Four Roles Lead Users Have to Play in the Multi-Actor Innovation Process

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I. The role of customers in design

The nature of customer involvement in new-product development has generated considerable work in marketing. Traditional marketing management approaches consider the customer to be passive, with given needs that must be analysed in order to conceive an offering. This concept is still very much alive in the NPD literature and stage-gate model, but has been the subject of criticism for the last 30 years or so. For researchers in industrial marketing (Hakansson, 1982), however, the customer is active in the transaction. Von Hippel (1986) considers the customer the starting point of innovation emergence and a decisive actor in determining the direction of the innovation's development, and Fichman and Kemerer (1997) recommend active user involvement in concept-generation phases prior to development.

Beyond affirming that the customer is an active co-creator of value, little is known about customer involvement: At what stage in new-product development should the customer intervene? On which types of project? On all project types, or only certain highly innovative ones? What are the precise customer roles in the design process? Which skills are required?

Indeed, the project-management literature identifies diverse roles in project teams and various project-organization models. On the other hand, work that emphasises a very specific designer category comprising lead users treats the issue in a unified way, without distinguishing among the various roles and facets encompassed. Moreover, this issue is all the more important given that the roles may be assumed by different actors from the same company or actors belonging to different companies. Our work is helping to shed light on two contributions, which both enrich the notion of the customer as covered in project-management literature by highlighting the innovative design role played by the customer according to lead-user literature and develop the notion of the lead user by relying on project-management literature.

For this purpose, we have chosen to study a case from the software industry, wherein software transforms end-user practices. Understanding the needs of such end users and the value

imparted to them is thus crucial for innovative developers, but also challenging. Various attempts at tackling this difficulty and experiments involving new forms of interaction with users (MacCormack et al., 2001) may be seen in the software industry.

Though innovative software companies are often small, customers – especially large companies – demand complete, reliable solutions, involving the set-up of appropriate project-management structures in order to guide development and coordinate the various contributors involved. Beyond specific, personalised applications developed for innovative customers, software companies also seek to contribute to a platform that would be sold on a broader scale and become a standard. Each development is an opportunity to recognize generic elements of the software that could become part of a platform and the partners required to offer a complete solution valued by end users.

For these three reasons, studying a software-industry case seems completely appropriate, given the issues we tend to highlight. We thus focus on the way first customers take part in a software innovation process, which then leads to a study of projects that implement new software concepts.

In the first part of this paper, which is devoted to a review of the literature, we will underline innovation characteristics in the software industry. We will then raise the issue of software architecture and the central role of the modularity concept in software design. We will continue by covering issues concerning customer involvement in innovation processes, including user innovation and management methods when information systems are deployed. After setting out our research methodology, we will present two projects involving innovative software development, PressPro and Exinis, from two independent software publishers (Temis and Mondeca) for two very different customers. In the final section, where our results are discussed, we will identify an original modularisation process that led to an innovative software platform and how the first customers were involved in the innovation process, and will explain the implications of such involvement on the innovation project's organisation. In examining the lead-user concept, we will also distinguish four roles played by various actors within the customer organisation.

II. Review of the literature and choice of theoretical framework

II.1 Characteristics of software-industry innovation: the *"winner takes all"* situation

The software industry is characterised by a regular flow of innovations, some of them radical, including new types of software application (e.g. ERP), Business Intelligence software and even Internet search engines. Such innovations regularly experience high failure rates, which lead innovative software companies to consider conditions for better connections between first customers and the first projects implementing the innovation they have designed. Such innovations are usually developed by independent technology start-ups that specialise in a given technology. In the research presented here, for example, the technology employed is text mining, which aims to extract and classify information from texts of various types, including newspaper articles, patent documents and legal content. These start-ups are active in a market-creation process involving a certain type of software for a given application, and face resource scarcity in terms of time and manpower. Their objective is to rank among the few publishers whose software achieves commercial success in a new market segment. The software industry faces a "winner takes all" situation (Cusumano, 2004), wherein only one piece of software, or maybe a few, will survive for a given application type, become standards and end up dominating their market segment. Examples of "winners" include Microsoft Office for office automation and the German company SAP for ERP-type software. A concentration phenomenon therefore occurs, resulting in the disappearance of a multitude of small software publishers. Software publishing thus experiences the regular creation of new companies and new applications followed by rapid concentration.

