Good Practices

Based on these 3 Operational Orientations, we have divided the current community on 3 sub-communities. Each member has been affected on one of the sub community to serve one of the above operational objectives.

To sum up, the previous community composed by 17 Members + 4 added persons was divided into 3 groups.

For the first Group, we kept only the “Product designers” and “the expert” motivated. We proposed them to work around the objective to develop specific process and tools for medium Hydro.

Two meetings were organized with managers to present the project and two meetings were organized with community members.

We launch for this group a collaborative platform that we will present later on.

For the group two, we kept only the “European Technical Project Managers (TPM)”. We proposed them to work around the objective to harmonize the European Way of Working with Indian TPM. We sent a full workshop Program to reach this goal. However, because this action was not in the scope of our PHD, we did not follow its progress.

For the group three, we kept only the calculators and proposed them to join an existing calculator community that used to share good practices about Ansys software. The access rights were opened for each of them and they joined the Ansys community. However, because this action was not in the scope of our PhD, we did not follow its progress.

8.2 Full application of the Methods on the Expert community

This Diagnosis has been requested by a manager of HRD. The objective was to give him a precise understanding of the current behavior of the expert community in order to help him to decide whether or not a collaborative platform is the best means to improve their level of collaboration and knowledge sharing. Note that the expert community covers the HRD and the HEM Organization. There is a stake to improve the communication between these two organizations and create bridge to cross the boundary.

The analysis was thus done on the 17 participants of the technical committee organized the 22th November 2011. On the 17 participants, we have counted six Principal Engineers, eight Experts and were also involved two managers and one member of the mechanical technology center.

Let's now analyze its 4 main characteristics thanks to different graphical representations.

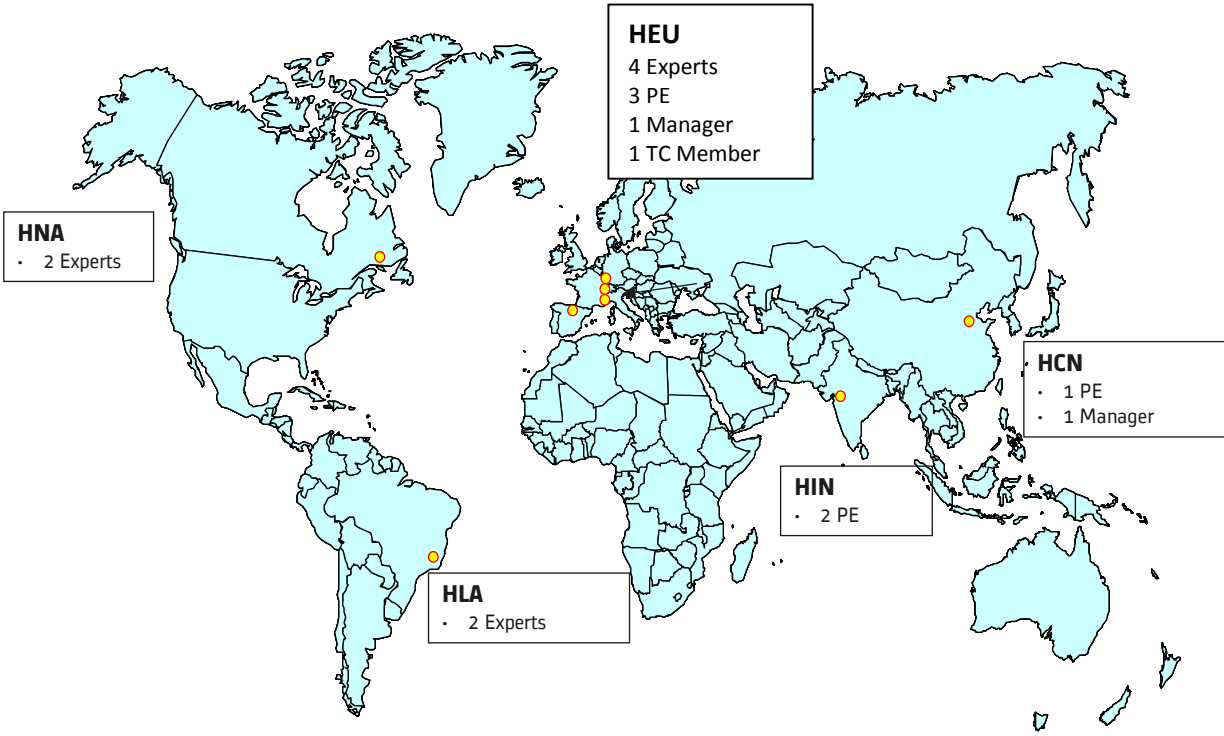


Figure 53: Community Studied for the diagnosis

8.2.1 Community orientation

In 2008, the global Expert Policy was cascaded among Hydro Business. The mechanical community was pushed by R&D and supported by the Business HR partner. If the own objectives of each community member are clearly defined in the Expert Policy, there is no clear definition of the objectives of this community itself for members.

This community had however a clear Strategic Objectives. The objective of this community was to create technical career paths as well recognized as the traditional management career paths and allow in fine Alstom employee attracted by technical field to have new perspectives in terms of career ascension.

8.2.2 Organizational context

(Size, Creation Process, Boundary Crossing, Degree of institutionalized Formalism, Leadership, Environment, Management and Key performance Indicators)

The Turbine Mechanical Expert and Principal Engineer community is a small group, composed of 17 persons including 2 animators from the mechanical technology center. This community is intentional that is to say it is deliberately established by the management and Human Resources who have defined its purpose and have selected key members. The community members have homogeneous roles. However since they are coming from different units, working on different types of machines, facing different kind of problems, they are facing a medium level of commensurability.

All members have a full English proficiency. The community is institutionalized, recognized formally within the organization. All community members have met each other during a technical committee that consisted of 5-day-workshops 2 times per year. Thanks to these regular meetings, all members seemed to know the field of expertise of each other one, even if it is confidential and not communicated officially neither by HR department nor by Management.

To understand deeper the working link inside the Community members, we have asked a question to each community member and ask them to fill in a table.

Question Asked: *Do you work with this person?*

Work means “to be implicate in a common project, collaborate punctually on project issue, Share difficulties.”

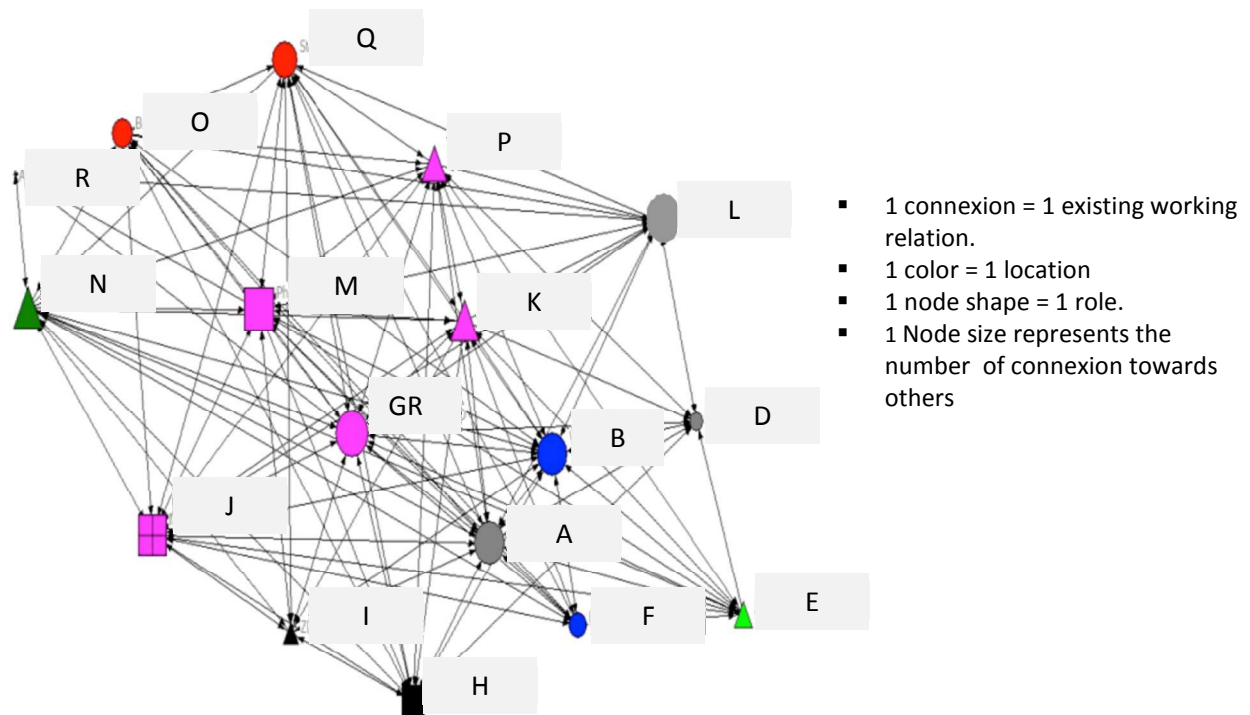


Figure 54: Visualization of the working link inside the Community members

Analysis

We can see in the graph that the majority of the members consider other community members such as colleagues with who they work. The network representation of the community highlights some characteristics of the community. The Ties are representing an existing working relation. The figure 54 highlights the fact that this community is globalized, each color representing a location (6 different locations for 17 members), with the maximum number of members per location being five. The community members have homogeneous roles (represented by the shape of the nodes) as they are mainly Experts or PE. Finally the size of the node indicates the number of ties towards others. GR, A and B have the highest number of ties toward others. These persons are considered to having the highest amount of working ties with community members. The low level of ties of Ajay A. is justified by the fact that he has joined the community very recently.

This graph provides a very clear representation of the extent of the community as well as its density (which experts has the higher amount of working links etc.) However, we will see thanks to the next question that these working ties representation has to be nuanced.

Question Asked: *To whom do you turn for advice before making an important decision?*

Visualization of the number of persons contacted by each Community member

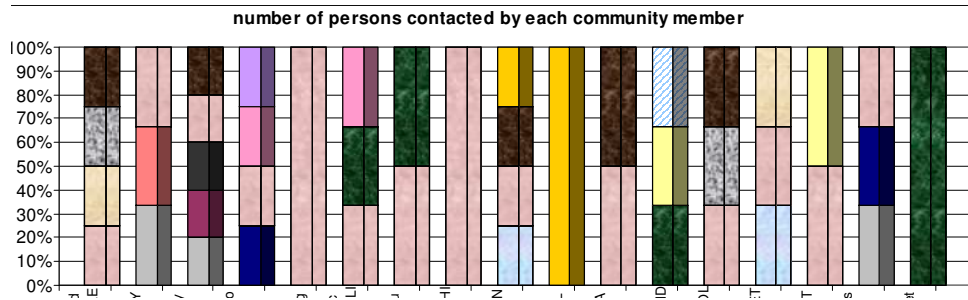


Figure 55: Key person contacted by each community member

Analysis

This figure 56 allows us to nuance the previous working link representation. We note that the average number of persons asked in case of issue is 2.6.

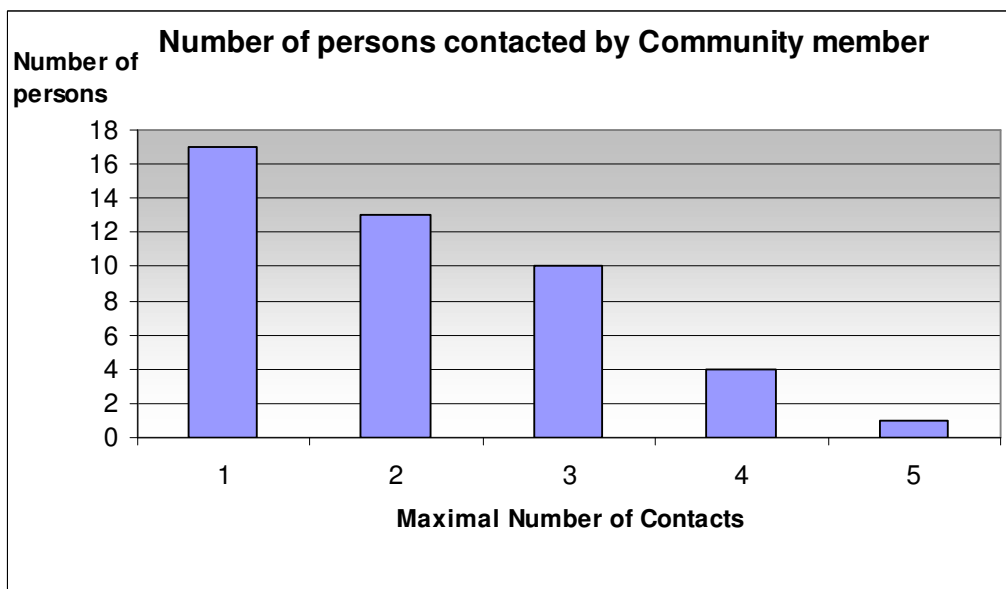


Figure 56: Number of Persons contacted by community members

Only 4 persons out of the 17 have a network bigger than 3 experts. It means that each community member asks in case of issue 1 to 5 persons maximum from the community.

→ The working relations exist but there are sub-groups that are working closely with one another in case of problem. We conclude that there are different degrees of working relation. The graph shown in Figure 56 also demonstrates that there is an imbalance mutual recognition between community members.

→ As the last conclusion of this graph, we note that the community member answers allow us to observe also two forms of leadership. The first form of leadership is leadership of the technology center members, who are more solicited in general by community members.

However, one leader identified as "Gr" in the graph, appears as the mechanical reference, advisers and supporter for 87% of the community members. This is another form of technical leadership, which is fully "negotiated" within the community.



Figure 57: Number of Experts and PE who ask GR in case of problem

Comments from Community members

*To be honest, we only solicit a few person of the community.
 Each technical problem is specific and we will try to find a solution with the right person . We will pick up the phone and call one colleague or send him an e mail. Do a tool can force us to contact most people and solicit indirectly more than one or two experts or TC members? I don't think so.*

To understand the interaction Frequency, we have asked **the following question**:

- *At which frequency do you share information with community members?*

Visualization of the interaction Frequency

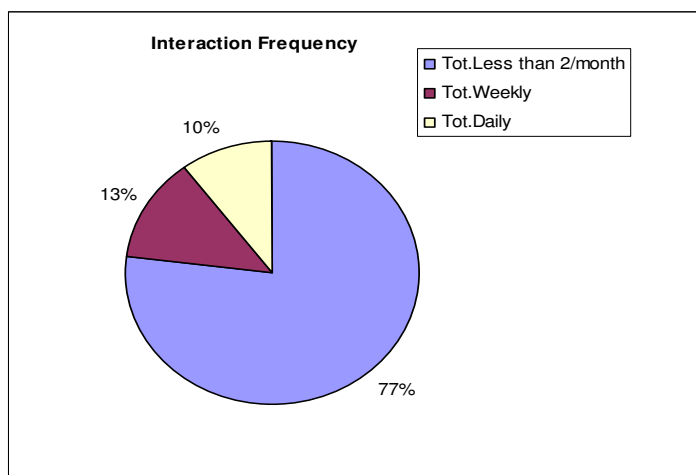


Figure 58: Global Interaction Frequency

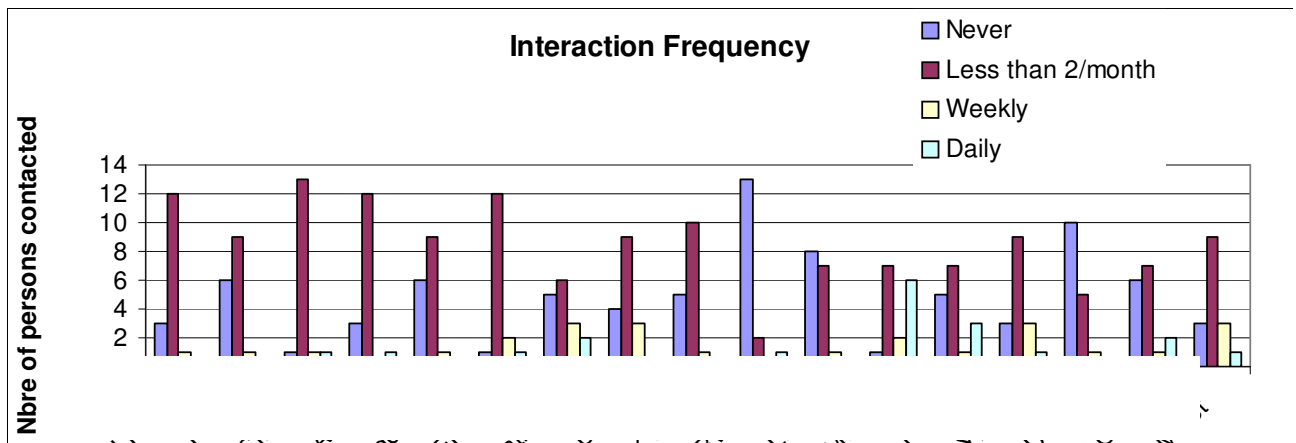


Figure 59: Individual Interaction Frequency with Community Members anonymated

Analysis

Except for “GR” who is majority solicited by community members daily or weekly, we note that the interaction frequency is low. 77% of the community members work with other community members less than 2 times a month and the other frequency refers to experts working in a same location.

Evaluation of the Mutual Engagement between Community members

Maturity Level evaluation criteria	Evaluation Grid		
	Low	Median (Average)	high
Mutual Support	Several individuals would like to receive help or support from others and provide help and support to others	Several persons are punctually (at least 1/month) helping or supporting each other	There is a network /a group where people are already helping and supporting each other
Mutual apprehension	Several individuals express a common understanding and vision of their activity	Several persons are aware that they share a common understanding and vision of their activity	There is a network /a group which has already set up and developed a common vision of their activity
Mutual Knowledge	Several individuals would like to inform people of what they know and determine who knows what in order to enable people to share with the right person	Several persons are informed and aware of their respective knowledge	There is a network /a group that has already mapped their respective knowledge to enable the group to share a common vision of who knows what
Management tool	Several individuals will be interested in developing common management tools	Several persons have designed and set up at least once a common management tool (example includes an excel file)	There is a network /a group that has already set up or have an on going project to set up common management tool

Table 39: Mutual Engagement evaluation: Low to Median

Analysis

The low frequency of communication between community members and the low to medium Mutual Engagement (table 39) could be due to a difficult environment. Most of experts are managed by the unit management and are over solicited. According to our investigation, except Canadians, they do not have concrete and measurable objectives regarding their abilities to work globally. Involved in various projects, they do not (except Canadians) have time officially allowed for sharing their Knowledge and Feed back of Experience (FOE) outside project involvement (design review, direct support to designers) or even time for self-training.

The key performance indicators and the general ability of the organization to promote learning and exchange between experts are not consistent. Managers are focused on project execution and Experts or PE have to support in priority the local design teams through design review and operational involvement. This direct involvement is a form of learning nurtured from the ground. However, these practices don't encompass global rationality of sharing and capitalization when problem is faced. Experts are not evaluated on their ability to work globally.

On contrary, the R&D members and the R&D Experts are evaluated on this capability. Therefore the TC community members may be more solicited by experts community members when support is needed.

Comments from Community members

It's difficult to keep informal contacts with members because of time.

We do not have time to read all our e-mails so read messages from community members sounds impossible.