Software publishers are subject to a double gamble: they must be extremely focused on their own technology and the market segment they are helping to develop, but must also integrate their software into that of other software publishers to be able to offer customers complete application solutions. Such integrated solutions may then become innovations in their own right in the form of software platforms. Other software may then be connected to such platforms according to "plug and play" principles. The platform notion is thus fundamental to the software industry. The software company that develops the platform benefits from a strong strategic position (Gawer and Cusumano, 2002). According to Cusumano (2004), software publishers seek to develop either platforms or complementary software. Under such conditions, the significance of the issue at stake is clear: a publisher of innovative software must seek to become an actor contributing to a platform that will become the standard.

II.2   Modularity: the focus of software-architecture literature

Since the 1970s, and since the work of Parnas (1972) where software is concerned, modularity has been the focus of research on creating innovation in the computer field. "Various companies may independently design and produce components like disk drives and operating software, and these modules will fit together into a complex, smoothly functioning product because the module makers obey a given set of design rules" (Baldwin and Clark, 1997). Modularisation involves the breakdown of a complex system into near-autonomous subsystems that may be independently conceived (Baldwin and Clark, 1997; Aoki and Takizawa, 2002), so modularisation may thus be seen as enabling a strategy of specialisation and division of tasks among companies contributing to an integrated solution. For Aoki and Takizawa (2002) the interest of this strategy is reinforced, because systems have become so complex that modularisation has spread to the modules themselves. Modularisation may also be considered a way of managing innovation, because each person or organization in charge of a specific module is in a position to innovate while respecting the rules laid down by the architect. However, the growing trend toward modularisation of technologies and the disintegration of systems implies the production of new types of knowledge (Steinmueller, 2002), including norms and standards (Shapiro and Varian, 1999). Moreover, the modularisation phenomenon in product architecture has been tackled by the literature from the angle of the breakdown of integrated architecture (Baldwin and Clarke, 1997), not from that of an architectural construction resulting from an aggregate of pre-existing, independent components: in such a case, how are design rules developed?

II.3   Customer involvement: lead users and key users

We will tackle two aspects of the literature, one relating to user innovation and the other to customer involvement when information systems are deployed. These two areas of the literature enable us to highlight a pair of important concepts: lead users and key users.

In the literature on user innovation, von Hippel (1986) suggests that firms should generate innovative concepts in partnership with lead users. Lead users are defined as those (individuals or organisations) who are aware of needs that will become requirements of a large number of users and who hope that, by satisfying these needs, they will make significant profits. Since it is generally difficult for a user to define needs in relation to new products, a possible approach involves selecting lead-user customers and then having them test prototypes in order to acquire information that may subsequently be exploited. Faced with the

accelerated pace of innovation in each industry, however, it may be beneficial to leave certain users to develop innovations themselves; such is the case for 80% of products in the scientific-instruments industry (Von Hippel, 1994). Some firms thus go even further by equipping their customers with tools that enable them to design and develop the products that suit them for themselves. Von Hippel (2001) suggests an approach whereby users receive tools ("user toolkits") that allow them to handle the design of the product completely, with any potential industrialisation left to the producers' responsibility. The objective is then to develop products designed by these lead users into robust, standard, less expensive products that will then interest more users (Thomke and von Hippel, 2002). Toolkits also enable customers to develop their own solutions according to their specific needs. The toolkit approach allows the innovation process to be broken down into sub-projects, with tasks assigned to either user or producer (von Hippel and Katz, 2002). Such task distribution may entail radical changes in product architecture and generally leads to the development of modular architecture, as was the case with open-source software (von Krogh and von Hippel, 2003).

The literature concerning information-systems management focuses particularly on the issue of software deployment (especially ERP) in large companies, its human and organisational impact and the conditions for optimising this deployment by taking into account users and uses (Markus, 2001). However, this literature is not interested in the design of the innovative software in itself. The notion of key user is employed in the literature to qualify those users with whom the innovative-software publisher and/or service provider (i.e. computer-services company) responsible for the deployment and integration of the solution is going to work, with regard to need specifications, solution customisation and the solution's adaptation to precise user needs. The notion of key user is frequently used in information-systems management and should be distinguished from that of lead user, even though the two notions have certain similarities. Key users are those who are going to take an active part in deploying a software solution within their company, the case of ERP software being one example. They do not take part in the innovation's design process, but work closely with one or more software publishers or the service provider responsible for integrating the solution. They therefore transfer part of the information linked to use of the solution in the company where it is to be deployed.

Commonalities between key users and lead users may arise from their perceptions of the benefits deriving from the innovation, which lead them to support its development and/or

deployment, and may also arise when both user types are equipped with special skills that distinguish them from other users. Key users are also intensive system users (Open Source Academy, 2006). Lead users are likely to contribute actively to the innovation design process, however, while key users are likely to take part in the deployment of an innovation that has already been designed. "Key users may carry out software fine-tuning and provide guidance on how to take full advantage of best practices enabled by the solution" (SAP, 2008), and are thus less likely to conceive of the innovation, unlike lead users.

The roles of lead users and their skills in relation to projects implementing a new software concept that constitutes a phase in the software-innovation process, just like interaction methods with suppliers, are not well covered in these works. Similarly, the role of key users in the event of multiple-participant innovation is not, in itself, really covered in information systems management literature. For us, a number of questions remain unanswered in terms of the nature and role of lead users and key users in projects that implement multiple-participant software innovation.

III.   Research methodology

Research question

Study of the literature leads us to highlight the different ways in which customers are involved in the innovation process. We feel that software represents an ideal application field for user innovation. Our research question is as follows: What role do first customers play in the multiple-participant software-innovation process, and how can we involve them in it?

Methodology

We have chosen the case-study method (Yin, 1994), adopting a longitudinal approach to analyse two projects that involved two software companies aiming to develop very similar applications (as far as the underlying technology is concerned) for two different customer companies. We followed this project in real time from June 2003 until June 2008.

The case studied is emblematic of the software industry, involving two technology start-ups focussing on their own innovative technology that came to combine their software in order to offer a complete solution that satisfies their customers and may become a new software platform. The innovation process studied led to a new software platform mainly comprising

two pieces of software: IDE, designed by software company Temis, and ITM, designed by software company Mondeca. This platform emerged after the two pieces of software were coupled to answer the needs of two innovative customers, PressPro and Exinis. The solution's development came about via two projects, which we will call the "PressPro" and "Exinis" projects. This new platform, called the "automated knowledge-base creation platform," was designed and developed mainly during the first (PressPro) project by Mondeca in collaboration with Temis. Unfortunately, the platform was not ultimately used by PressPro, but was improved upon and adapted by Temis and Mondeca together and then successfully implemented during the second (Exinis) project. The companies' expectations regarding the new application and the projects' main characteristics were as follows:

- The **PressPro project** was aimed at creating a knowledge base for PressPro, a leading French newspaper group. It was designed to facilitate the work of journalists in compiling information already published about the life of celebrities. The new software platform's end users were 40 archivists working in Press Pro's documentation department. The project was set to last 3.5 years (June 2003-December 2006) and its budget was €630,000.

- The **Exinis Project** involved the creation of a knowledge base for Exinis, an international publishing house whose aim was to compile legal summaries for sale to corporate law firms. The solution's end users were 50 writers and editors specializing in legal summaries. The project was set to last 4 years (April 2004-June 2008) and its budget was €600,000.

For the first time, these projects combined various independent software components that allowed for:

- The extraction of information using IDE, an information-extraction engine developed by Temis. IDE enables the extraction of specific information (news concerning a celebrity or a molecular discovery, for example) from any non-structured text, from newspaper articles to patent documents. Text-mining software, which allows for the extraction, categorisation and mapping of information in the body of any text (including newspapers and legal and patent documents), is a research area that Temis specializes in, and this expertise led to the creation of IDE.

- Knowledge storage using ITM, a knowledge-management system developed by Mondeca. In order to store knowledge concepts, their properties have to be defined along with links between concepts. Such systems are based on ontologies (in computer science, representations of a domain's knowledge), which must be precisely defined for each customer. ITM helps generate ontologies in a coherent way.

For each customer, specific development was required for the Mondeca and Temis software and the coupling (a software bridge or gateway) between the two pieces of software.