Question Asked: *Do you need more frequent contacts with the community members?*

Visualization of the need expressed by community members to have more frequent contacts

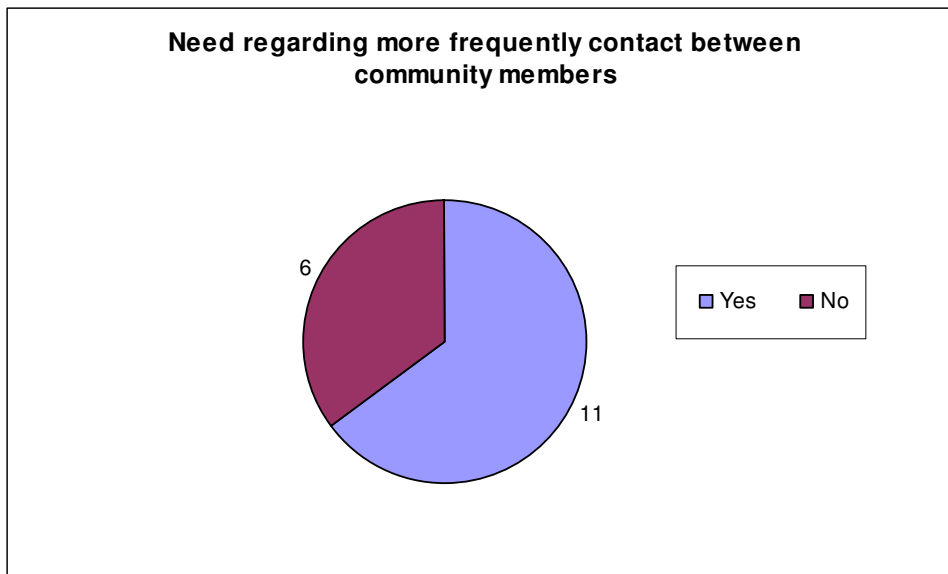


Figure 60: Member needs regarding more contacts with community members

Analysis

11 members answered that they need more contact with community members but they systematically have added comments regarding the time pressure.

8.2.3 Membership characteristics

(Geographic Dispersion, Cultural Diversity, Member selection Process, Member enrolment, Membership Stability, Member Mutual recognition, Topics Relevance to members, Member ICT Level of Confort)

The community members are scattered around the world (high dispersion) leading to a high level of cultural diversity. The selection process of Experts and PE is performed by HR and managers according to pre-defined criteria.

In this context, the members' enrolment is voluntary and it is a chance for members to become a member of this community. This Community has permanent members and is moderately stable according to the nomination, each year, of new PE and Experts. This stability can encourage the development of trust among the community members. In this community, there are different sub-groups where community members have more qualitative and quantitative contacts. This induces an imbalance mutual recognition between community members.

To know on which types of topics the community members communicate, we ask the following question:

Question Asked : *On which types of topics do you communicate?*

Visualization of the topics discussed between Community members

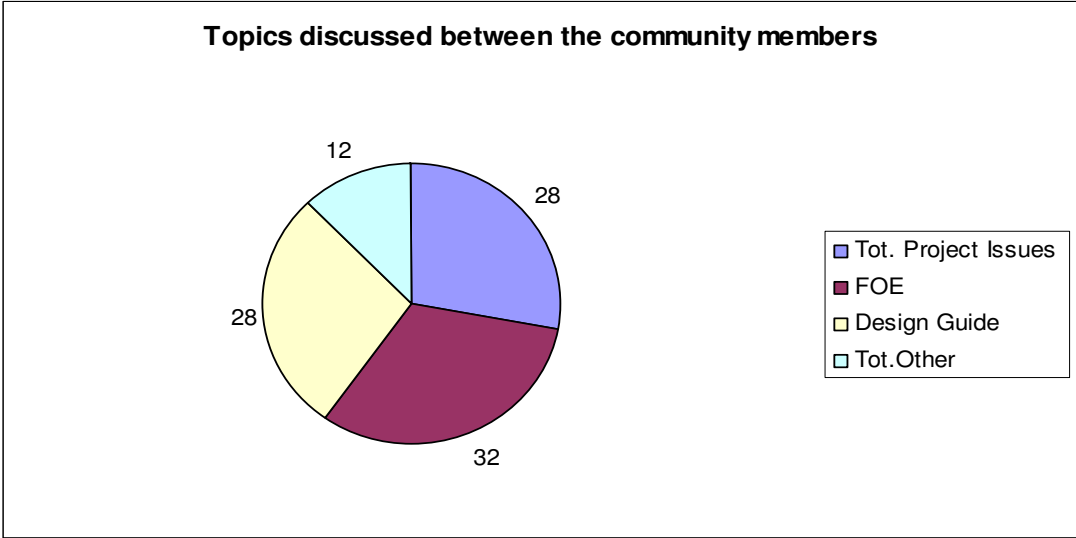


Figure 61: Consolidation of Topics discussed between Community members

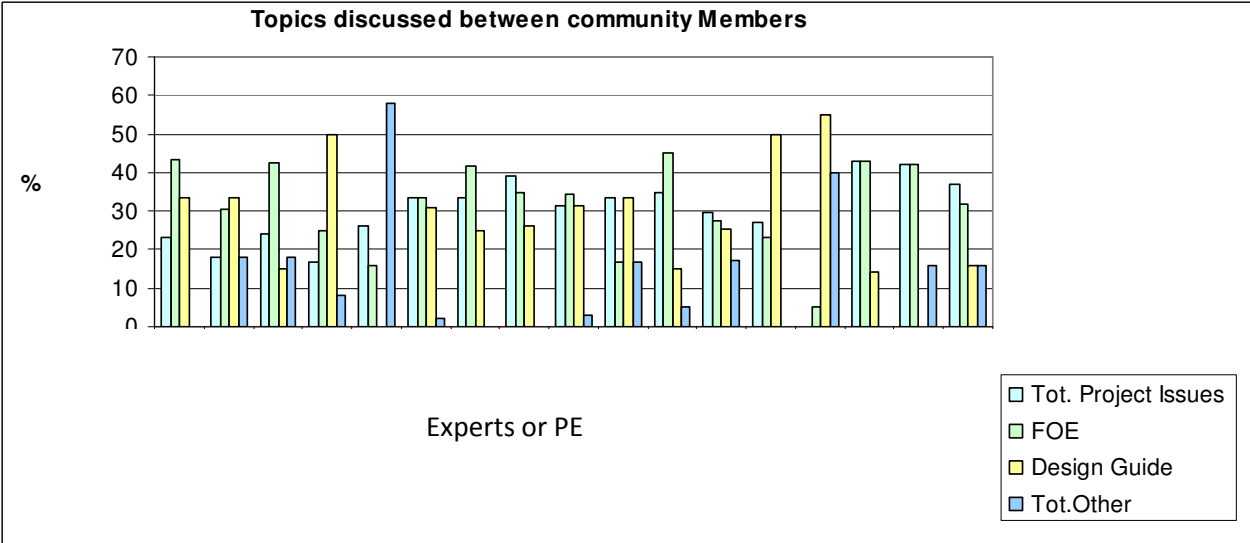


Figure 62: Topic discussed between Community members

Analysis

The range of topics exchanged within the technical community is wide (CF Workshop Program).

However, we notice that the community members communicate essentially about project issues, FOE and Design Guides. All members have expressed their interest to work on project issue and design guides and to communicate on feedback of experiences. These three topics have a high degree of relevance for the community members. The appropriate

roll out of the Design guide in their respective units is part of their respective yearly target evaluated by the hierarchy.

The FOE, Design Guides and Project issue can be some unifying topics for this community. However a question arises: Could these topics be some topics of cooperation and co-construction of solutions?

To know how the community members communicate, we ask the following question

Question Asked: *How do you communicate with community members?*

Visualization of the tools used by community members to communicate

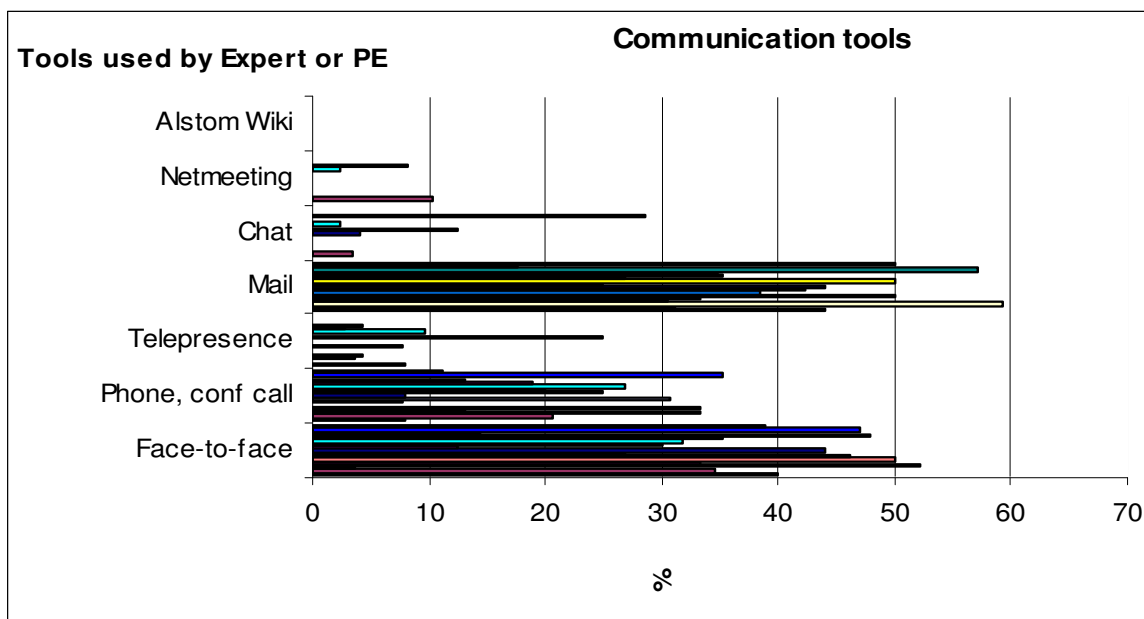


Figure 63: Communication tools

Analysis

Each year, the community has 2 one-week-workshops in order to intensify their exchanges and tighten their relationships. Meantime, the media used to communicate between technical committees are simple.

Phone Call, mail and Face-to-face. (see Figure 63 depicting the Communication tools)

If we consider the level of comfort members feel towards the use of ITC, we can say that it is low in that sense that the community members use simple media such as the email to inform and keep trace of the decisions and discussions with peers. The level of comfort members feel towards the use of ICT is low.

8.2.4 Technological environment

(Degree of reliance on ITC, ITC Availability)

To investigate the Technological Environment characteristic, we have asked the following question.

Question Asked: *Do you know 2.0 tools (Forum, facebook,yammer...)?*

Visualization of person who have never heard about web 2.0 tools

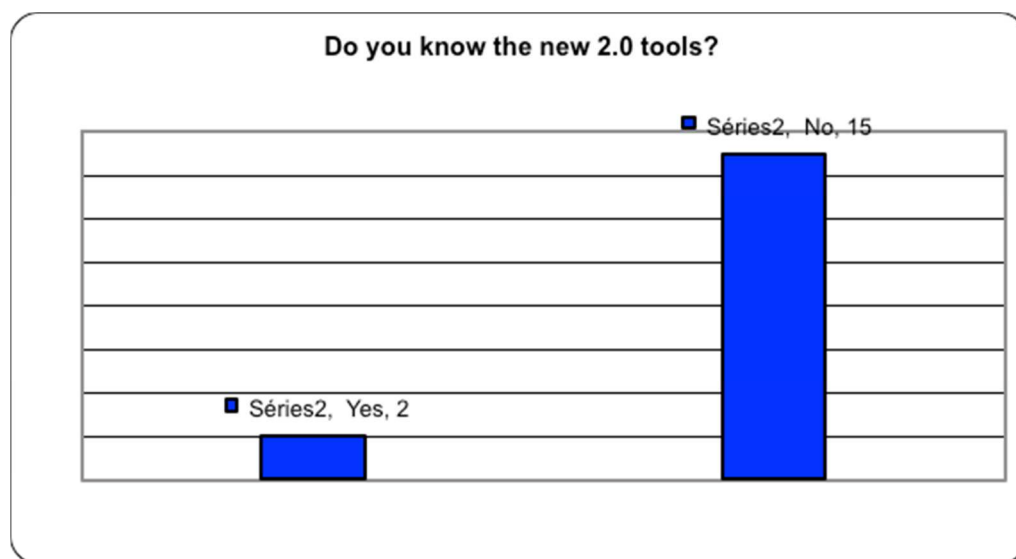


Figure 64: Community members Knowledge regarding web 2.0 tools

Analysis

Globally, the community members prefer meeting people directly to solve problems and/or use the telephone. They are globally not attracted by technology or other more modern media such as forums. Most of them don't know these new technological tools of communication and information exchange.

Comments from Community members

What are a Forum and a Wiki?

What is the benefit of these tools compared to our current tools and e-mails?

To complete this comments, we ask the following question.

Question asked: *Do you think a collaborative platform would be a good way to collaborate together?*

Visualization of the opinion of community members regarding the set-up of a collaborative platform

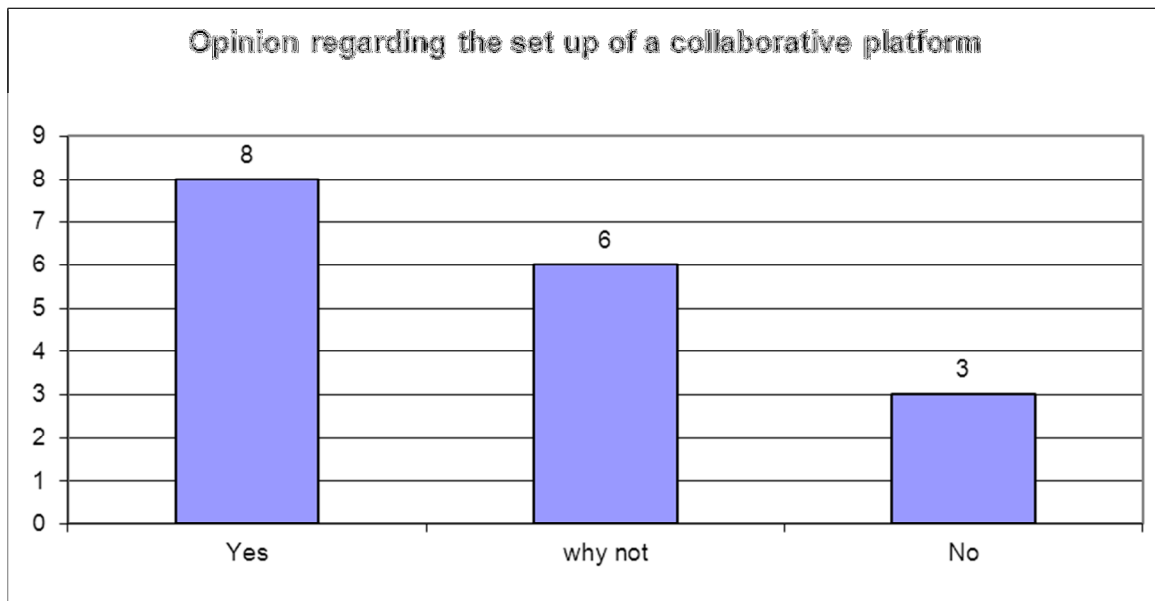


Figure 65: Opinion regarding the set up of a collaborative platform

Analysis

Community members are divided regarding this question. Globally, they do not know new collaborative technologies resulting from Web 2.0 (wiki blogs, collaborative platforms, etc...) proposed by Alstom Collaborative Way department. Some of them even have fears regarding such new tools. The main fears were around how time consuming online collaboration could be in addition the already hard context that the experts have to face in Europe particularly.

These technologies in particular make it possible to update, document and annotate knowledge thanks to the traces of the use, which is made. These tools are based on the new approaches of the modeling of knowledge resulting from research in cognitive sciences.

These technologies and the collaborative IT environment exist in ALSTOM thanks to ACW but in Hydro the management has to work on people management and new ways of working to deploy such collaborative way of working.

Comments from Community Members, 2011

A forum could be nice if it could decrease the number of e-mails...

If we want to try with a Collaborative Platform, we have to pay attention to the tool that is crucial in the further use of it. For instance, with colLeagues, we met problems in terms of notification. We received a huge number of e-mails that were not linked to our collaborative space. The switch from e-mail to platform and vice-versa was not so convenient.

Web shall not become a frequent interruption in the work. We have to take care of that kind of deviance.

Usually, we need information ASAP and solicitation of the one person that we consider to be the right person. This way of working is not in line with the forum idea.

The collaborative platforms are interesting, could be helpful but they are for sure not indispensable.

The talent retention should be the top most priority of ALSTOM Management. If that kind of tool could encourage young talents to stay, why not.

8.1.5 Evaluation of the community configuration

Community Structuring Characteristics		Description	
Orientation	1. Objectives	In 2008, the global Expert Policy was cascaded among Hydro Business. The mechanical community was pushed by the R&D department and supported by the Business HR partner. This community had a clear Strategic Orientation. The objective of this Expert and PE community was to create technical career paths as well recognized as the traditional management career paths and allow in fine Alstom employee attracted by technical field to have new perspectives in terms of career ascension.	1
	2. Creation Process	This community is <u>intentional</u> , (i.e. deliberately established by the management who defined its purpose and selected key members).	1
Organizational context	3. Member level of commensurability	The community members have homogeneous roles. However since they are coming from different units, working on different types of machines and facing different kind of problems, they face a medium boundary crossing.	2
	4. Context	The environment is difficult. Most of the experts are managed by the unit management and are over solicited. Involved in various projects, they do not (except Canadians) have time officially allowed for sharing their knowledge (FOE) outside project involvement (design review, direct support to designers) or even time for self-training.	1
	5. Level of Sponsorship	The Key performance indicators and the general ability of the organization to promote learning and exchange between experts are not visible. Managers are focused on projects execution and experts or PE have to support in priority the local team through design reviews and operational involvement. This direct involvement is a form of learning but do not encompass global rationality of sharing and capitalization when a problem is faced. Experts are not evaluated regarding their ability to work globally or it is not really consistently expressed in their objectives. On the contrary, the members of R&D and the R&D Experts are evaluated on this capability. That may explain why the TC community members are more solicited by experts community members when support is needed.	1

Membership Characteristics	6. Corporate Recognition Degree	The degree of institutionalized formalism relates to the degree to which a community has been integrated into the formal structure of an organization. The community is institutionalized (official status and functions).	3
	7. Consensus on Leadership	We observe two forms of leadership within this community. The first is leadership through the technology center members who are more solicited than the other ones. However, one leader appears: Jacques Bremond is naturally the mechanical reference, adviser and supporter for 87% of the community members asked. This other form of leadership is fully «negotiated" within the community.	3
	8. Size	This Turbine Mechanical Expert and Principal Engineer community is a small group, composed of 17 persons. 2 are animators from the mechanical technology center. (Trust and intimacy could be set up)	3
	9. Selection Process	HR and Managers perform the selection process of Experts and PE according to pre-defined criteria.	1
	10. enrolment	The Members' enrolment is voluntary because it is a chance for member to become a member of this community.	3
	11. Stability	This Community has permanent members and is moderately stable according to the nomination each year of new PE or Expert. This stability can encourage the development of trust among the community members.	3
	12. ITC level of Confort	The media used to communicate between technical committees are simple. The main means of communication are the following: phone calls, e-mails and face to face exchange. If we consider the Member ICT level of confort, we can say that it is low in the sense that the community members use simple media such as e-mails to inform and keep trace of decisions and discussions with peers.	1
	13. Cultural Diversity	The community members have a high level of cultural diversity.	1
	14. Topics Relevance to members	Each year, the community has two 1-week-workshops in order to intensify their exchange and tighten their relationships. The FOE, Design guide and Project issue topics have a high degree of relevance for the community members. All members have expressed their interest to communicate and work on feedback of experiences, design guides and Project issues. However a question arises: Could these topics be some topics of cooperation and co-construction of solutions?	2
	15. Geographic Dispersion	The community members are scattered around the world (high dispersion) leading to a high level of cultural diversity.	3

Technological Environment	16. Degree of reliance on ITC	Globally, The community members prefer meeting people directly to solve problems or to use the telephone. They are globally not attracted by technology or other more modern media such as forums.	0
	17. ITC Availability	ALSTOM Collaborative Way can provide collaborative tools for all ALSTOM employees. The collaborative IT environment exists but in Hydro the management has to work on people management and new ways of working to deploy such collaborative ways of working.	4

Table 40: Evaluation of the community configuration

8.2.6 Visualization of the Community Configuration and Level of online interaction forecast

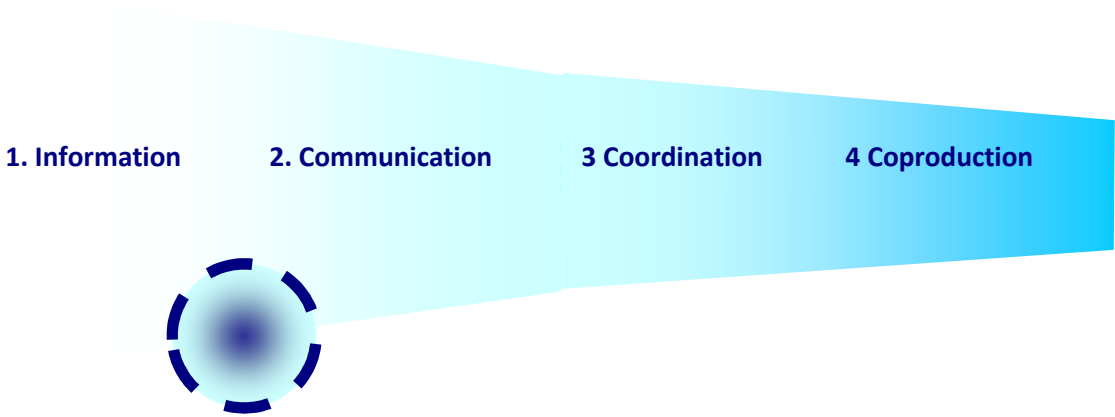
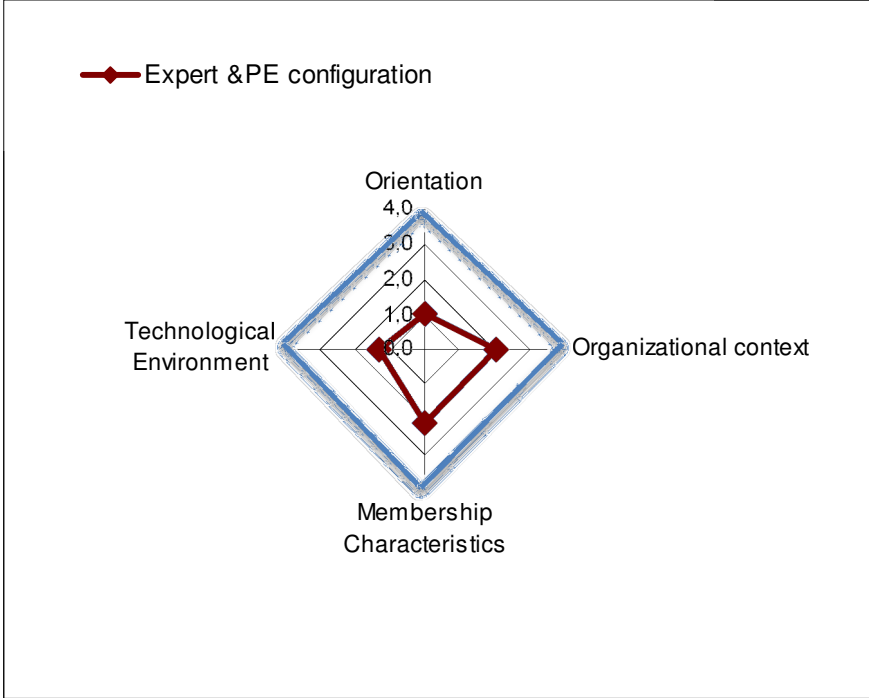


Figure 66: Level of online Interaction Forecast and configuration status of the Expert Community

8.2.7 Expert Community Analysis Conclusion

The analysis performed on the 17 participants in a technical committee, allows us to highlight that today a collaborative platform is not the best leverage to improve this community's interaction.

Before thinking of launching any collaborative tools, work on the community configuration is crucial.

Many reasons were cited by members of the collective to justify their current low interaction frequency. Currently, most of experts are managed by the unit management and are yet over solicited due to a difficult environment of design offices with the pressure of quality, cost and lead-time.

According to our investigation, except Canadians, they do not have concrete and measurable objectives regarding their abilities to work globally. Involved in various projects, they do not have time officially allowed for sharing their Knowledge (FOE) outside project involvement (design review, direct support to designers) or even time for self-training. One possibility could be to extract in ALPS (Alstom people soft: Human Resources software) the objectives of experts and propose concrete and measurable objectives regarding their abilities to work globally.

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CONCLUSION: Theoretical and Managerial Implications

A brief summary the questions asked in this thesis:

- What kind of activities of a Virtual Community of Practice (VcoP) can be supported by a collaborative platform?
- How does one model these activities?
- How does one detect or implement a favourable Virtual Community of Practices configuration that will ensure online collaboration and Knowledge sharing?

Theoretical Contributions

To model the interactions of the studied forums, we have transferred and adapted an existing coding model: the model Rainbow, in the engineering world. Indeed, we have explained that this model was originally designed for modeling synchronous interactions between students and that the original question of the debate was asked by the teacher. We have explained that in this context, the answer existed. The purpose of the debate between students was thus more to deliver an answer according to Plato’s definition of didactic. However, the design activity consists to create new solutions.

That is why; we have introduced the concept of “question” in the sense of “problem” and “idea” in the sense of “proposition of solution”.

Our enriched rainbow model is one of the theoretical contributions of this thesis.

Then, this coding scheme allows us to demonstrate that a collaborative platform such as a forum can support different levels of interaction from information transfer to the co-construction of knowledge.

Scale	Interaction Dynamics
1	Information
2	Communication
3	Coordination
4	Production

Table 41: Scale corresponding to the interaction dynamic forecasted online

Our work has also allowed for empirically testing some theoretical grids from scientific research and proving their operational interest.

The first theoretical grid used was the interface grid (adapted from Koike and Surbier). The second one was the virtual community of practice configuration (adapted from Dubé).

Our exploratory study and our experiments have proved the relevance of these enriched analysis grids. On one hand, an accurate diagnosis of the interface was done. On the other hand, an appropriate analysis of the community’s behavior and functioning was done.

By testing the enriched community configuration grid, we have empirically validated some key success factors of virtual communities. We have also identified 2 key success factors inherent to the success of an online engineering community.

Here below are the criteria that will play a key role in an engineering community:

Benefits	Critical Success Factors
A CP allows: Collaboration, Knowledge sharing and co-production of solutions.	<ul style="list-style-type: none"> ▪ Community Objectives ▪ Context ▪ Level of sponsorship = Context : Time to build up the CoP ▪ Consensus on Leadership ▪ Member stability ▪ Topic relevancy ▪ Membership Mutual Recognition ▪ ICT skills

Table 42: Key success factors for engineering community determined in our analysis

Compared to the table 34, we remove several criteria and added two Critical success factors for an engineering community:

- The topic relevancy which corresponds to the nature of the problem formulated in the platform. If the problem is urgent, the platform is not the best medium to support the discussion because, an urgent problem has to be closed within 3 days before generate huge problem for the designer.
- The membership Mutual Recognition refers to the balance of qualitative and quantitative contacts between community members that allow building the “trust” among members. The mutual recognition can be high or low. A low MMR refers to a mutual recognition imbalance. This phenomenon can be identified when some members are over solicited and some other never solicited.

We then developed a tool for a quick visualization of community configuration which forecasts a projection of their capacity to go online. Because a collaborative space is not useful and desirable for any virtual community, before setting up one up, it may be wise to seriously consider the need for such space to avoid investing in a collaborative space that may never be used.

We have proven that our tool used to project the state of a community turned out to be very useful and reliable in projecting the capacity of a community to collaborate online.

Finally, the contribution that this work/study makes lies in the interdisciplinary approach adopted to tackle the issue of knowledge management. This transversal research aimed at enriching the engineering field of knowledge management with a reliable interface model, community configuration model and coding scheme proposal. Throughout our research, we have tried to never segment the science. We have always tried to use its various disciplines to enrich our work. We made the decision to adopt an integrated vision of the concept of knowledge, with the same importance given to the instrumental vision, and the pragmatic and interactional vision. We used grids from Industrial Engineering Science to assess management practices and vice versa.

Industrial Contributions

Our thesis gathers the four criteria that ensure the quality of action-research: Participation, real-life problems, joint meaning construction and workable solutions.

Our work has consisted of endless recursive loops between scientific models and the company. We have changed, to a certain extent the way our industrial partner thinks about knowledge management and international collaboration. We have brought external knowledge to the topic of knowledge management by doing a literature review of over 150 scientific articles. Through our restitutions and interaction with the industrial partner, its way of reasoning problems has progressively changed.

We first explained to our partner that a multitude of research dealing with knowledge management topics, as well as many tips and methods were-already in existence to improve their current practices of formalization and dissemination of knowledge. We also explained that these practices existed according to a certain vision and understanding of "knowledge". We have exposed, on one hand, the vision where knowledge was regarded as a "transferable" object and reducible to information. And on the other hand, a pragmatic vision with an understanding of knowledge as a relationship between an individual and the world with which he interacts. We have also explained that we believe that these understandings of

knowledge were complementary. Our interest was therefore to help the industrial partner to set up a balanced system of knowledge management and switch from local knowledge sharing practices to global.

Today, industrial companies set up more sophisticated collaborative platform such as SharePoints to manage global collaboration. This instrumentation may lead to huge costs. Our work is interesting because we propose a method that is a decision-aid tool for management teams. Our methods allow any participant interested in the setting up of Vcop to understand the behavior and influences of the studied community and anticipate its capacity to go online.

The interest of our method has been safely illustrated thanks to the analysis done in the expert community. The interest of our method has also been illustrated through its use by different internal partners. Indeed, we were contacted by HEM global quality manager to support the setting up of a collaborative platform named HySpec. With our methods, and the feedback of colleague related experience, we have helped them to set up their community and collaborative platform. HySpec is today a success in the sense that the platform has improved knowledge sharing and collaboration among distributed communities

Thus, without claiming to be widely disseminated, our method has been applied to other communities not of communities of practice and the results remained valid.

Research Limits and Perspectives

Our thesis and experimentation are based within the same company. It then has all the limitations of this single case study and therefore can not claim a generalization. However, it responds to the vocation of a doctoral work that is to enrich the theoretical corpus, deepening a line of research, namely that of knowledge management.

Several perspectives can be outlined from the work presented here. Firstly, the applicability of this method in other industries should also be validated. Other companies in the low-volume field should be investigated, for example in the aerospace field (Airbus). This implementation will highlight other challenges.

Further work has to be done in order to achieve automatism in the interaction dynamic modeling and visualization. Also, the indicators can also be in part, monitored automatically, and online collaboration traced. We explored different methods of tracking the exchanges within the collaborative platform. At present coding is done by hand but it remains a strong

possibility that in future works opportunities to automate indicator collection and the building of representation of communities exchanges will arise.

At present, it remains difficult to measure the effectiveness of a forum. Most people have a desire to set up indicators for quantitative findings. But, there is value to be measured by indicators of the improvement of employee feelings, a gain of interest in their work...It is also a good idea to highlight the problems avoided due to the improved interaction among employees and their access to information. Measuring the value of the problems avoided is not a simple thing. This is found in the Glitch concept which we briefly introduce.

The sharing of knowledge is inherently difficult to measure (Kogut and Zander, 1992; Grant, 1996). However, Hoopes and Postrel (1999) have defined the concept of "glitch". The "glitch" counts the number of critical errors on a project related to poor circulation of information and knowledge. Glitches are defined costly mistakes that could have been avoided if some of the parties involved had understood things that were known by others participating.

In fact, improved sharing of information and knowledge is correlated with a reduction of "glitches" that is to say to the reduction of errors.

Hoopes and Postrel (1999), the "glitches" can be avoided if the actors have the knowledge and are able to understand and interpret this knowledge. Thus, the objective of management is to define clear rules for exchange between stakeholders in order to reduce errors related to inadequate flow of information.

Hoopes and Postrel (1999) demonstrate that as well as improving knowledge,-sharing increases the performance of the development of new products by reducing errors and lead-times.

We might be able to use their work to map previous errors and avoid re-making them thanks to the improvement of the collaboration among remote colleagues using forums to communicate.

The knowledge sharing: A key goal for occidental engineers

We therefore would like to close this thesis with a constat.

Globalization has led Chinese and Indian units to integrate knowledge from western partners for more than 20 years. The next wave is the shift of Asian units "*from good imitators towards true innovators*" (*Interview of Yves Doz in the journal Knowledge of the Insead*). We are all playing in a global world where we have to be able to learn from each other regardless of background, location etc.

Accoring to Yves Doz and Wilson Keeley (Doz Yves L and Wilson Keeley 2013): "*knowledge flow is reversed*". Indeed, for years, companies used to bring western capabilities to new acquisitions without searching to make a loop by bringing back ideas and knowledge from

abroad units. What is new today is that central teams have to be able to set up the right system to benefit from the knowledge and innovative capabilities of the periphery. They have to be able to integrate and aggregate the knowledge diffused in a network of members' separated into units.

Following this thesis, the linear information systems design with a rationality of knowledge prescription is not relevant anymore for actors working in product development activity. These systems have been designed with a rational vision of the Product Development where some of the actors think and the others execute. These information systems have to be complemented by some collaborative practices.

That is why the management has to create a balanced system, that is to say, solicitate different methods to allow employee interaction.

Alstom Hydro has to pass from a global model to an international one as represented in the figure 30 (p.97) where distributed network and communities are created.

Our humble contribution is to say that in a global environment and a distributed context, a forum could improve to a certain extent knowledge sharing between the central research team and the local design offices and between design offices themselves, and more generally, the communication and collaboration among members of an international company.

In other words, evaluating the configuration of a Virtual Community of Practice (VcoP) allows for the forecasting of various collaborative online activities ranging from information transfer to co-production of solution and knowledge sharing.

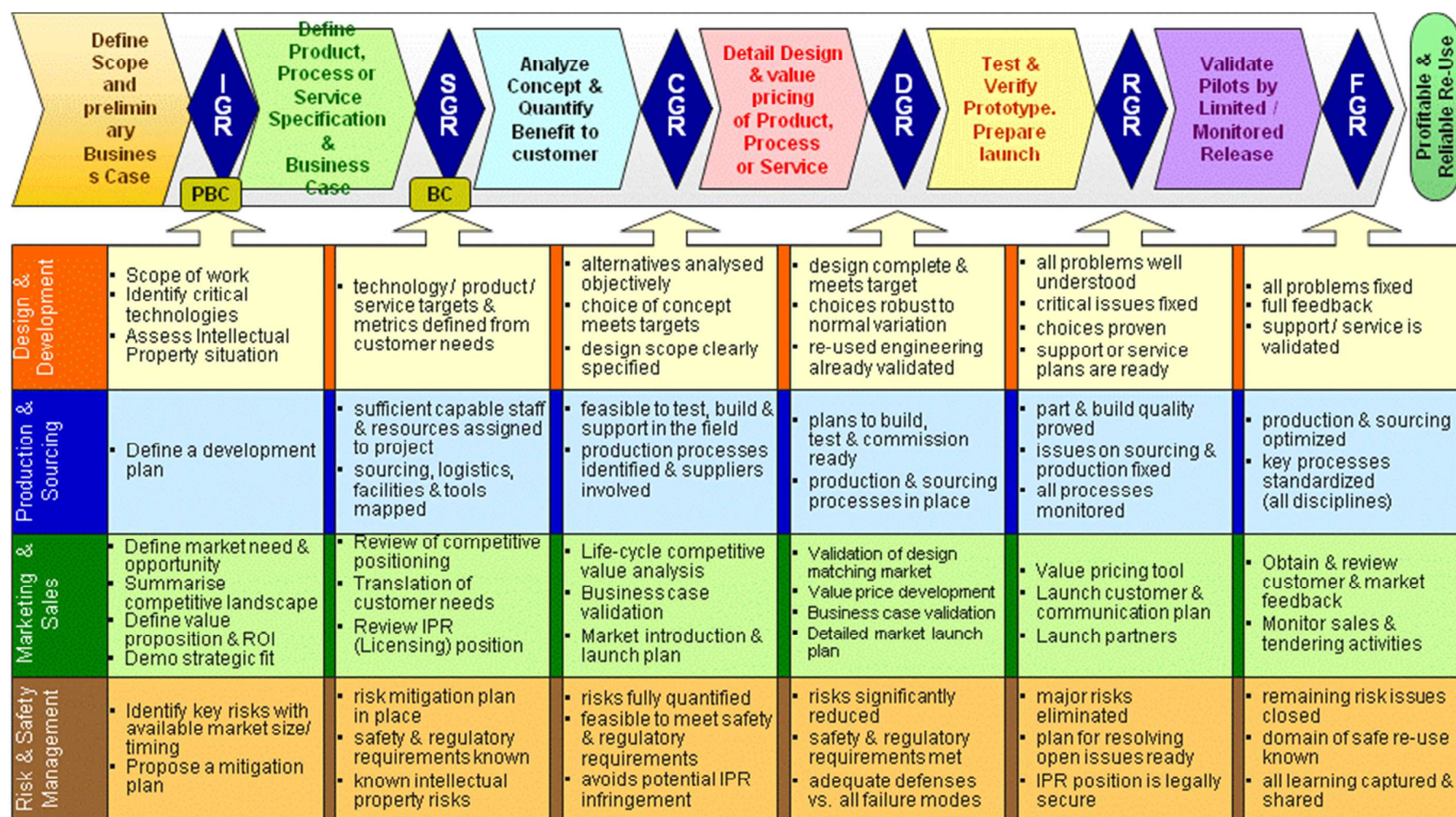
To the question: "*what have you learned by writing your thesis*"?

I would also say that I have learned, among all other things that a global company is an extensive ground of communication and global collaboration. If yesterday's R & D was centralized with a linear model of information and knowledge prescription, today, in order to continue to innovate, the R & D management teams would have to drain ideas from different sides of the planet, then intelligently orchestrate, integrate and aggregate them. In order to continue to demonstrate the sustainability of the work division within the product development process, local teams have to be capable of collaborating together. Central teams must give the time and means to their employees to learn and work together. This is

critical to the quality of the products developed and the capability of the company to continue to design and manufacture products of quality worldwide.