Both IDE and ITM were very innovative, based on a combination of original semantic-analysis and statistical-analysis algorithms. Together, they enabled the automatic extraction and gathering (in a knowledge base) of information contained in various types of text and its later retrieval and use, and thus introduced a huge change in practices. In fact, the solution's use altered the way in which firms that adopted it worked by enabling automated text analysis involving automatic (or semi-automatic) indexation and categorisation, until then a manual task. This subsequently allowed for electronic storage of documents (enriched with metadata like publication dates) and the knowledge they contain (such as an article's main theme) in a knowledge base. Automated storage of such knowledge also changed the working habits of archivists, who until then had done it all by hand.

Data collection

We had the opportunity to follow the PressPro and Exinis projects longitudinally. Throughout these projects, one of the authors interviewed – regularly, once every two months on average – the Temis and Mondeca personnel in contact with customers (project, technical and account managers) via semi-directive interviews, as well as project managers at PressPro and Exinis. We also participated in internal project meetings. Between June 2003 and June 2008, we were involved in 59 meetings and interviews:
  - 18 interviews with personnel at Temis involved in the PressPro project.
  - 6 interviews with personnel at Mondeca involved in the PressPro project.
  - 19 interviews with personnel at Temis involved in the Exinis project.
  - 10 interviews with personnel at Mondeca involved in the Exinis project.
  - 3 in-house meetings at Temis, two on the PressPro project and one on the Exinis project.
  - 3 interviews with customer project managers (one at PressPro, two at Exinis).

In monitoring the two ongoing projects, our observation concentrated on the types of actor involved, their roles, interactions between them (software publishers, customers and computer-services companies responsible for integrating the solution) during the various phases of each project, the gradual emergence of the platform and the methodology required for its design and implementation.

IV.   Case study

To make this case study easier to understand, it is important to point out that the two projects presented concern applications involving two customers (PressPro and Exinis) that required coupling between Temis IDE information-extraction software and Mondeca ITM knowledge-representation software. This IDE/ITM coupling resulted in the creation of a software platform. For each specific application (PressPro or Exinis), personalisation involved information extraction (IDE), a knowledge-management system (ITM) and a software bridge (between IDE and ITM). The chronological account of these two projects shows how all actors involved interact in the innovation process and the coupling between Temis IDE information-extraction software and Mondeca ITM knowledge-representation software.

The structure to be adopted and the various coordination-mechanism roles needed emerged progressively. The successive accomplishment of two projects with two clients developing the same core software helped to outline what proved to be crucial elements in the success of the second project and the strategic development that unfolded with this customer.

The PressPro project

The PressPro project was initiated in June 2003 by the manager of the PressPro documentation department after a meeting with Mondeca representatives at *i-expo,* the French strategic-information and business-intelligence exhibition. The manager was looking for a solution that would tackle his need for the automated extraction of information found in press

articles and the categorisation of this information in a knowledge base. These tasks were carried out on a daily basis by some 40 archivists and took most of their working time. He had the idea of coupling IDE and ITM, a concept that had already been formulated a year earlier by an international pharmaceutical company, which had encouraged Temis and Mondeca to work together on such an application but did not launch a development project. Thanks to this pharmaceutical company, however, Temis and Mondeca realized that there were complementarities between their software. PressPro's request encouraged Mondeca to take on a partner dedicated to the design and development of a software gateway that could link the ITM and IDE software.

The companies involved

In the beginning, PressPro had to work solely with Mondeca, which, for its part, had to work with Temis (see fig. 1). However, Mondeca did not have the skills needed to speak to PressPro on behalf of Temis regarding the issue of information extraction. As a result, Temis set up a direct contact with PressPro. In addition, PressPro insisted on joining forces in the project with Xyleme, a software publisher that offered an archival solution for XML-format documents (see fig. 2).

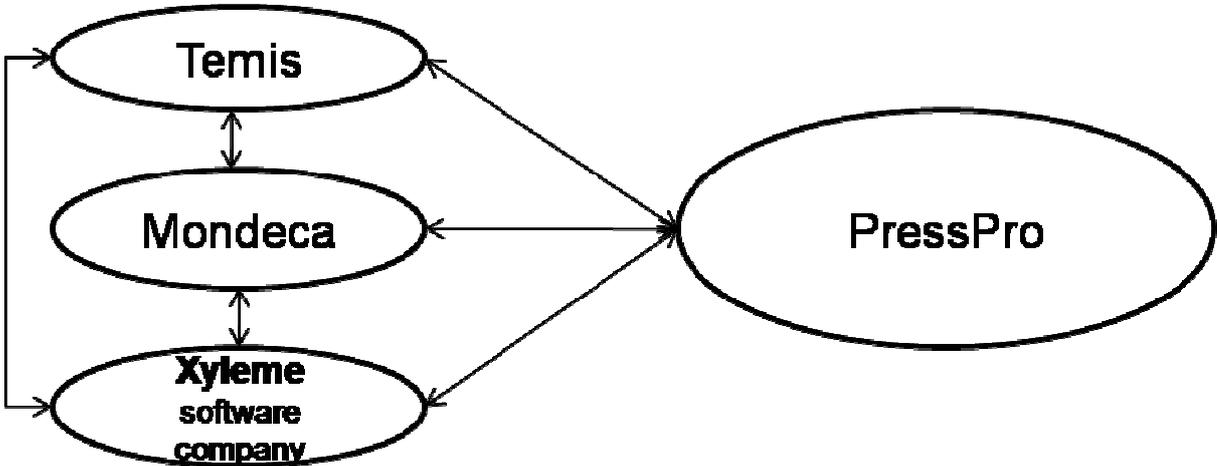**Fig. 1: Interactions between companies involved in the PressPro project (first phase)**

Fig. 2: Interactions between companies involved in the PressPro project (second phase)

Specifications

Work aimed at defining functional specifications for the solution began soon after PressPro's decision to launch the project. As the IDE/ITM coupling was still only at the design stage, it was impossible to offer a prototype, i.e. a simplified version of the projected solution that would generate customer reaction and make it easier and quicker to lay out the specifications of the targeted application. A list of specifications regarding the expected performance level was finally drawn up; this ended up being rather inappropriate, however, something that became obvious only at the end of the project. In fact, certain user requirements remained implicit, as was the case for information-extraction rates and the most relevant knowledge-base categorization compared to manual treatment. The final objective was to search for and supply information and articles corresponding precisely to PressPro journalists' needs.

Project contributors and their assignments

Various actor categories served key roles in the two projects studied, with some corresponding to categories defined in the project-management literature (i.e. heavyweight project managers, or HWPMs) and others newly defined (i.e. innovation architects). These categories are set out in the following table (see table 1); next to each is a corresponding series of tasks conducted within the context of the Exinis and PressPro projects.

Table 1

Categories	Tasks carried out during the projects
Innovation architect	- Designs a new software application using his cross-functional skills; acts as a "gatekeeper" [Allen T. (1971); Tushman and Nadler (1986)]. - Chooses various pieces of software to construct the new application. - Convinces top company management of the innovation's importance [acts as "champion" for the innovation (Roberts and Fusfeld, 1981; Howell and Higgins, 1990)]. - Persuades the software publishers involved to work together on this new application's design. - Takes part in the definition of project specifications.
Heavyweight project manager (Clark, K. B., and T. Fujimoto, 1991)	- Takes part in the definition of project specifications. - Supervises the project to implement the innovation. - Regularly monitors the work of the operational project manager.

	- Regularly monitors the work of the coupling project manager.
	- Occasionally interacts with the suppliers' various project managers.
	- Defends the project with top management [acts as "champion" of the innovation (Roberts and Fusfeld, 1981; Howell and Higgins, 1990)].
	- Redirects the project when difficulties or opportunities occur.
	- Redefines tasks during the project, as necessary.
	- Occasionally interacts with certain users at key project stages (launch, some design choices, testing, production implementation).
Operational project manager (Charue-Duboc, 1997)	- Is responsible for completing the work.
	- Allocates, monitors and controls the various tasks.
	- Works closely with and reports regularly to the HWPM.
	- Interacts with the suppliers' project managers to coordinate their actions and ensure coherence in the various contributions.
Software implementation project manager	- Designs and develops the software solution's user interfaces.
	- Observes the various usages.
	- Works closely with users who must transfer "sticky" information related to their uses of the innovation.
Coupling project manager	- Takes part in project-specification definition.
	- Designs the software gateway linking the pieces of software (in this case, IDE and ITM).
	- Works with the suppliers' personalisation project managers.
	- -Works with software developers at his software company.
Supplier personalisation project manager	- Takes part in project-specification definition.
	- Personalises his company's software.
	- Works with certain users.
	- Works with software developers at his software company.
	- Interacts with the supplier operational project manager at his company.
Supplier operational project managers	- Allocates, monitors and controls the various tasks that concern his software company (software development and personalisation).
	- Works with software developers at his software company.
	- Interacts with the operational project manager.
Users	- Are observed so as to help define project specifications.
	- Transfer "sticky" information (von Hippel, 1986) related to their usage through collaboration with supplier personalisation project managers and coupling project managers.
	- Give ad hoc opinions on design options.
	- Test the beta and final versions of the software platform.