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4.1 Product Development Quality Process



4.2 Company Key Dates

L'HISTOIRE DE NEYRPIC (Français)

1854 Création par Casimir BRENIER d'un atelier à La Tronche près de GRENOBLE.

1867 Sous l'impulsion d'Aristide BERGES, la maison BRENIER se lance dans la fabrication des turbines hydrauliques.

1917 Formation des ateliers NEYRET-BEYLIER et PICCARD-PICTET (N.B.P.P.).

Implantation sur le site actuel de BEAUVERT.

1927 Les Constructions Electriques de France, dont l'ALSTHOM sera le successeur, prennent une participation importante dans le capital de N.B.P.P.

1948 La Société adopte la raison sociale NEYRPIC.

1949 - INTERNATIONALISATION DE NEYRPIC

1949 Création de NEYRPIC ESPANOLA - Création de NEYRPIC ARGENTINE.

1955 Le laboratoire d'hydraulique devient une Société indépendante : SOGREAH (Société Grenobloise d'Etudes et Applications hydrauliques).

1959 Entrée de NEYRPIC sur le marché des équipements nucléaires.

1967 NEYRPIC devient une Division de la Société ALSTHOM, son principal actionnaire.

1969 Création de NEYRPIC SFAC (Appelée plus tard NEYRPIC Creusot-Loire).

1977 Création de l'actuelle Société NEYRPIC, avec comme actionnaires CREUSOT LOIRE (65 %) et ALSTHOM-ATLANTIQUE (35 %). Elle continue les activités énergie hydraulique et nucléaire. Les autres activités sont poursuivies par l'établissement NEYRTEC d'ALSTHOM-ATLANTIQUE qui s'implante à PONT de CLAIX.

1978 BVS fusionne avec NEYRPIC.

1979 NEYRPIC prend une participation majoritaire dans SDEM.

1985 A l'occasion des opérations de liquidation de CREUSOT-LOIRE :

- NEYRPIC devient filiale d'ALSTHOM (50 %) et de FRAMATOME (50 %),

- NEYRPIC prend le contrôle de son licencié brésilien MECANICA PESADA

10/1989 NEYRPIC cède son activité Nucléaire et Mécanique à la Société NFM - NEYRPIC FRAMATOME MECANIQUE - filiale de FRAMATOME et devient filiale à 100 % de GEC ALSTHOM.

- NEYRPIC décide de centrer son activité sur l'hydraulique,

- Les activités mini-hydro. sont transférées chez sa filiale DUMONT.

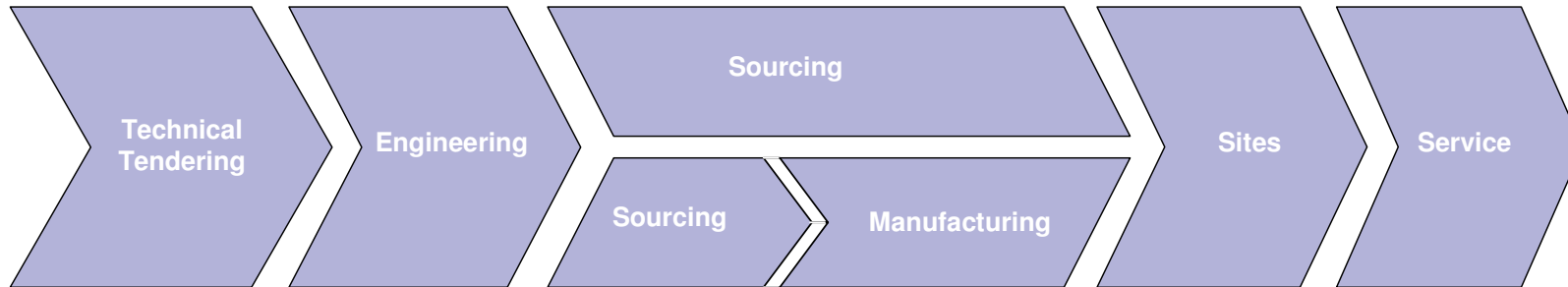
1992 Augmentation du capital de NEYRPIC DE 70 039 300 FF à 170 093 300 FF.

1993 NEYRPIC change de nom et devient GEC ALSTHOM NEYRPIC (GANP).

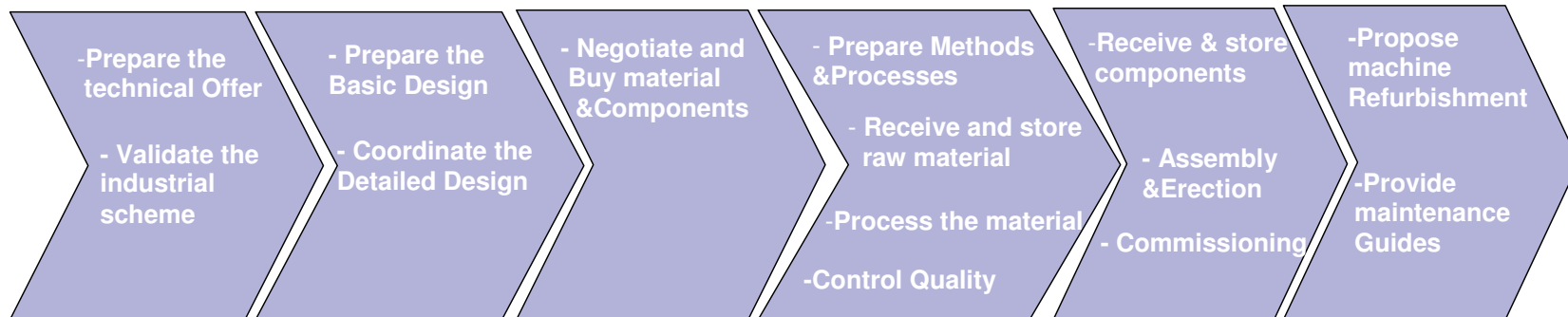
4.3 Improvement proposals done on Pelton Flasque Common Design

Product life through technical activities work-flow

Technical Functions



Main Technical Activities



4.4 Presentation of the follow up Methodology used to ensure the formalization of Expert Knowledge

<p>Document Presentation</p>	<p>The following document will present the follow up methodology used to ensure the formalization of knowledge for subject A, a manufacturing expert.</p> <p>First, we will present the methodology and the planning followed. Then, we will explain the objectives assigned for each interview and we will detail the work achieved by the Ombudsperson and the expert. In order to clearly explain how we have proceeded, we propose a system of “Note” to explain how exactly we handle our mission and a system of “golden Rules” to highlight key rules regarding the method we have followed to handle the interview. These “notes” and “golden rules” could be useful for further projects.</p> <p>The idea is to really capitalize on that project and propose feed back on personal experience to help colleagues to handle that type of KM initiative in the future.</p> <p>At the end of this document, a research note is proposed.</p>
<p>Context Presentation</p>	<p>Objectives assigned by Management:</p> <p><u>First Objective:</u> Ensure the standardization of the way Francis runner turbines are manufactured in a Hydro plant <u>How?</u> Set up and provide a « Francis Runner Manufacturing guidelines » to ensure that each Francis manufactured in Hydro a plant respects the same manufacturing methods.</p> <p><u>Second Objective:</u> Deploy a methodology to help Experts formalize their knowledge and deploy engineering and manufacturing processes and guidelines.</p>
<p>Persons involved</p>	<p>Expert: A Ombudsperson: B</p>

Methodology Representation¹⁴

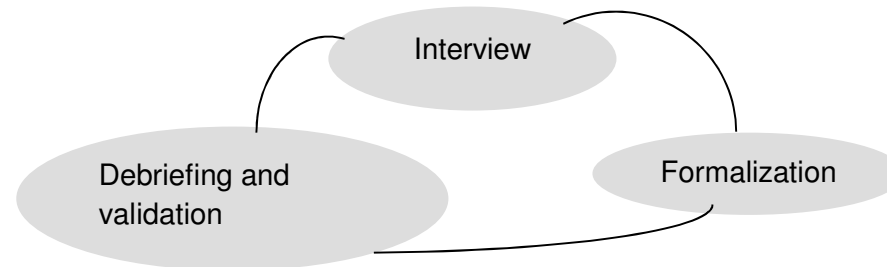
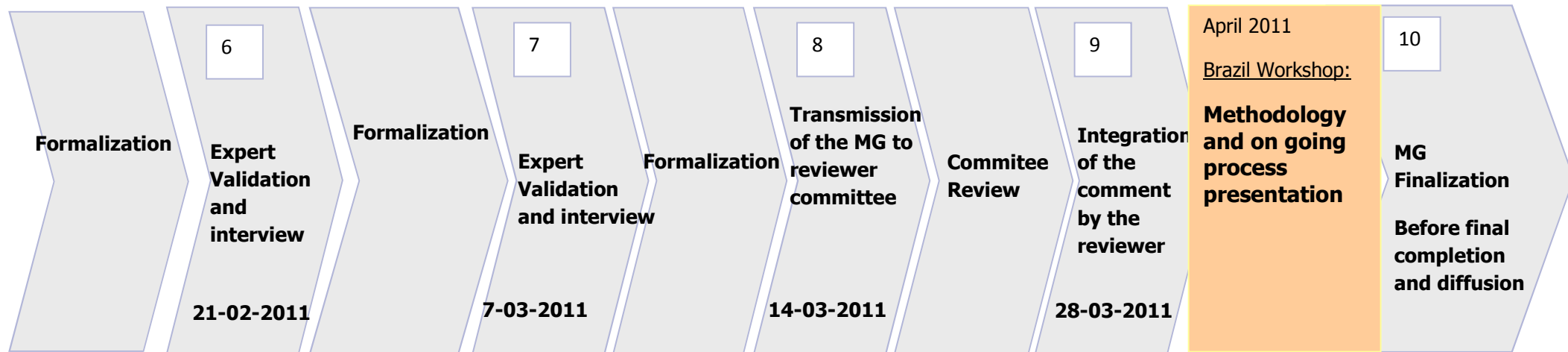


Figure: Knowledge Capture and Formalization cycle From Mask Method of Jean-Louis Ermine

¹⁴ Based on the work of Jean Louis Ermine (Atomic studies Centre). *Chapitre 8 : Le livre de connaissances, support et outil pour le recueil et la transmission des connaissances. Dans l'ouvrage : Management des connaissances en entreprise, Ermine et Boughzala, 2003, Edit. Lavoisier.*

Planning



Legend

□ Interview

2. Objectives assigned for each interview and detail of the work achieved by the Ombudsperson and the expert.

Interview n°1: 12th January 2011

Objectives:

1. Obtain a mutual and common understanding of the work to achieve

Golden Rules:

In order to check that both parties have a shared understanding of the work requested by the management, the ombudsperson has to ask the expert to express his understanding of the need formulated by the management. Then, the ombudsperson has to express his or her own vision of the request to obtain a mutual and common understanding of the work to achieve. The Ombudsperson and the expert must be consistent and fully agree with the work to be done.

If the understanding is not shared, the ombudsperson has to clarify the objectives of management and demystify the subject by showing examples of similar project achievement if necessary.

2. Obtain a mutual and common understanding of the scope of the document and the way it will be used

Golden Rules:

The ombudsperson has to ensure that the scope of the "manufacturing guidelines is clear to both parties: What, to whom, how, when, where... Determinining the target of the guideline is crucial. The guideline's organization and content have to be suited to the skills of the receiver to be understood and well handled.

3. Agree on a Methodology and follow up planning

Golden Rules:

According to our methodology, the expert had to identify a panel of reviewers (The reviewing committee shall include users of the Manufacturing guideline). When the identification is done, the expert has to Inform the reviewing committee about the project and inform them about the date when they will be involved for reviewing the guidelines. For the review our Project, we selected: N,B,C

During the discussion about the methodology, the expert proposed that I start from an existing document already written by him. We agreed to work from this document and not to **carry out** any research of other possible guidelines within ALSTOM (within Archives for instance).

Regarding our tools, we used: Net meeting, computer, phone, notebook

4. Agreed on key principals:

Golden Rules:

On one hand, the Ombudsman is committed to helping the expert to select and explain his knowledge. The Ombudsman is committed to formalizing, structuring and ordering the information transmitted by the expert during the interview. He undertakes the showing of the results of the formalization based on its progress and with a great attention to detail.

Formalization n°1

Objectives:

Propose and send to the expert:

- The document scope, objectives, Target
- The Formalization of the Methodology proposed and the key agreements undertakes by both party

On the other hand, the expert must be committed to freeing up time between interviews. If necessary, identify an imputation code to determinet the time spent on the project. The expert undertakes the task of expressing, his state of mind on the work in progress (How he perceives the progress of work, does he feels helped by the ombudsman).

Golden Rules:

Confidence is key to progress in formalization. This confidence will be gained by the expert if the Ombudsman respects and brings an added value to the expert all throughout the project.

Few behaviour rules have to be respected by the Ombudsman. The ombudsman has to let the expert to talk freely and avoid cutting him off when he tries to explain something. Usually, the expert will ask spontaneously if it is clear, if his receivers have understood or not. The ombudsman has to wait for his question to express if necessary his difficulty in understanding. Also and even if it seems to be obvious, criticisms, judgments as well as the disrespectful statements are to be avoided. The idea is really the valorization of the experience gained by the expert and to help him to organize most of his explicit knowledge in order to let other employees to gain .this same knowledge.

Interview n°2: 24th January -2011

Objectives:

- 1. Debriefing on the methodology and especially about the planning**
- 2. Debriefing on the document model including: The document scope, objectives, target**

Note: Even if we started from an existing document, I had to help the expert to express a global vision of the key stage to manufacture a Runner. The key stages that structured the product manufacturing within the workshop were a key stage of this second interview.

- 3. Identification of the key stages or phases of the manufacturing process**
- 4. Exchange about stage 1 of the process**

Golden Rules:

- The Ombudsperson has to think as the receiver does while he or she awaits explanation.
- The Ombudsperson needs to force the expert to detail his thoughts making him realize progressively the complexity of the information he manipulates and the jargon he uses. The jargon should be defined in a glossary attached.
- The Ombudsperson shall drive the expert to systematically explain his or her rational thinking. Why like that? Why now?
- The difficulty of working in different places is that the expert's reasoning works mainly by drawing. "*A good drawing is better than a lot of words...*"
- The drawings are not captured by the Ombudsperson during interview. The expert must therefore redouble efforts to verbalize his knowledge.
- The difficulty for the Ombudsperson is in memorizing all the information collected during the interview. Even if the expert mainly pursues a work of simplification, the amount of information is still important.

Lessons learnt: Maybe it would have been interesting to use a microphone to record the conversations.

Formalization n°2

Objectives:

Propose and Send to the expert:

- A Formalization of the stages or phases of the manufacturing process
- A Formalization of stage 1 with a proposal of a logical organization of information within each stage including: Receive Input Data, Prepare the work, Process machining...
- A Proposal of a drafting rule.

Note: For our work, we agreed that within each stage are listed the actions to be implemented. An action is formulated with the use of a verb. Actions are ordered chronologically. A system of definition, note and warning is in place to explain an action or warn the reader about something that he or she has to pay attention to.

<p>Interview n°3: 31st January -2011</p> <p>Objectives:</p> <ol style="list-style-type: none"> 1. <u>Debriefing on the proposed logical organization of information within the document</u> 2. <u>Debriefing on the formalization of stage 1</u> 3. <u>Follow up of the exchange related to stage 2</u> 	<p>Formalization n°3</p> <p>Objectives:</p> <p>Propose and Send to the expert:</p> <ul style="list-style-type: none"> - A Formalization of the interview N°3, A Formalization of stage 2
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<p>Interview n°4: 7th february-2011</p> <p>Objectives:</p> <ol style="list-style-type: none"> 1. <u>Debriefing and validation of the formalization done for stage 2</u> 2. <u>Follow-up of the exchange related to stages 3 and 4</u> 	<p>Formalization n°4</p> <p>Objectives:</p> <p>Propose and Send to the expert:</p> <ul style="list-style-type: none"> - A Formalization of the interview N°4, A Formalization of stages 3 and 4
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Information Session n°1	Date	Content
Status meeting with HEM Director	10 February 2011	<p>Presentation of the follow up method and the guideline progress to Sergio,</p> <p>Sergio's Comments:</p> <ul style="list-style-type: none"> - Presentation of his vision: Process type "IKEA, " Philosophy of a visit guided such as the "<i>Hergé Museum</i>" in Belgium - Presentation of good practices identified in India "<i>3d drawings</i>" - Reminder on the importance of connecting the guideline with the HMC concept and the QQQ initiatives. -

<p>Interview n°5: 14th February-2011</p> <p>Objectives:</p> <ol style="list-style-type: none"> 1. <u>Debriefing and validation of the formalization integrated the comments made by HEM Director</u> 2. <u>Validation of the formalization of stages 3 et 4</u> 3. <u>Follow up of the exchange related to stages 5 and 6</u> 	<p>Formalization n°5</p> <p>Objectives:</p> <p>Propose and Send to the expert: - A Formalization of the interview N°5, Formalization of stages 5 and 6</p>
<p>Interview n°6: 21-February-2011</p> <p>Objectives:</p> <ol style="list-style-type: none"> 1. <u>Debriefing and validation of the formalization of the stage 5 and 6</u> 2. <u>Follow up of the exchange related to stages 7 and 8</u> 	<p>Formalization n°6</p> <p>Objectives:</p> <p>Propose and Send to the expert: - A Formalization of the interview N°6, Formalization of the stage 7 and 8</p>
<p>Interview n°7: 7th March-2011</p> <p>Objectives:</p> <ol style="list-style-type: none"> 1. <u>Debriefing and validation of the formalization of stages 7 and 8</u> 2. <u>Global revision of the document before sending to the reviewing committee</u> 	<p>Formalization n°7</p> <p>Objectives:</p> <p>Propose and Send to the expert: - The Formalization and integration of the corrections and improvements made by the expert</p>

<p>Interview n°8: 14th March 2011</p> <p>Objectives:</p> <ol style="list-style-type: none"> <u>Debriefing and validating of corrections and improvement proposals</u> <u>Transmission of the guidelines to the reviewing committee</u> <p>Golden Rules: Reviewing objectives: correct the manufacturing guideline and insert all the necessary feedback to improve it.</p> <p>Note: One week was given to the reviewer to ensure the reading and correction of the document</p>	<p>Formalization n°8</p> <p>Objectives:</p> <p>Propose and Send to the expert:</p> <ul style="list-style-type: none"> An Integration of the comments and corrections made by the committee <p>Note: To formalize the progress brought about by the collaboration with our reviewers, a monitoring table was created:</p> <table border="1" data-bbox="1205 499 2157 799"> <thead> <tr> <th colspan="3">Reviewer Feed back qualification</th> <th colspan="3">Expert Reaction Qualification</th> </tr> </thead> <tbody> <tr> <td>Questions asked</td> <td>Problems that arise</td> <td>Comments or suggestions</td> <td>Answer & Proposed Solution</td> <td>Integration of the comment within the Process</td> <td>The problems that arise need more details to be understood</td> </tr> </tbody> </table>	Reviewer Feed back qualification			Expert Reaction Qualification			Questions asked	Problems that arise	Comments or suggestions	Answer & Proposed Solution	Integration of the comment within the Process	The problems that arise need more details to be understood
Reviewer Feed back qualification			Expert Reaction Qualification										
Questions asked	Problems that arise	Comments or suggestions	Answer & Proposed Solution	Integration of the comment within the Process	The problems that arise need more details to be understood								

<p>Interview n°9: 28th March 2011</p> <p>Objectives:</p> <ol style="list-style-type: none"> <u>Revision of the comments issued by the committee.</u> <u>Integration or rejection argued at the monitoring table.</u> 	<p>Formalization n°9</p> <p>Objectives:</p>
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Information Session n°2	Date	Main Outp
Methodology information session	April 2011 Brazil	

4.5 Action Plan to set up a collaborative Platform

	OPERATIONAL MISSIONS	OBJECTIVE
1	Clarify the Platform objectives	Write the : Root analysis of the initiative Problem that has to be addressed your vision with concrete examples
2	Expose a General Design of the Collaborative Platform	Have a global idea about: the platform structure, Users, Objectives, Main technical Specifications
3	Position the platform initiative into the quality landscape and Corporate and Hydro initiatives	Articulate the platform initiative with the action of the QQQ ALSTOM plan Articulate the platform initiative with ACW strategy Articulate the the platform initiative with the community objectives
4	List all the specifications of your platform	Set up the whole specifications of the platform
5	Send a Request to open the platform to ACW and Ask a training to be able to program your specifications on SharePoint	Officialise your Project
6	Be train on Share point	Try to set up your technical support committee Start to Program your space on Share point.
When the platform is nearly finalized		
7	Prepare users documentation	Support members to connect and to understand how to use the tools.
8	Prepare training sessions documentation	Support moderators to connect and to understand how to use the tools Train moderators about their roles and their missions
9	Prepare the Invitation letter to invite members to connect to the Collaborative Platform	Create the event : Event title : "Engineering Corner"

Community

10	Kick-off meeting with managers	<p>Present the collaborative platform to the "Steering Community". It's objectives and functionalities:</p> <ul style="list-style-type: none"> - Information exchanges - Collaboration - Social Networking <p>Define or present the pilote ('Members and Moderators) of the the communities:</p> <p>Present the main stage of the experimentation and the results expected and involve them in the first stage if needed</p>
11	Develop the "Mutual Understanding" documentation	<p>Prepare the Working sessionfor community Members including :</p> <ul style="list-style-type: none"> - "Mutual Understanding" PPT presentation for the Community - Questionnaire <p>It can be done by the Managers</p>
12	Deploy the "Mutual Understanding" working session	<p>Organize the meeting with all the community members and animate the working sessions in order to:</p> <ul style="list-style-type: none"> - Ensure the relevancy of the current community perimeter in order to redesign it if needed - Obtain a precised view of each member experience and knowledge - Inform, motivate, detect the common interest focus of members - Analyze the data collected - Fine tune the community according to the results of the working session (Remove members and add new one if it is requested and agreed by the community members) - Build the communities and initiate their collaboration
10	Book the agenda for the training session of community members	Reserve the room and resources requested
11	Animate training sessions for Users	Train users in their roles and missions within the platform
12	Animate training sessions for Moderators	Train Moderators in their roles and missions within the platform
13	Open the platform and send the Invitation through e-mail	Invite members to connect and to use the collaborative platforme
14	Set up information sessions for people interested	Present the experimentation Project to other department if requested

During the platform deployment

15	Accompany the community toward the platform utilisation	<ul style="list-style-type: none"> - Ensure a hotline and solve the users difficulties - Work closely with users and support them in their handle of the platform - Work closely with moderators to ensure consistency - Integrate and program new options - Monitor technical improvement on the platform if requested
16	Improve the existing KPI	<ul style="list-style-type: none"> - Work on the Automatisation of the indicators reporting in order to record the activity on the platform - Propose enhancements on the scientific grid dedicated to characterize the activity of the observed communities
17	Model the platform activity	Analyze the platform activity and demonstrate if it generates some knowledge Sharing and learning
18	Propose a weekly Newsletter and send it through e-mail to community members	<ul style="list-style-type: none"> - Inform community members about the platform activity and key problem raised up
19	Deliver a survey	Build an assessment program to understand what the community member feel regarding the platform and ensure modification if needed
20	Benchmark company collaborative platform	
21	Report the platform activity	Report what has been observed in the platform

4.6 Specification proposals for an engineering collaborative platform

One of our main constraints was setting up a collaborative platform in the given IT environment of the company. We first spent time trying to understand how the current tools proposed by the company worked, their functional possibilities and the technical IT language used to program the platform. We quickly realized that to set up a space friendly and ergonomic system, we had to ensure a bit of programming in HTML.

Then after understanding the technical possibilities and limits of the environment proposed, we ensured the operational deployment of the collaborative platform with the support of two persons working in IT coordination in Poland. At the beginning of the project and during the first month, our Polish supporters were solicited every day. After having understood the global principals, we became more autonomous so as to be able to ensure the technical programming of the platform unaided. However, throughout the deployment phase our technical supporters were still very much essential in aiding us.

We spent several hours with moderators and users to collect their needs. Our main challenge was setting up a platform answering user requests but with the limits imposed by the given IT environment of the company.

4.6.1 Pragmatic advice before launching a collaborative platform drawn from literature

The literature was very abundant regarding how to set up and run a forum applied to Product Development . We propose thus to synthesis all the advices drained in scientific articles and professional blog about collaborative platform implementation.

The main objective while setting up the collaborative platform is to transform the needs of users into an ergonomic platform appropriate for them on all levels. The first idea is to think ahead with users how to facilitate the management of content over the long term. The secondary idea is to co-construct a platform with users, making them complicit in the projects' technical deployment of the tool in a participative rationality.

The tool will to a certain extent organize the collective action in the community because the nature of what will be exchanged or not will depend on it (images, texts, videos ...).

However, if the community is motivated, the technical limitations won't be barriers in the use of the platform.

Principle: The main principle of a collaborative platform is to let members discuss and exchange informally. Criticisms, harsh judgments as well as disrespectful statements are unwelcome. The idea is to encourage members to bring up problems and create debate through sound argumentation.

Confidentiality: Because the platform is hosted by the official Information System of the company, all content is secured and managed by an access rights system.

4.6.1.1 Define a critical number of participants

Critical mass is a key concept in the success or failure of virtual communities. The community leader must ensure and maintain an appropriate number of participants without exceeding a "critical mass". The number of people that define critical mass is not clearly stated because it depends on the resources given to the management team of the space. It should in any case be able to generate enough content without falling into a chaos of posts that do not allow simple control. The critical number is at the discretion of community leader and moderators of these spaces.

However, note in this respect, a general platform that will generate exchanges of connections between users in the professional sphere must start with a small number of members (<14).

4.6.1.2 Inform the management of the community members upstream

The management has to obtain a global presentation of the main stage of the project, the members of the community and the results expected to involve them in the first stage if needed.

Question that has to be answered: Why set up a Collaborative platform for Engineers

The role of a collaborative platform is usually tied to addressing key issues or answering a collaborative need. There is no exhaustive list of platform objectives. However, the pillar of any platform objective is to improve and facilitate the collaboration within a community. It is thought of as being a dynamic system enabling one to support knowledge mediation and co-production between actors.

4.6.1.3 Fulfill the specific golden rules for an engineering population

Encourage the problem setting

In an industrial context, it is usually recommended to propose solutions as opposed to asking questions or raising an issue. Nevertheless, it is thanks to problem sharing that team and community members will improve their knowledge. Being able to ask questions and raise issues has to be encouraged by the management as they seek to set up a collaborative spirit in a collaborative platform.

The platform has to be of value to the users but does not have to manage urgent problem solving.

In the design office, the pressure induced by the “quality-cost-lead-time” objectives does not really help in the set up of a collaboration dynamic that could be perceived as time consuming. In that sense, members first have to be aware of the benefits they could draw from this global collaboration. Secondly, the topics shared have to be relevant and as much as possible, not linked with a direct urgent operational issue that is more convenient to discuss by phone or face to face with experts.

Visual reasoning would occupy 40% of the collaborative activity

In engineering and especially in design activity, describing the cognitive processes of designers relies on visual reasoning. We know that the information communicated and documented in engineering design includes sketches, design requirements, constraints, functions, behaviors, concepts, and ideas. Visual representations are especially important in design for sharing/conveying ideas and for documentation. Because pen and paper is a primary medium used in design, the inability to easily record sketches and other hand produced visual representations is a barrier to the first step toward collaboration between design offices. A numeric table can also be budgeted beforehand. Consider using: tablets, cameras, and touch screen tables to complement the use of the platform.

4.6.1.4 Set up KPI

In terms of quantitative data, interesting figures to look at for example are:

- Number of users
- Number of connections by user and per month
- Number of comments per topic written by user per month
- Number of comments or topics read per user
- Number of new topics created per month
- Number of users involved per discussion

In terms of qualitative data (concerning the nature of the exchanges) areas to look at are:

What kind of information is shared within the platform?

- Does the platform gather problems, issues?
- Does the platform gather solutions?
- Number of days to close a discussion
- Lead-time (Nombre of day) to actualize a standard, a common design...

Identification of "Champions"

Some members will immediately show special attention to interacting with their counterparts and gradually build legitimacy. It is therefore interesting that the system incorporates an automatic categorization such as champion. The "Champions" are the fuel of the community. They will welcome newcomers, answer questions and encourage participation and interactivity on the site.

Reward users for their participation. For example, after 150 replies, designate a user a 'champion'.

Some studies show that it is important to recognize these players and develop them to avoid any disparaging and demeaning on the part of others bothered by these new tools. For example, "Ha, he has time to do this kind of thing ..."

Identifying champions is also a way to indicate the ability of an employee to network which could serve as an index of notoriety to ascribe increases and share variables. It would be a way to address the issue of recognizing these actors with a fairly standard management approach. The management could then detect "network nodes", that is to say, the key circulators of information within the organization. Ref to social net : Becky, Cross

4.6.1.5 Actions to complete when the platform is launched

Work closely with users and support them in their handling of the platform,

- Ensure a hotline to solve user difficulties
- Ensure that Member Profiles are created

You can ask members to complete a mini-CV with questions such as:

- What are your main experiences?
- Do you have a field of study or an area of expertise?
- Do you have a particular topic of interest to share with the community?
- What type of information would you like to receive from community members?
- Do you want to add something about yourself?

4.6.2 ColLeague set up example

→ Ref. Appendix 4.5 for overview of the action plan.

4.6.2.1 Set up the Forum title

ColLeague platform was set up in a participative rationality with all members involved in the pilot of the design community (21 members). To make up a name for the platform, we proposed ColLeague as a combination of the words:

- Collaboration
- League

Forum title: ColLeague

ColLeague is hosted in the official IT system of the company.

4.6.2.2 Define the key objectives of your CP

The objectives were to exchange on common design with European partners and R&D central team and co define new needs for medium Hydro.

4.6.2.3 Define the key roles in administrating the community and their exchanges

Inside Hydro Company, it is hard to get people involved and contributing to a collaborative platform. Experience shows that people need time before actually starting to add content to a collaborative space. Participating in a collaborative platform does not come naturally, the first reaction is to wait and see.

That is why it was crucial to identify the Key Roles of the community members and clearly define their respective activities.

Main Roles	Objectives
Technical Supporter	Support the technical deployment of the platform Ensure that the platform meets the users expectations Support the users in their daily activity on the platform
Animator	Animate the community Encourage users to connect and use the platform Ensure the management of content over the long term

Moderators	Help users to formulate their problems and questions if needed Encourage the problem setting Propose solutions to other user's problems and questions Validate solutions proposed to problems and questions Post topics to share their knowledge and mutualise their Feed back of Experiences Ensure the management of content over the long term
Users	Inform others about problems and questions to be solved Propose ideas to contribute to the solution of other users' problems and questions Post topics to share their knowledge and mutualise their Feed back of Experiences

Table 43: Role identification and objectives

The first idea was to think ahead with the moderators how to facilitate the management of content over the long term. The secondary idea was to co-construct their platform with users, making them complicit in the projects' technical deployment of the tool.

Our main objective while setting up the collaborative platform was to transform the needs of moderators and users into an ergonomic platform appropriate for them on all levels. We ensured the operational deployment of the collaborative platform with the support of It in Poland.

At the beginning, the technical supporter has to be very close to users in order to solve the problems of password retrieval and, create user profiles. A FAQ's space displaying all previous problems and the ways in which they were addressed has been made to newcomers. As such, the FAQ's space will prevent newcomers from asking questions already addressed by members in an earlier phase.

The Animator, himself, has more of a governance role. For ColLeague, He began by raising the issues identified upstream of the community's constitution, and issues of common interest. Note that, the animator is usually the community leader.

The moderator has to avoid any problem in the space. On the Internet, a moderator is a user whose role is to "moderate" a forum on a website (usually community), deleting or moving

any messages that have no place in a discussion forum. A moderator must be impartial in the debate, to temper his personal opinion so that it does not affect his decisions, and only to call to order participants that are off-topic. The moderators have the key objectives of controlling and validating the content posted within the collaborative space. They have to guarantee the technical validity of the solution proposed by community members.

The animators and the moderators have been trained in their roles as well as the importance of their places in the collective. They were guarantors of the success of this space of exchange, and the distance collaboration. Moderators have to demonstrate to members that the interest for them was to not have to repeat the same thing to different people, while encouraging members to request each other if something goes wrong, in this way moderators offload some of the work they must do in terms of technical management (Design Review) of the design activity. They will have also to ensure the management of content over the long term

4.6.2.4 Creating profiles

At the beginning, we impose to community members to identify themselves with their real name and give a picture of them. In other words, prohibit the using of avatars to avoid possible suspicions of identity.

4.6.2.5 Define the Key administration Processes

9.2.5.1 Establish rules of conduct and avoid in certain cases the presence of management

We establish rules of conduct and avoid management presence

Most of the time, it is convenient to set up a "Functioning Charter" that the moderator must make members respect and that helps him to know what to punish. It is about simple and clear rules understood by users. It should also be notified that space is: - open to both solutions and problems and that no one has to judge the questions asked. It is also proven that it is better to restrict space access to managers. Indeed, when management is involved in these platforms, a decline is noted in exchanges between users. These space exchanging should be spaces of freedom and not a show of strength and skills. They must be areas of controversy in discussions to reach a true dimension of learning.

Functioning Charter example given below:

Principles	Definition
Uniqueness & Simplicity	Documents must be stored in a unique location within the platform: Links must be used to avoid the duplicating of information. Simplicity in demanding the right to access information
Quality	The system must be : accurate, valid, up-to-date (Any invalid or out-of-date document must be deleted or archived) reliable user-friendly, ergonomic, compliant with user needs
Responsibility	The individual authors are responsible for any information they publish
Security	Published information must comply with confidentiality rules and clearly specify that it can be used For internal purposes only. All employees who decide to leave their position have to be erased from the system during the notice period.
Dynamic	The system has to allow dynamic exchange between people

Table 44: Definition of Key principals

Note: It can be decided that the content of the system, (especially the documents such as technical instructions, Standards...) are not to be printed or exported from the database to the user computer. We thus have to block some actions for users in the system such as the ability to export discussions related to documents considered to be critical and confidential. Only moderators have this right and if a user wants to manage such action, he has to ask one of the moderators.

9.2.5.2 Allocate time for community members and set up individual collaborative objectives

The community members need support and time granted to their activities. An “Imputation code” for engineering teams has been created to help them to register the number of hours spent on the collaborative platform contributing to the collaboration.

Also it is highly recommended to set up individual objectives at least for moderators in the platform, such as:

- At least contribute 8 times to the co-production of a solution on the platform.
Post at least 1 message by way of open discussion.

9.2.5.3 Define Platform Access rights

The content of the platform has to be protected. Rules and access rights have to be done.

The database is only accessible to patented professionals who are technically supposed to be part of the community or interested in the topics managed.

Depending on the community size, we recommend you set up at the beginning a correspondent list that gives access rights in each location. These local correspondents are under the supervision of the community leader who is usually as mentioned previously the animator. Two positive agreements are necessary in order to give someone access to the platform.

9.2.5.4 Ensure that the platform is able to communicate with the company's various applications

Make direct links inside the platform toward other ITC systems such as Microsoft messaging...

It is also recommended that users be able to easily send a "notification for comment" with a simple click to community members when they feel that they need advice before going further in their work. Community members are notified directly via their email inboxes.

To finish, if the user is working on an existing downloaded document, it is highly recommended to ensure that the document is directly charged on the discussion page, instead of being downloaded in an external page or another window.

9.2.5.5 Users request

A need of the community members was to have the option to classify a topic as urgent. An urgent topic is a topic that needs a prompt and quick solution and validation within 24hrs. Topics classified as urgent are shown in the section "Urgent Topics" on the home page, where all users can see them. Thus, every user can see on the home page these types of problems and can thus try to resolve the topic. The moderators undertake the task of either giving a solution or approving the solution proposed within 24hrs. To be able to classify the

topics I used labels. Each time a user wants to classify his or her topic as urgent, he or she can write “urgent” as a new label for his or her page.

Moderator Request

The moderators wanted a decomposed partial assembly product rationality structure and a good Search engine, searching key-words (even non consecutive) in the title, authors and summary of technical instructions.

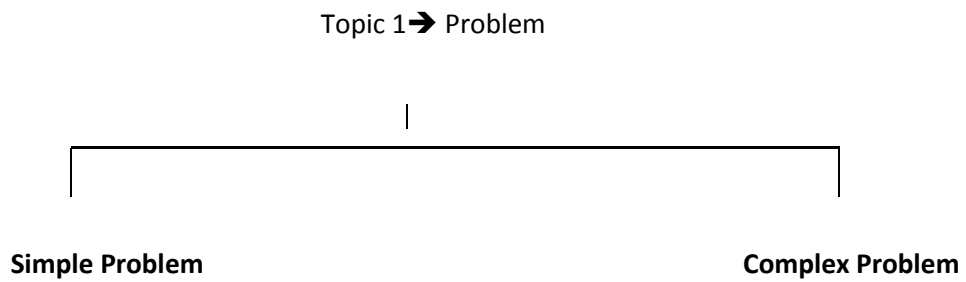
They also requested that a limited access to the platform, only to patented design engineers and professionals who fundamentally are supposed to know the “know why” to succeed in their design.

We have to protect all the content of this database that extra precautions are taken: forwarding technical guides or instructions to a subcontractor/supplier/customer is prohibited. Access rights are defined and maintained by local correspondents in each location, under the supervision of Central research team. Two positive agreements are necessary to permit a new user access to the database.

The platform was thus a private garden.

For the Moderator, we also have proposed a Process of solving problem

We categorize a problem as either “simple” or “complex”. The way to pass from a problem to a solution is as follows:



A simple problem is a problem already faced and with an existing solution known by the moderator. In this case:

- Answer to the post



A complex problem refers to an issue with no existing solution known by one of the moderators. In this case:



- Ask an involvement of the Central R&D teams by email.

- Receive a solution from the central teams or
- Go to 8D methodology (available on HMS)



For the Moderator : Defining the Process of discussion closing

4.6.3 Organizational structure, Ergonomic efforts to fulfill engineering needs

The literature was very abundant regarding how to structure a forum. We propose to synthesis all the advices drained in scientific articles and professional blog about collaborative platform structure.

4.6.3.1 Pragmatic Advices for the Home page

Back to basic- Ergonomic Rules

It must attract immediate interest of the site and allow users to access in seconds the subjects or topics of his interest.

It is recommended that the home page:

- fit on one screen
- be regularly updated

Some important observations:

Only 10% of users scroll through the pages that are outside of the screen. We must therefore think about putting important information at the top of the page.