The following table (table 2) summarizes the roles (according to the categories we have defined) and positions of project members in the two projects studied.

Table 2

Categories	PressPro project: position of actor	Exinis project: position of actor
Innovation architect	<u>PressPro documentation manager</u>	<u>Exinis web manager (a.k.a. "innovation architect")</u>
Heavyweight project manager	<u>PressPro documentation manager</u> → none	<u>Exinis web manager (a.k.a. "innovation architect")</u>
Operational project manager	<u>PressPro project manager</u> → Xyleme project manager	<u>Exinis project manager</u>
Software implementation project manager	<u>PressPro project manager</u> → Xyleme project manager with <u>non-expert users</u>	4D concept project manager with <u>two expert users</u>
Coupling project manager	Mondeca coupling manager	Mondeca coupling manager
Supplier personalisation project manager	Temis (language) and Mondeca (ontology) experts with <u>non-expert users</u>	Temis and Mondeca experts with <u>two expert users</u>
Supplier operational project manager	Temis and Mondeca project managers with <u>non-expert users</u>	Temis and Mondeca project managers with <u>two expert users</u>
Users	<u>40 archivists</u> (none skilled in knowledge management or text mining)	<u>50 writers</u> (<u>two</u> skilled in knowledge management, <u>expert users</u>)

Underlined roles in the projects studied indicate those of the customer's project members.

The **PressPro project manager** was:

- The IT manager of the documentation department.
- Present at meetings dedicated to the development of user interfaces.
- Responsible for developing user interfaces.

Xyleme had to take on coordination among the three software publishers involved: Temis, Mondeca and Xyleme.

- The IDE/ITM coupling work was carried out by **the Mondeca coupling project manager** in collaboration with experts from Temis and Mondeca.

- The task of defining user interfaces was first allocated to **two computer analysts** from the PressPro IT department, under the supervision of the PressPro project manager.

- Several user workshops were set up, bringing together (according to given themes) PressPro user groups, software publisher company (Temis, Mondeca and/or Xyleme) project managers and the PressPro documentation department manager. Over a period of several months, these workshops also brought together all the PressPro archivists, who prior to this had no knowledge-management or text-mining skills.

Six months after the project-launch decision, responsibility for **user-interface development** was entrusted to Xyleme, which did not normally carry out this type of work (a task that is usually given to computer-services companies, also called service providers). In fact, the PressPro project manager and computer analysts did not manage to take on this task, and their work did not move forward. (At the same time, the Mondeca coupling project manager was working on the development of the OntoPop platform linking IDE and ITM software.)

After six months, user workshops were suspended as the archivists refused to collaborate on project implementation, which would lead to reduction in their numbers. Automation of certain archivist tasks did in fact reduced staffing requirements. Work then continued with two PressPro archivists devoted to the project working at Mondeca's premises with the appropriate Mondeca and Xyleme experts and project managers on ontology and user-interface definition. These personnel also worked together regularly on definition of user interfaces and the database.

At this point the project moved forward, organised into three sections involving the design of:

- User interfaces.

- The "celebrity" knowledge base (ITM).

- The OntoPop platform (IDE/ITM coupling).

Coordination between these three sections was not really provided by the PressPro documentation department manager, who had an implicit duty to do so but lacked both skills in the technology being used and an overall vision of the project that would enable him to redirect it according to constraints and difficulties encountered. Indeed, the three software publishers involved (Temis, Mondeca and Xyleme) complained about the lack of leadership but did not want to take it on. The various tasks progressed in this way, but problems arose

with the Mondeca ITM and Xyleme XML software that took up the PressPro project manager's entire attention. He dedicated two archivist users to overcome this issue, and assigned responsibility to the user group for testing this part of the solution, which was finally improved and judged satisfactory.