Always Keep in Mind that the number of clicks to access to the information requested has to be kept to a minimum.

Involve the research rationality of the community members

The structure has to be in line with the research rationality of the community. The first step is to plan ahead with moderators how site content will be managed over the long term.

In the engineering field, we know that the rationality of the designer is based on the product breakdown structure rationality.

It is thus highly recommended to use the Hydro Numbering System rationality to structure the collaborative space navigation.

Set up a search engine

You have to allow the users to access a specific topic within the platform via an efficient Search Engine.

Set up an interface that incorporates the user centric principles

One of the user centric principles consists of showing the user only the information or links he is interested in. For instance, in the show room, force the system to filter on the topic he is interested in.

If this is not possible, offer users a “subscription option for topics”. The users can for instance have the option of receiving through e-mail every update of a specific page or document regarding the entire sub-space activity he is interested in.

Ensure that the user knows at a glance where is he located in the collaborative space

Another key element of the user centric principle is the navigation system. A navigation tree can be visible at the top of the page, while all pages selected by the user can be highlighted with a specific color.

Consider the needs of the user and helping him to easily return to the home page by placing a quick link in each page of the collaborative site.

4.6.3.2 ColLeague Structure proposal

We propose a platform structured in a partial assembly product rationality.

It was important to choose proper ergonomics for the platform.

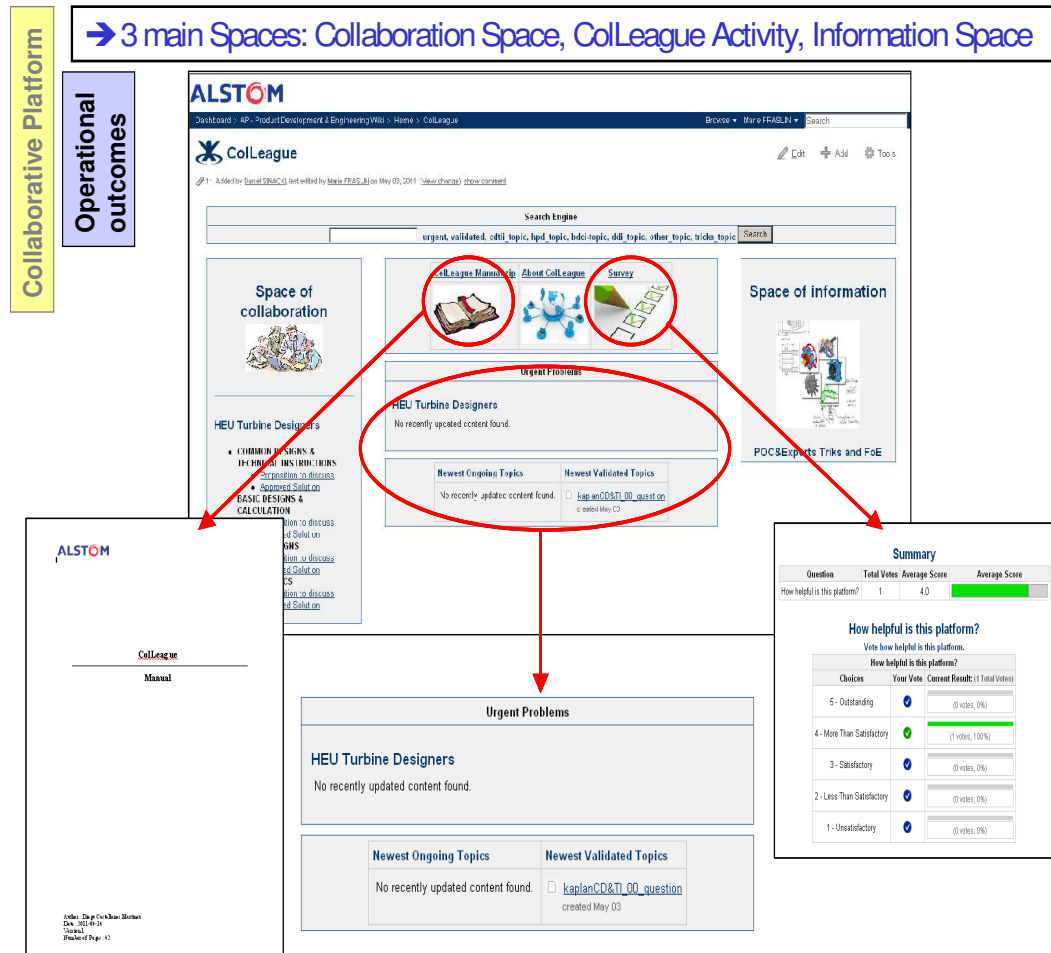


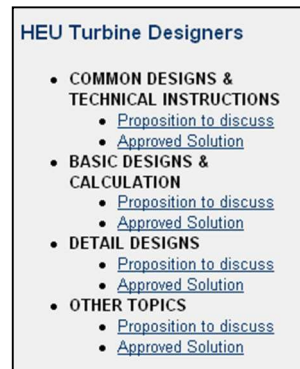
Figure 67: ColLeague Home Page Content

The homepage was divided into three columns:

- Left column: designated to collaboration. From here users can access the main topics and create related sub topics by opening a discussion. The main topics identified are:
 - Common design: this space was created to discuss subjects in relation to instructions from the R&D department.
 - Basic design: this space was created to discuss subjects in relation to basic designs of the design office.
 - Detail design: this space was created to discuss subjects in relation to the detail designs of the design office.

- Other topics: this space was created to discuss subjects without relation to the subjects above.

Screen shot of the structure of ColLeague →



- Each topic contains 2 folders:
 - Proposition to discuss: This space is dedicated to members who want to openly discuss and share unstructured information and problems. The main objective is to ensure the co-construction of problems and solutions between members.
 - Approved Solution: This space is dedicated to storing the discussions that have been validated by moderators and are therefore closed to new comments.
- Center column: here users can find the urgent Problems posted by their colleagues. This Urgent Problems have to be solved within 24 hours. Below, a section "Newest Topics" is destined to show the latest topics posted by users and topics validated by moderators.
- Right column: is the space of information where users can post and read all the tips and tricks that their colleagues have or have learned while working on projects. It is the space of feed back of experience.

4.6.3.3 Set up a Manual for Users and think about offering training

When the platform was ready to be used, user manual was created to help the members of the community (users and moderators) to get started and also to teach them how to use it.

The user manual covers the following topics:

- Log in the Alstom Wiki
- Use of the Platform
 - How to fill in the profile
 - How to make a Mini-CV to foster mutual understanding among participants
 - How to post a topic
 - How to delete a topic
 - How to upload a picture
 - How to attach a file to your topic
 - How to find a topic
 - How to classify your topic as URGENT
 - How to connect to instant messenger application at Lotus Notes software
 - Label key principals
 - How to become a watcher of a page

For Moderators

- The process of problem solving
- How to validate a solution

We also organized training sessions for users and moderators by showing them with examples how to post new topics, and make comments to answer the topics that already exist, etc.

When the platform was launched, we had to:

- Ensure a hotline and solve the users difficulties,
- Work closely with users and support them in their handle of the platform,
- Work closely with moderators to ensure consistency,
- Integrate and program new options,

The platform we set up was not ideal in the sense that we had to develop everything with the existing technology and some of the functionality we wanted to insert was not possible. We

wanted for instance to have an alert system for informing the moderators and users that a new post was created. This functionality was impossible to set up in the given environment.

4.7 Questionnaire 1/3: Working Tie Questionnaire

Working Links

Date :

Please complete this file and send it back to us. It will take around 10 minutes. Thank you :-)!
Name of the Project Leader

Page 1/3

How to fill in this chart ? Really easy :-)!
for instance, you are A, take the column 1 and complete it from top to bottom.
a. Do you know this person ? : Yes=1 or No=0.
b. Do you work with this person more than twice a month? : Yes=1 or No=0.

Color code	To know means : "To know the role and activity of this person in alstom".
Question 1 (Left column)	Do you know this person ? : Yes=1 No=0.
Question 2 (Right column)	Do you work with this person more than 2/month? : Yes=1 or No=0.
	Work means : "to be implicated in a common project, collaborate punctually on project issue, Share difficulties."

Fill in the name of the community members

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	A	0													
2	B		0	0											
3	C			0	0										
4	D				0	0									
5	E					0	0								
6	F						0	0							
7	G							0							
8	H								0	0					
9	I									0	0				
10	J										0	0			
11	K											0	0		
12	L												0	0	
13	M													0	0
14	N														0
15	O														

Question 2 To whom do you turn for advice before making an important decision? It can be persons that are not mentioned on the proposed list.

How to answer the following questions?
Please only indicated the abbreviated form of your answer

Question 3: Did you volunteer to be a member of this community? YES NO Comments

Question 4: Do you think that other persons could be involved in the current perimeter of the community? If yes, who? YES NO Comments


4.8 Questionnaire 2/3: Interaction Frequency

Interaction Frequency and Nature

Date :

Please, complete this document and hand it in to me at the end of this session. Thank you ;-)!
Indicate your Name...

.....

Here below, are list the Community Members 	Do you share information with these community members? Please mark the appropriate box with an X	How do you communicate with these community members? Please mark the appropriate box or boxes with an X	On which types of topics do you communicate ? Please mark the appropriate box or boxes with an X	What are your exchange spaces"? Please mark the appropriate box or boxes with an X																				
A	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%; text-align: center;">Never</td> <td style="width: 50%; text-align: center;">Less than 2/month</td> </tr> <tr> <td style="text-align: center;">Weekly</td> <td style="text-align: center;">Daily</td> </tr> </table>	Never	Less than 2/month	Weekly	Daily	<table border="1" style="width: 100%;"> <tr> <td style="width: 33%;">Mail</td> <td style="width: 33%;">Chat</td> <td style="width: 33%;">Phone, conf - call</td> </tr> <tr> <td colspan="2">Telepresence</td> <td>Net meeting</td> </tr> <tr> <td>Alstom Wiki</td> <td colspan="2">Face to face</td> </tr> </table>	Mail	Chat	Phone, conf - call	Telepresence		Net meeting	Alstom Wiki	Face to face		<table border="1" style="width: 100%;"> <tr> <td style="text-align: center;">Project Issue</td> </tr> <tr> <td style="text-align: center;">Feed-back on experience</td> </tr> <tr> <td style="text-align: center;">Design guide</td> </tr> <tr> <td style="text-align: center;">Others...</td> </tr> </table>	Project Issue	Feed-back on experience	Design guide	Others...	<table border="1" style="width: 100%;"> <tr> <td style="text-align: center;">Formal (Project, Hierarchical relationship)</td> </tr> <tr> <td style="text-align: center;">Informal (meals, coffee break other)</td> </tr> <tr> <td style="text-align: center;">Both</td> </tr> </table>	Formal (Project, Hierarchical relationship)	Informal (meals, coffee break other)	Both
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Both																								

4.9 Questionnaires 3/3

4.9.1 Questionnaire distributed for existing community



Authors:

Project:

Stage 1:

Questionnaire for members of the candidate community	
<u>Main Objective:</u> Evaluate the mutual community commitment	
Criteria	Questions
Mutual knowledge	Would you like to be part of this proposed community? Would you like to share your knowledge and that of others to find out how your respective educations can help each other? Have you identified other appropriate participants to include in this community? If so, who?
If your response to question 1 is “no,” please finish the survey by completing the two following questions/ 4 &5. All interested candidates please skip to question 6.	
What is your main reason for rejecting a commitment to this community?	
Would you like to be part of another global community? Have you identified units and potential colleagues?	

Subject of common interest	Do you have a particular interest in a topic to share with community members?	Do you have any occasional contact with community members to discuss a common topic? If so, who?	Do you already know any members of the community and maintain informal contact with them?
Voluntary Action	Are you considering interacting with some members of the community? If yes, which ones?	Are you already engaged in an action or a common project with members of the community? If yes, please explain.	
Mutual Help Specify which projects, problems, or topics....	Would you like to give and receive help to members of the community?	Do you already occasionally cooperate with members of the community?	Do you already systematically help each other?
Collaborative platform	<p>What do you expect from your collaboration with community members? (quote direct or indirect Benefits)</p> <p>Do you think a collaborative platform is a good way to collaborate?</p> <p>What are your fears about these types of tools?</p>		

Need of similar knowledge	<p>What type of information would you like to have from community members?</p> <p>Which topics usually pose the most difficulty for you? Would you give some examples?</p> <p>How do you solve these difficulties? (i.e. documentation sources, support from colleagues or experts)</p>
Other	Do you want to add questions, or comments? If yes, please explain.

4.9.2 Questionnaire distributed for community candidate



Authors:

Project:

Stage 1:

<p>Questionnaire for members of the candidate community</p> <p><u>Main Objective:</u> Evaluate mutual community commitment</p>	
Criteria	Questions
Mutual knowledge	<p>Would you like to be part of this proposed community?</p> <p>Would you like to share your knowledge and that of others to find out how your respective educations can help each other?</p> <p>Have you identified other appropriate participants to include in this community? If so, who?</p>
<p>If your response to question 1 is “no,” please finish the survey by completing the two following questions/ 4 &5. All interested candidates please skip to question 6.</p> <p>What is your main reason for rejecting a commitment to this community?</p> <p>Would you like to be part of another global community? Have you identified units and potential colleagues?</p>	

Subject of common interest	Do you have a particular interest in a topic to share with community members?	Do you have any occasional contact with community members to discuss a common topic? If so, who?	Do you already know any members of the community and maintain informal contact with them?
Voluntary Action	Are you considering interacting with some members of the community? If yes, which ones?	Are you already engaged in an action or a common project with members of the community? If yes, please explain.	
Mutual Help Specify which projects, problems, or topics....	Would you like to give and receive help to members of the community?	Do you already occasionally cooperate with members of the community?	Do you already systematically help each other?
Collaborative platform	<p>What do you expect from your collaboration with community members? (quote direct or indirect Benefits)</p> <p>Do you think a collaborative platform is a good way to collaborate?</p> <p>What are your fears about these types of tools?</p>		

Need of similar knowledge	<p>What type of information would you like to have from community members?</p> <p>Which topics usually pose the most difficulty for you? Would you give some examples?</p> <p>How do you solve these difficulties? (i.e. documentation sources, support from colleagues or experts)</p>
Other	Do you want to add questions, or comments? If yes, please explain.

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Part 6 – SUMMARY IN FRENCH OF MY THESIS

Thèse défendue :

Evaluer la configuration d'une communauté de pratique virtuelle permet de prédire les types d'interactions en ligne allant d'un transfert d'information entre membres à un partage de connaissances jusqu'à une coproduction de solutions.

Résultats originaux :

- **Un diagnostic des pratiques de gestion des connaissances à partir des grilles d'analyse des interfaces (Objets Intermédiaires et Temps Synchrone d'échange) permettant de fournir des recommandations en termes d'outils informationnels et dispositifs de capitalisation et de partage des connaissances tacites.**
- **Un outil d'analyse des interactions virtuelles dans un outil collaboratif.**
- **Un outil d'analyse de configuration des Communautés de Pratiques Virtuelles (Vcop) et d'évaluation de leur capacité à interagir en ligne.**
- **Une méthode d'analyse des besoins d'un réseau collaboratif en termes d'interaction (virtuelles ou non), permettant de fournir des recommandations pour des outils collaboratifs**

Résumé de mes travaux de recherche

Cette page a pour vocation de vous exposer brièvement le contenu de ma recherche.

Mon travail fut commandé par la direction R&D du business Hydro de la Multinationale Alstom en 2009.

A l'heure où les termes Web 2.0 et management des connaissances sont d'actualité, mon travail s'est focalisé sur l'apport des plateformes collaboratives pour améliorer le partage des connaissances et la collaboration en conception produits dans un contexte global et distribué.

Le problème industriel fut formalisé comme suit :

- Comment organiser le partage des connaissances et la collaboration dans un environnement R&D global et distribué ?

La question de recherche fut posée comme suit :

- Comment une plateforme de travail collaboratif améliore le partage des connaissances et la collaboration dans un contexte de développement produit globalisé ?

Pour y répondre, j'ai diagnostiqué à l'aide de grilles scientifiques les stratégies et pratiques de gestion des connaissances déployées au sein du business Hydro. Mon étude a permis de révéler que les pratiques prépondérantes déployées par le management d'Hydro étaient des pratiques instrumentales de formalisation des connaissances inscrites dans une conception techniciste de cette dernière. De nombreux processus, guides de conceptions et règles diverses étaient ainsi produites et diffusées par les instances centrales R&D.

En revanche, j'ai constaté que ces règles publiées étaient utilisées et comprises sur le terrain, grâce aux interactions entre acteurs en phase avec l'approche pragmatique de l'acquisition des connaissances.

Ces pratiques terrains reflétaient des logiques d'accès à la connaissance très locales qui n'étaient pas en phase avec les logiques de globalisation du business.

J'ai donc proposé d'explorer les possibilités offertes par les forums et les communautés de pratiques virtuelles. L'idée était d'offrir au management d'Hydro et aux concepteurs une solution transversale complétant les pratiques de gestion des connaissances.

Quand j'ai passé en revue la littérature traitant des plateformes collaboratives déployées en milieu R&D et des communautés de pratiques virtuelles, j'ai constaté des vides théoriques :

- Un vide théorique sur les outils de modélisation des interactions en lignes.
- Un vide théorique sur le lien entre le type d'interaction en ligne et la configuration des communautés R&D virtuelles instrumentées

Pour combler ces gaps théoriques, j'ai proposé une méthode d'évaluation et d'analyse de contenu des interactions sur forum.

Mon travail opérationnel a consisté dès lors à modéliser le contenu de 4 forums existants instrumentant des communautés de pratiques virtuelles R&D d'Alstom Power Hydro.

Je'ai démontré au travers de ces modélisations qu'un forum pouvait soutenir différents types d'interactions allant de la transmission d'informations à la co-construction de connaissances et coproduction de solution.

Ensuite, je me suis intéressée à la configuration de ces Vcops. En m'inspirant des travaux de Line Dubé, j'ai parié sur le fait qu'il existait un lien fort entre la configuration d'une Vcop et ses types d'interactions en ligne. Mon travail consista à adapter la méthode d'analyse de Dubé pour visualiser une tendance de succès d'une communauté en termes de capacité à fonctionner en ligne.

Ce travail « industrialo-scientifique », eut pour résultat une méthode outillée permettant d'accompagner tout projet de création de communauté R&D virtuelle et/ou d'instrumentation de ses interactions.

Cette méthode a été utilisée en interne, chez Alstom Hydro, pour diagnostiquer le besoin en termes d'outils de communication de plusieurs communautés existantes. Mon travail est actuellement poursuivi par un doctorant en convention CIFRE au sein d'Hydro.

Publications:

- Marie Fraslin, Eric Blanco (2011). "*Interface qualification between The Research central team and Design offices in order to evaluate the knowledge sharing*", International Conference of Engineering Design
- Marie Fraslin, Eric Blanco (2013). "*Empirical evidence of collaboration through online interactions within R&D communities*, International Conference of Engineering Design"
- .

Plan d'ensemble de mon travail de recherche

Objectif	<ul style="list-style-type: none"> Comprendre et optimiser les stratégies de gestion des connaissances et la collaboration dans une organisation R&D globale et distribuée 	
Actions 2009-10	<p><u>Diagnostic réalisé:</u></p> <ul style="list-style-type: none"> Diagnostic des pratiques de gestion des connaissances chez Hydro. Qualification de l'interface entre Centre de Technologie mécanique et le Bureau d'Études de Grenoble (mobilisation de grille scientifique-Interface et Objets intermédiaires) <p><u>Constat majeur:</u></p> <ul style="list-style-type: none"> Les acteurs accèdent aux informations et Connaissances techniques grâce à leur réseau social « local ». Les pratiques instrumentales doivent être optimisées et les pratiques de médiation globalisées. <p>Contribution 1 : Un diagnostic KM à partir des grilles IO et SIT permet de fournir des recommandations en termes d'outils informationnels et dispositifs de capitalisation et de partage des connaissances tacites.</p>	
	Pratiques d'instrumentation des connaissances	Pratiques de médiation des connaissances
<p><u>Actions déployées :</u></p> <ul style="list-style-type: none"> Amélioration des objets Frontières (Common designs) Optimisation des bases de données techniques et formations utilisateurs à la philosophie du « User Centric » et au « design rational ». <p><u>Valorisation terrain :</u></p> <ul style="list-style-type: none"> Création de l'interface du common design d'un produit (la Pelton Flasque). Cette interface a 	<p><u>Proposition d'une expérience de recherche :</u></p> <ul style="list-style-type: none"> Modéliser le contenu d'un Forum pour savoir si un forum soutient des phénomènes de collaboration et de partage de connaissances dans une Vcop globale. (Passage d'une logique prescriptive et de médiation locale à une logique participative de médiation globale). <p><u>Identification de vides théoriques :</u></p> <ul style="list-style-type: none"> Vide théorique sur les outils de modélisation des interactions en lignes Vide théorique sur le lien entre le type 	

	<p>été dupliquée sur l'ensemble des nouveaux Common Design.</p> <ul style="list-style-type: none"> • Satisfaction des utilisateurs dans la réorganisation des bases de données • Prise de conscience du besoin de globaliser les échanges et le social networking (Passer de logiques de capitalisation et partage locales à globales) <p><u>Valorisation Scientifique :</u></p> <ul style="list-style-type: none"> • Article accepté pour l'ICED 2011 	<p>d'interaction en ligne et la configuration des communautés R&D virtuelles instrumentées</p> <p><u>Etude réalisée</u></p> <ul style="list-style-type: none"> • Mise au point d'un schéma de codage pour modéliser les interactions en ligne <p>→Contribution 2 :</p> <p>Un outil d'analyse des interactions virtuelles dans un outil collaboratif.</p> <p><u>Valorisation Scientifique :</u></p> <ul style="list-style-type: none"> • Article accepté pour l'ICED 2013
<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><u>Actions 2011</u></p>	<p><u>Actions implémentées :</u></p> <ul style="list-style-type: none"> • Formalisation des connaissances d'un expert : Rédaction du processus de Fabrication. • Publication d'une méthode de formalisation des connaissances. 	<p><u>Etudes Réalisées :</u></p> <ul style="list-style-type: none"> • Modélisation du Forum CAD • Modélisation du Forum CAE <p><u>Résultat Recherche :</u></p> <ul style="list-style-type: none"> • Un forum soutient différents types d'interactions en ligne allant de transmission d'information à co-construction de connaissances et production de solutions. <p><u>Question soulevée :</u></p> <ul style="list-style-type: none"> • Comment expliquer les disparités observées au sein des forums modélisés ? • Quels sont les facteurs intrinsèques à la communauté qui jouent un rôle dans le type des interactions en ligne ? • Quels sont les liens entre configuration des communautés et niveau d'interaction en ligne. <p><u>Expérience déployée :</u></p> <ul style="list-style-type: none"> • Mise en place d'une communauté Européenne d'ingénierie Globale (Management de Projet MUP) • Mise en place d'un forum pour instrumenter cette communauté

Etude réalisée

- Mise au point d'une grille d'analyse permettant de caractériser la configuration d'une communauté et d'un outil d'évaluation permettant de prédire ses chances de succès collaboratif en ligne.

Etudes Réalisées :

- Caractérisation de la configuration de la communauté CAD
- Caractérisation de la configuration de la communauté CAE
- Caractérisation de la configuration de la communauté ColLeague
- Caractérisation de la configuration de la communauté des Experts

Résultat Recherche :

- La configuration a un rôle direct sur le niveau d'interaction en ligne
- L'évaluation d'une configuration peut prédire le niveau d'interaction en ligne projetable dans un Radar Kiviat (Excel)

→Contributions 3 et 4 :

- **Un outil d'analyse de configuration des Vcop et d'évaluation de leur capacité à interagir en ligne.**
- **Une méthode d'analyse des besoins d'un réseau collaboratif en termes d'interaction (virtuelles ou non), permettant de fournir des recommandations pour des outils collaboratifs.**

Résumé extensif de ma thèse

Cet écrit est consacré à un résumé extensif de ma thèse en langue française. Mon manuscrit est intitulé « Évaluer le potentiel d'une communauté de pratique virtuelle R&D à interagir en ligne : Le cas d'ALSTOM Power Hydro ». Il se compose de 193 pages hors annexes (42 pages) et références bibliographiques (6 pages). Il est rédigé en anglais et est divisé en une introduction et quatre parties (dont les annexes en partie 4), regroupant un total de huit chapitres.

L'introduction compte 12 pages. Elle présente brièvement le contexte de la recherche, la démarche globale de notre recherche-action puis le plan du manuscrit.

La partie 1 s'intitule : La globalisation de la R&D et les objectifs du partage de connaissance chez ALSTOM Power Hydro

Cette première partie compte 3 chapitres. Ces trois premiers chapitres expliquent le contexte problématique industriel d'Alstom Power Hydro dans lequel s'est déroulée notre thèse CIFRE et le cadre théorique de la gestion des connaissances.

Le Chapitre 1 présente la compagnie ALSTOM Hydro

Le paragraphe 1.1 présente l'activité du business Hydro du secteur Power de la multinational ALSTOM. Ce business conçoit et met en service différentes gammes de Turbines/alternateurs sur un marché international de la production électrique hydraulique.

Pour fournir un ordre d'idée, Hydro génère : 900ME de Chiffre d'Affaires, emploie environs 7000 employés dans le monde, et couvre des projets lancés dans 70 pays.

Les particularités de ce marché font que chaque turbine/alternateur vendu est unique et doit répondre à de nouvelles contraintes ou besoins énoncés par le client. Par contraintes, on entend l'ensemble des données environnementales, géologiques, hydrauliques ou économiques. Il s'agit par exemple de la hauteur de chute et du débit, des rendements, des types de fluides... Ces contraintes vont influencer systématiquement sur le profil d'utilisation du produit et donc sur sa conception. C'est pourquoi le mode de production d'Hydro est appelé « make to order ». Ainsi, à chaque nouvelle offre, un nouveau produit sera proposé impliquant une nouvelle conception.

Le paragraphe 1.2 montre la transition du modèle organisationnel R&D.

En effet, pendant presque 50 ans, le business Hydro a évolué sur un secteur industriel protégé : l'énergie. Toute l'organisation Hydro fut à l'origine imaginée pour que chaque entité acquise garde toutes les fonctions nécessaires pour servir son propre marché. La direction d'Hydro contrôlait les résultats de ses divisions par un système d'évaluation des performances basé sur les mesures de profits et de rentabilité des investissements.

La libéralisation du marché en Europe a fait évoluer l'organisation du travail en conception des turbines/alternateurs. Les entités qui fonctionnaient jusqu'ici de façon indépendantes se sont retrouvées interconnectées dans des réseaux complexes coordonnés par des équipes centrales.

Ainsi, pour s'inscrire de façon pérenne dans un environnement mondialisé et libéralisé, l'organisation fut revue. L'idée était d'allier la force d'une expertise reconnue sur l'ensemble du globe et un prix compétitif. La direction mit en place dès lors une stratégie d'intégration des unités dans une optique de mutualisation, standardisation et réduction des coûts.

Concrètement, l'enjeu était de passer d'un modèle organisationnel, de type « Multinational » selon A. Bartlett (1998), à un modèle de type « Global ».

Dans un modèle multinational donc décentralisé : Le sommet stratégique (Head quarter) décentralise son pouvoir aux directeurs des unités. Ces dernières sont assimilées à des portefeuilles d'activités et doivent générer du bénéfice que le sommet stratégique contrôle. Néanmoins, le sommet stratégique est incapable de s'assurer que les projets et les ressources humaines sont gérés de manière efficiente. Il n'est pas en mesure, non plus, de créer des synergies qui permettraient, entre autre, de réduire les coûts. Il n'a pas de vision globale.

Dans un Système global donc centralisé, le sommet stratégique centralise son pouvoir et détermine une stratégie pour coordonner les unités et développer une vision globale. Cette dernière permet notamment d'organiser un schéma industriel intégré et de lisser la charge mondiale. Cette organisation requiert de standardiser les pratiques (outils et méthodes) sur sites et assure une optimisation des coûts au niveau global.

Conséquence de la globalisation sur l'activité de conception

L'impact de la globalisation de l'organisation sur l'organisation de la R&D fut conséquent. L'activité de conception, "cœur de métier" du business Hydro, entra ainsi dans une dynamique de "globalisation" dès 2000 avec la création d'une instance centrale nommée

"Centre de Technologie" (CT) localisée sur l'unité de Grenoble d'Hydro et constituée majoritairement d'ingénieurs expérimentés venant du bureau d'études de Grenoble.

L'organisation de l'activité de conception devint, ainsi, séquencée au niveau mondial entre des équipes d'études centrales, devant fournir des méthodes (CT); et des équipes d'ingénierie locale regroupées au Bureau d'études (BE), devant appliquer en local ces méthodes.

Cette rationalisation de l'activité fut également concomitante à la délocalisation du parc Machines vers les pays à bas coûts (Georges Dureault, 2006). Pour exemple, l'ensemble du parc machines de Grenoble fut délocalisé en Chine.

En 2006, la fonction R&D centrale matérialisée par le Centre de technologie se divisa en deux sections R&D en charge de capitaliser, partager et créer la connaissance sur les produits et une section ingénierie et fabrication en charge de capitaliser, partager et créer les connaissances sur les processus. Cette réorganisation marqua la séparation des activités de la "recherche" et du "développement" (le Masson, 2006).

Ces 2 entités furent prénommées HRD et HEM:

	Hydro Recherche & Development (HRD)	Hydro Engineering & Manufacturing (HEM)
Missions	Recherche&Innovation Produit : <ul style="list-style-type: none"> • Capitaliser les connaissances techniques de conception et particulièrement celles "tacites", • Transférer "les logiques de conception", • Créer de nouvelles connaissances Produit et innover. 	Recherche&Innovation Process : <ul style="list-style-type: none"> • Capitaliser les connaissances Process • Optimiser la rationalisation du développement produit afin de réduire les cycles de conception en termes de QCD (Qualité Coût Délais). • Mettre en place un schéma industriel global et intégré, et décliner des méthodes de fabrication standards. • Créer de nouvelles connaissances Process et innover.

Concrètement, HRD et HEM édictèrent des aides à la conception génériques destinées aux membres des bureaux d'études (BE). Il s'agit de méthodes, de référentiels communs nommés plus généralement guides de conception. Ces derniers regroupent des informations et documents, tels que des dessins, des modèles, des notices de calcul, méthodes de dimensionnement, préconisations de solutions, des instructions techniques, des maquettes numériques, etc.

Ces outils, qui vont constituer une partie de l'interface, ont pour objectif la diffusion de règles et de langages communs devant faciliter une capacité de lissage de la charge au niveau mondial. Chaque entité devait ainsi accéder à une certaine polyvalence et être capable de concevoir différents composants grâce à l'appropriation des guides et procédures développées. Ces règles devaient aussi permettre de minimiser les risques de défaillance lors de la phase de conception appliquée aux projets, et de réduire les temps de conception et de fabrication.

Pour fédérer le transfert des connaissances au sein des BE répartis sur le globe, de nouveaux outils d'information et de communication furent développés. Notre manuscrit les liste.

Le paragraphe 1.3 décrit ensuite le fonctionnement du site de Grenoble, avec, en 2006, la décision de délocaliser la conception détaillée en Inde. Cette réorganisation de l'ingénierie pose plusieurs problèmes :

Nous expliquons que cette division du travail en conception à l'échelle globale est contestée. La frontière entre les activités inhérentes au Basic Design et celles au Detailed Design est complexe et les concepteurs rencontrent des difficultés dans le partage et la coordination du travail. Pourtant, il est rappelé que cette division du travail et la collaboration entre l'Inde et l'Europe est cruciale. Il en va de la compétitivité du Business ainsi que de la qualité des produits conçus.

Dans ce paragraphe, nous mettons en exergue que le partage des connaissances entre européens et indiens est tout aussi crucial que leur collaboration. En effet, démunie du parc machine, les concepteurs Français doivent maintenir leurs connaissances en production pour continuer de concevoir des machines fabricables. Ils doivent communiquer et apprendre des indiens qui eux détiennent une connaissance en production. D'un autre côté, les ingénieurs indiens doivent apprendre de l'expérience européenne. Le départ de

personnes très expérimentées en Europe combiné au turn over critique des gens formés en Asie (Inde et Chine) pose de lourdes questions sur la pérennité de cette organisation. .

La conclusion du chapitre 1 pose ainsi les enjeux de la communication, du partage des connaissances et de la collaboration dans l'environnement de travail globalisé décrit.

Chapitre 2 : Cadre théorique pour le diagnostic

Le chapitre 2 compte 16 pages. Il y est présenté successivement, le cadre théorique de la gestion des connaissances (2.1) puis le concept d'interface et les objets intermédiaires (2.2) pour évaluer la collaboration et la partage de connaissances dans la pratique d'Alstom Power Hydro. Les paragraphes 2.1 et 2.2 sont les piliers de notre diagnostic permettant une compréhension fine des pratiques de gestion des connaissances déployées au sein d'Hydro.

Il nous semble donc important de bien expliquer ces paragraphes. Commençons par expliquer le concept de connaissance qui est clé dans notre travail de recherche. Pour tenter d'appréhender l'objet « connaissance », nous exposons dans notre manuscrit la célèbre dichotomie codification/personnalisation proposé par Cook et Brown (Cook and Brown 1999). Ils distinguent deux approches de gestion des connaissances :

- La première est celle de la possession où la connaissance est considérée comme un objet codifiable et malléable. La connaissance y est perçue comme une substance qui peut être extraite de l'individu et placée sur un support selon un processus de codification puis transférée pour enrichir « le capital connaissance » de l'organisation globale.
- La seconde est celle de la pratique et se concentre sur le caractère socialement construit de la connaissance et sur les phénomènes d'apprentissage.

L'approche dite « de possession » renvoie à une conception « instrumentale » de la gestion des connaissances alors que l'approche dite de pratique renvoie à une conception plus pragmatique de la gestion des connaissances inscrite dans l'action et les dynamiques d'interactions sociales.

Dans l'approche de la possession, la connaissance est duale (Grundstein 2004).

On distingue :

- les connaissances explicites.
- les connaissances tacites.

Il est acquis que les connaissances « *explicites* », sont conscientes, facilement exprimables et donc codifiables et formalisables. A l'inverse, les connaissances « *Tacites* » sont implicites, intériorisées et parfois même inconscientes pour les acteurs qui les détiennent et seulement transmissibles dans l'interaction et la pratique par l'observation, l'imitation et l'expérience.

Polanyi illustre ce qui est entendu par « connaissance tacite » en prenant pour exemple la codification et la transmission des connaissances constituées par la pratique d'un sport ou d'un instrument de musique : « si je sais comment faire du vélo ou comment nager, cela ne veut pas dire que je peux expliquer comment réussir à garder mon équilibre sur le vélo ou à ne pas couler » (Polanyi *et al.*, 1969 :141). Selon lui, les connaissances tacites ne peuvent, en d'autres termes, être exprimées et transmises que dans l'action de celui qui les détient.

Le courant théorique du « Knowledge Based View » initié par Grant (1996) est typiquement inscrit dans une approche instrumentale de la connaissance.

Grant considère les connaissances tacites et explicites comme des ressources stratégiques qu'il s'agit de protéger, d'identifier et codifier pour capitaliser (Chanal, 2003). Selon lui, ce sont avant tout les connaissances « tacites » qui ont potentiellement le plus de valeur stratégique. L'idée soutenue est que la firme est un « processeur et un créateur de connaissances » qui vont lui garantir une longueur d'avance notamment grâce à son potentiel accru d'innovation.

Le facteur clé de succès de l'organisation engagée dans cette dynamique instrumentale de la connaissance repose sur la performance de la technologie et les moyens mobilisés pour identifier, codifier et surtout transmettre ses connaissances explicites et tacites. C'est d'ailleurs en abordant cette question de l'encodage qu'est initiée la hiérarchisation entre

donnée, information et connaissance¹⁵ (Davenport et Prusak, 2000). Perrin explique que la codification des connaissances désigne, dans une approche instrumentale, le processus de conversion d'une connaissance en un message, qui peut être ensuite manipulé comme de l'information (Perrin, 2008).

A la différence de l'approche dite instrumentale où *la connaissance par le biais de sa codification peut être placée sur un support, celle-ci étant désormais libérée de son rattachement à une personne* (Foray, 2000 p.48) et donc transférable, l'approche pragmatique désigne la connaissance comme un « potentiel d'actions » attribué à un acteur individuel ou collectif dans le contexte d'une situation au sein de laquelle celui-ci poursuit un projet. (Zacklad 2004).

La conception de la connaissance en tant « *que version raffinée de la connaissance* » (Grundstein 2004) est complètement contestée. La connaissance est plutôt perçue comme l'aboutissement d'un traitement du cerveau d'un individu conditionné par ses affects, ses sens, son cadre de représentation et sa culture.

La distinction entre connaissance tacite et connaissance explicite est également contestée. Les efforts à consentir pour transférer des connaissances sont très divers et ne se réduisent

¹⁵ **Données**

Une donnée est un ensemble de signes (chiffres, lettres, images, sons, etc.) utilisés pour décrire des objets ou des événements. Par exemple, le fait qu'il fasse 5°C est une donnée. Les données sont la matière première de l'information. Elles deviennent de l'information par un processus d'interprétation qui leur attribue de la signification, du sens.

Information

Selon Reix (2002) L'idée d'information est liée au contexte d'interprétation des données et d'action (immédiate ou différée). Le passage des données à l'information n'est possible que grâce à un modèle d'interprétation propre au récepteur.

Selon Perrin, l'information est donc porteuse de sens, un sens que les individus créent individuellement ou collectivement. L'information est une matière première qui génère la connaissance.

La connaissance

La connaissance est le dernier maillon de la chaîne. Elle reflète la capacité à traiter une information en fonction de ce qui est déjà dans notre mémoire pour la transformer en action afin de résoudre une tâche ou un problème.

pas au couple explicitation, formalisation. C'est pourquoi, l'ensemble des supports de connaissance sur lesquels vont s'appuyer les acteurs pour effectuer des « transactions » vont être nommés des « instruments sémiotiques ». La transaction va être possible par la conduite de certaines activités, psychiques, sociales, physiques, qui vont permettre aux individus de manipuler le support documentaire et d'interpréter les signes qu'il contient.

Les supports de connaissance ne possèdent pas en soi, de potentiel d'action et l'aide qu'ils sont susceptibles d'apporter est donc complètement conditionnée par les activités d'interprétation des acteurs en situation.

L'idée centrale, en empruntant les termes d'Hatchuel (Hatchuel 1999), est qu'*on ne peut penser que les connaissances se « transfèrent » ou se « transmettent » malgré la familiarité de telles notions : Chacun doit construire les savoirs qui sont les siens par le biais des interactions qu'il peut construire avec autrui.* C'est donc dans l'action, quand l'être est confronté à des problèmes concrets, et en interagissant que les individus vont apprendre, intégrer et donner du sens à leur situation de travail.

L'approche pragmatique va donc intégrer les travaux en sciences cognitives tentant de comprendre comment la connaissance est représentée dans l'esprit de l'individu et quels sont les types de traitements menés à partir de ces représentations qui permettent les activités mentales telles que se rappeler, percevoir, raisonner, résoudre un problème et prendre une décision (Anderson, 1983). La conception de la connaissance proposée y est plus humaine, produit de la relation qu'une personne entretient entre son propre cadre de référence, les objets qui l'entourent et l'expérience qu'il acquiert dans la pratique et qu'il enrichit grâce aux interactions avec autrui. La connaissance se crée dans la controverse et l'argumentation. (Prudhomme, Pourroy et al. 2009)

Wenger s'intéresse, aux mécanismes de transmission des connaissances individuelles et à l'apprentissage organisationnel en prenant comme unité d'analyse la communauté de pratique. La théorie des communautés de pratique consiste ainsi à observer des groupes d'individus qui partagent une même pratique (par exemple une pratique professionnelle), avec un sentiment de responsabilité et d'engagement mutuel. L'exercice d'une pratique commune, et les échanges qu'elle génère, créent des ressources (notamment des connaissances) qui constituent le fond commun de savoir de la communauté (appelé « répertoire partagé »). Cette unité d'analyse permet aux chercheurs une observation simple des apprentissages effectués (Cappe, Chanal, 2006 et al).

Selon Karl E. Weick, l'acquisition des connaissances est une combinaison entre les expériences vécues, les sens, les affects et des représentations que les individus vont combiner avec d'autres individus ou une situation, le cadre de référence d'une personne qui va rentrer en interaction avec une situation ou des individus.

S'il rentre en interaction avec des individus, l'échange d'interprétations personnelles va permettre par exemple de modifier les schémas mentaux des individus par une convergence des interprétations, sans toutefois que celles-ci se confondent.

Dans cette logique, mais en sciences de la conception, Guy Prudhomme, Franck Pourroy et Kristen Lund inspirés par des courants didactiques, expliquent que la connaissance émerge grâce au lien personnel que l'individu va construire avec "l'objet de la connaissance" dans un contexte donné. L'objet peut être aussi bien matériel (un composant, une machine) que symbolique (une formule, des mots, une représentation graphique). Une information peut-être aussi considérée comme un objet de connaissance. Le sens de cette information, que l'individu va construire, va dépendre d'un contexte donné et de facteurs intrinsèques à l'individu. Ce sens est dynamique et va évoluer pour se hisser ou non au rang de nouvelle connaissance dans la tête de l'individu. L'apprentissage va pouvoir se mesurer par l'évolution du rapport que la personne va entretenir avec l'objet de connaissance manipulé. (Prudhomme, Pourroy et al. 2009)

Dans l'approche pragmatique, on ne parlera pas de « transfert de connaissance » mais plutôt de distribution de « transactions communicationnelles » ou « d'ingénierie collaborative » c'est à dire de la dissémination d'un potentiel d'action à d'autres individus, communautés, organisations. L'apprentissage de l'individu va en fait dépendre de la combinaison et de l'interaction entre l'individu, l'objet et son environnement. Le sens va se co-construire. L'apprentissage va être matérialisé par un changement du cadre initial de représentation de l'individu. La technologie et les bases de données seront néanmoins des média d'informations et d'objets intermédiaires qui contribueront à l'opération de « transaction » comme énoncé précédemment. Le premier enjeu pour l'entreprise sera donc d'aider les personnes à construire dynamiquement le sens à donner aux informations et objets dont il va devoir se saisir. Les outils pourront prendre en compte les travaux portant sur l'importance de la qualification et de la co-construction des informations ainsi que sur la qualification des espaces de travail (Beylier. Cyril 2007; Grebici, Blanco et al. 2007)–Le second enjeu sera de multiplier les espaces d'interaction et de rencontre des salariés. Nous concluons cette clarification du concept par des exemples de pratiques d'entreprise inscrites dans les deux approches et donnons certains conseils émanant de la littérature.

Ensuite le paragraphe 2.2 veut clarifier le concept d'interface. Selon Koike et al. (2005), on peut caractériser une interface en cinq composantes : acteurs, espaces/temps, objets intermédiaires, règles et procédures, outils. Une focalisation est faite sur les « objets intermédiaires » (IO) (extension du célèbre concept d' « objets frontières » de Star et Griesemer 1989). Des grilles de caractérisation très précises des IO sont proposées : une grille structurelle, et une grille fonctionnelle (Synchronous Interface Time : SIT) (Surbier 2009).

Le Chapitre 3 : Méthode de diagnostic et résultats décrit l'audit mobilisant les grilles d'interfaces expliquées au chapitre précédent. Le diagnostic est mené sur une équipe centrale de recherche et un bureau de conception. Le travail de diagnostic est réalisé sur une période de 12 mois, en organisant des entrevues, des ateliers avec les acteurs du centre technique et du bureau de conception de Grenoble, les données recueillies permettent de remplir des grilles d'objets intermédiaires et de SIT légèrement modifiées.

Ce diagnostic permet de comprendre en partie comment travaillent les acteurs de ces services et leur besoins informationnels. Les principaux objets intermédiaires pour l'interface équipe centrale/bureau d'études sont :

- les guides de conception (« common design »)
- Les instructions techniques (« standards ») du centre technique

Des problèmes sur les bases de données, les guides de conception sont listés tels que leur difficulté d'accès, leur structuration, leur mise à jour...

Ce diagnostic conclut que les pratiques prépondérantes émanant de HEM et HRD sont des pratiques instrumentales de formalisation des connaissances inscrites dans une conception techniciste de cette dernière. Ces pratiques ne sont pas efficaces et les utilisateurs se perdent dans les méandres de données générés. Néanmoins, il n'y a rien d'alarmant, car sur le terrain, existent des formes d'actions hybrides pour l'apprentissage plus interactionnistes et pleinement en phase avec l'approche pragmatique que nous défendons.

Ainsi, si le partage des connaissances via les bases de données et les guides de conception est faible, à Grenoble, les concepteurs apprennent au fil de leurs échanges et interaction avec leurs superviseurs qui les accompagnent dans leur projet de conception.

Le réseau d'experts est donc le garant du succès des échanges entre les équipes centrales et les concepteurs (succès de la socialisation, faiblesse de l'instrumentation), d'où un déséquilibre entre la pratique de codification et la pratique de personnalisation.

En revanche, nous posons les questions suivantes :

- Cette « logique réseau » prépondérante au sein de l'unité de Grenoble existe-t-elle sur chaque site Hydro ?
- L'accès aux informations techniques et les apprentissages requis sont-ils aussi bien accompagnés au sein des autres unités qu'à Grenoble ?
- Toutes les unités ont-elles un superviseur sur lequel les concepteurs puissent compter pour trouver l'information requise et apprendre ?

Par ailleurs, le diagnostic révèle que la division du travail opérée entre la conception de base (en Europe) et la conception détaillée (en Asie) est complexe et nécessite une collaboration accrue entre les acteurs. Les concepteurs expriment en effet le souhait de pouvoir échanger les plans plus facilement et être dans une dynamique collaborative qui n'existe pas encore réellement. Les concepteurs souhaiteraient aussi centraliser les questions posées aux superviseurs ainsi que les échanges avec leur « expert».

Les propositions pour améliorer l'échange des connaissances et la collaboration chez Hydro sont données à l'issue de ce diagnostic.

Enfin, la conclusion de la partie 1 explique que la littérature est pléthorique pour aider HRD et HEM à optimiser leurs pratiques de gestion des connaissances instrumentales. En revanche, il existe un gap théorique sur le potentiel des outils 2.0 et particulièrement des plateformes collaboratives pour améliorer la collaboration et le partage des connaissances à l'international. Nous proposons ainsi d'exploiter ces pistes. En effet, les plateformes collaboratives numériques s'inscrivent dans une approche pragmatique de la connaissance et sont en phase avec les nouveaux besoins de coopération et de réactivité des concepteurs. Elles peuvent donc soutenir dynamiquement la vie de communautés dont les membres sont répartis sur le globe et compléter, voire globaliser, les « silos » de connaissances actuellement très localisés.

Partie 2 : Revue de littérature et cadre méthodologique

Nous effectuons une revue de littérature en partie 2 qui compte 40 pages. Elle débute par une introduction de 2 pages qui présente très sommairement la formalisation de trois questions concernant le rôle des plateformes collaboratives dans les activités des communautés de pratique en termes de collaboration et partage de connaissance.

- Quels types d'activités peuvent-être soutenus par une plateforme collaborative instrumentant une communauté pratique virtuelle ?
- Existe-t-il des grilles pour modéliser le contenu des échanges en ligne ?
- Y-a-t-il une configuration de communauté de pratiques virtuelle optimale qui garantisse une collaboration et des échanges de connaissances en ligne ?

Le chapitre 4 (8 pages) présente le concept d'interaction et son rôle dans la communication et la transmission des connaissances. Il est prouvé que le dialogue entre interlocuteurs permet la co-construction de sens. C'est en effet grâce à la confrontation d'idées, l'échange de questions, d'arguments pour ou contre une idée que l'apprentissage se construit. Ce dernier est en d'autres termes le fruit de l'interaction entre différents interlocuteurs. Le pari est fait que l'interaction en ligne ouvre les mêmes perspectives qu'en face à face. L'interaction en ligne peut donc assurer la médiation des connaissances.

Les opportunités pour favoriser la collaboration et l'apprentissage présentées par les forums sont ensuite soulignées. L'hypothèse qu'une plateforme collaborative peut offrir des opportunités pour les pratiques en gestion des connaissances est formulée et les questions suivantes guident la réflexion :

- La collaboration au sein d'une communauté est-elle rendue fructueuse par la configuration des outils utilisés ou par la caractérisation de la communauté ?
- Quels sont les facteurs qui jouent un rôle clé dans l'accélération de la collaboration et du partage de connaissances entre les membres d'une communauté ?

Le chapitre 5 (16 pages) s'attache à fournir un modèle pour décrire des interactions en ligne. Une des questions des recherche se précise alors : il s'agit d'élaborer et d'utiliser un codage des discussions en ligne qui permette de faire ressortir les partages de connaissance, à partir des interactions de type argumentation, négociation ... qui participent à la création de sens. Ce chapitre expose ainsi différents éléments de codage proposés dans la littérature pour analyser les activités collaboratives de construction des

connaissances et la logique de conception. Une analyse de ces schémas de codage et de leur opérationnalisation conduit à proposer une méthode d'analyse et de codage mixant différentes propositions de la littérature permettant au sein de la même représentation d'identifier les différents types d'activités et leur enchaînement, illustrant la logique de collaboration.

Le chapitre 6 décrit une grille d'évaluation d'une communauté de pratique virtuelle, basée sur les travaux de Dubé et al. 2006. Il y a quatre classes de critères, avec 21 critères. Cette grille a pour objectif de comprendre la configuration d'une communauté. Notre objectif est d'adapter cette méthode pour visualiser une tendance de succès d'une communauté en termes de capacité à fonctionner en ligne.

Le travail sur cette grille consiste essentiellement en un travail d'opérationnalisation et de simplification. C'est pourquoi, certains critères sont renommés. La grille modifiée comporte en revanche le même nombre de critères. Une explication détaillée de chaque critère est proposée et une évaluation y est annexée. En revanche, une évaluation spécifique est proposée pour le critère intitulé « engagement mutuel ». Ce dernier est évalué selon les trois niveaux d'évaluation de la maturité d'une graine de communauté proposés dans les travaux d'Emmanuelle Cappe 2008, basés sur les travaux d'Etienne Wenger.

Ainsi, à chaque critère est associée une échelle d'évaluation de 1 à 4, qui est la même pour tous les critères, et qui évalue ce qui est appelé la « dynamique d'interaction », qui est en fait caractérisée assez classiquement par le mode d'interaction informationnelle dans la communauté : information (niveau 1), communication (niveau 2), coordination (niveau 3), production (niveau 4). Ensuite, 6 critères clés sont identifiés parmi les plus importants. Ces critères bénéficient d'une pondération 2.

Ensuite, une visualisation sous la forme d'un graph Kiviat est proposée. Cette évaluation, permet de projeter les chances de succès en termes de collaboration et de partage des connaissances en ligne.

La conclusion de cette deuxième partie résume les propositions faites pour pouvoir caractériser les logiques de collaboration d'une part et les spécificités d'une communauté d'autre part afin de pouvoir mener une démarche expérimentale dont les travaux font l'objet de la troisième partie du manuscrit.

Partie 3 : Expérimentations

Cette troisième partie (58 pages) présente en introduction deux contextes expérimentaux.

Le chapitre 7 utilise les outils de codage et caractérisation proposés en partie 2 pour caractériser le fonctionnement de deux communautés de pratique différentes dans des activités de support et de résolution de problèmes.

Le paragraphe 7.1.1 présente brièvement la « communauté CAD », dont l'objectif est d'assurer le déploiement d'une méthodologie d'usage commune du logiciel CAD.

Le paragraphe 7.1.2 présente la modélisation du contenu des échanges enregistré sur le forum CAD. Nous concluons sur le constat que le forum CAD soutient différents types d'interactions en ligne allant de transmission d'information à co-construction de connaissances et production de solutions ;

Le paragraphe 7.1.3 s'intéresse à la communauté CAE qui est caractérisée selon la grille de Dubé dont les critères ont été analysés à travers des questionnaires et des entrevues. La communauté CAE comporte 15 personnes, elle a été créée par le directeur pour partager des idées sur les problèmes du logiciel CAE. Leur forum est séparé en deux espaces : l'un pour les mécaniciens, l'autre pour les hydrauliciens

Le paragraphe 7.2 fait le bilan des analyses :

- Communauté CAD : il y a 447 posts sur 54 sujets sur le forum, 72% ont été codés
- Communauté CAE : 17 discussions ouvertes, qui ont toutes été codées

Un certain nombre de données quantitatives et qualitatives sont données et permettent de faire des comparaisons entre les deux communautés. Les résultats des évaluations selon la grille de Dubé modifiée sont donnés pour les deux communautés.

Nous concluons que la configuration a un rôle direct sur le niveau d'interaction en ligne. Ainsi, l'évaluation d'une configuration peut prédire le niveau d'interaction en ligne projetable dans un Radar Kiviat (Excel). Nous identifions même des critères clés de succès de la configuration de la communautés.

Le chapitre 8 présente des applications concrètes des outils et méthodes déployés.

Le paragraphe 8.1 présente un projet (« Mutual Understanding Project »), qui est une phase préparatoire à la constitution d'une communauté de concepteurs (initialement composée de 21 personnes dont 3 experts) entre la France et l'Espagne. La grille de Dubé a été utilisée dans ce projet, avec l'évaluation sous forme de radar, mais cette fois-ci dans une vision

prospective. Un grand nombre d'obstacles potentiels ont été soulevés quant au succès d'un forum collaboratif pour cette communauté. Ce forum ayant effectivement finalement échoué, la communauté (de 21 personnes) a été divisée en trois, et au moins une plateforme collaborative a été initialisée pour le premier sous-groupe.

Le paragraphe 8.2 concerne un diagnostic d'une communauté d'experts de 17 personnes, formé des membres de la filière expertise créée par la RH. Il s'agit de savoir si une plateforme collaborative peut être utile à cette communauté. Le diagnostic a utilisé un questionnaire basé sur la grille de Dubé. Il aboutit à la conclusion qu'un forum n'est pas un outil de communication adapté aux besoins de cette communauté. Ainsi, avant de penser à implémenter un outil collaboratif, il est conseillé de retravailler sur la configuration de la communauté ».

Conclusion : implications théoriques et managériales

Une conclusion de 7 pages reprend les questions adressées dans le manuscrit. Des contributions théoriques et industrielles sont identifiées.

La première contribution théorique concerne la proposition d'un modèle de codage enrichi pour l'analyse expérimentale et la caractérisation des interactions numériques (allant du transfert d'information à la co-construction de connaissances).

La seconde concerne la caractérisation des communautés de pratique où les critères difficiles à évaluer ont été supprimés et deux autres critères sont ajoutés (la pertinence du sujet de la discussion et la reconnaissance mutuelle de l'appartenance à la communauté).

Une contribution industrielle est identifiée. Il s'agit d'une méthode d'analyse des besoins d'un réseau collaboratif en termes d'interaction (virtuelles ou non), permettant de fournir des recommandations pour des outils collaboratifs.

Des limites aux travaux de recherche sont enfin discutées en termes de généralisation ouvrant sur des perspectives de travaux à poursuivre d'une part et à compléter avec des approches complémentaires pour caractériser l'effectivité d'un forum, sa valeur par exemple en utilisant le concept de « glitch » permettant de tracer les erreurs / accidents liées au manque de partage de connaissance au cours d'un projet collaboratif.

Le manuscrit conclut sur les enjeux du partage des connaissances pour la soutenabilité d'une ingénierie occidentale, et en particulier européenne, coupée aujourd'hui de la proximité des moyens de production manufacturière.

Résumé de thèse

Nous basant sur plusieurs études de cas effectuées au sein de communautés R&D virtuelles d'Alstom Power Hydro, nous démontrons d'une part, qu'un forum peut soutenir différents types d'interactions allant de la transmission d'informations à la co-construction de connaissances et co-production de solution.

Opérationnalisant et améliorant des grilles scientifiques visant à caractériser des communautés de pratiques virtuelles, nous démontrons aussi, qu'il existe un lien entre la configuration d'une communauté et le type de ses interactions en ligne. Nous démontrons qu'il existe une configuration optimale, de communautés de pratiques virtuelles appliquées à la R&D, qui garantit des interactions de type co-construction de connaissance et co-production de solution entre ses membres.

A l'heure où Microsoft équipe chaque jour 20000 nouveaux utilisateurs de l'application Share point, cette thèse prend tout sens.

En opérationnalisant une méthode d'évaluation des communautés de pratiques virtuelles, et en apportant des conseils pour déployer un forum appliqué à la R&D, nous accompagnons tout projet de création de communauté R&D virtuelle et/ou d'instrumentation de ses interactions par un forum.

Mots Clés :

Entreprise globale, Développement Produit, R&D, Gestion des connaissances, Communauté de pratiques virtuelles, interaction en ligne, collaboration.

ABSTRACT

In this dissertation, we explore the potential of a forum to support collaboration and knowledge sharing among Virtual Communities of practice.

We thus propose a coding scheme based on the Rainbow model and test it in order to analyze the content of two forums of R&D VcoP. We demonstrate that a forum supports asynchronous argumentative activities and thus enhances global collaboration and knowledge sharing among R&D VcoP members.

We then propose an enriched model based on the work of Line Dube and tested it to characterize the R&D VcoP studied. We prove that the community configuration has a direct impact on the online dynamic of the community. We point out the main factors that play a key role in fostering online collaboration and knowledge sharing between R&D Virtual community members.

Key words :

Global Company, Product Development, R&D, Knowledge management, Virtual Community of Practices, Online Interaction, Collaboration.