During this period, Temis only worked with the PressPro documentation manager from time to time on adapting the Temis IDE extraction engine to the specificities of texts involving celebrities, and in the end it could be neither finalised nor tested; as a result, the IDE/ITM coupling could not be tested, either. The initial deadlines had by then already been considerably exceeded. The archivists rejected certain parts of this automated-extraction module, deeming it unsuitable – which was logical, given that little time had been allocated to their finalisation. PressPro then decided to suspend the project rather than continue to pay for further information-extraction and IDE-personalisation developments.

The Exinis project

The Exinis project began while the PressPro project was still underway. The Temis IDE software and Mondeca ITM software coupling was almost completely designed under the Mondeca coupling project manager's direction, and was still not implemented at PressPro.

Exinis is a publishing company specialising in legal publications whose customers are legal professionals like business lawyers. Exinis provides them with the legal information they need. Exinis' editors compile a huge amount of legal information in a manner that is valued by such customers. Putting this compiled information online was the responsibility of Exinis France's IT department web manager (or simply "web manager"), who had the idea of adapting Temis and Mondeca software to help tag the information and partially automate the editors' work.

The companies involved (see Fig. 3)

- The Exinis project thus began in April 2004, with the companies listed below as the main actors in software development (see fig. 2): Temis was in charge of developing a module specialising in legal-information extraction ("legal-skill cartridge").

- Mondeca was in charge of developing a knowledge base for the legal domain.

- 4D Concept, a small service provider specialising in document processing that had not mastered such technologies as text mining and knowledge representation but had already worked for Exinis. 4D Concept was responsible for developing user interfaces.

Here again on this project, three companies were asked by a customer to work together on developing a complete solution that would satisfy his requirements. This was the second time Temis and Mondeca had the opportunity to couple ITM and IDE.

As with the PressPro project, the precise interfaces for the various pieces of software and each company's scope of responsibility were not completely set at the beginning of the project. However, through this project it was very important for Temis and Mondeca to establish the performance of their software in a complete solution used by a company, as their software was highly innovative but still have a very limited market. When the project moved forward, they thus accepted additional duties, as necessary, to achieve a working application.
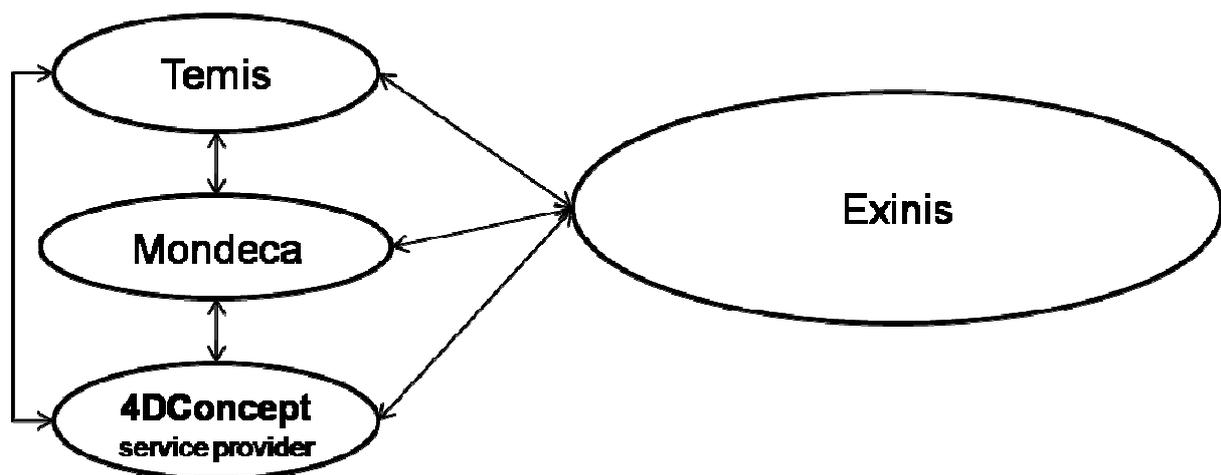

Fig. 3: Cooperation among companies involved in the Exinis project

Roles and assignments (see table 2, p.13)

At Exinis, the organisation was as follows:

- The IT department web manager (the so-called "innovation architect") who initiated the project and made the decision to involve the companies selected.

- A project manager dedicated to the project whose background was as a computer analyst specialising in databases and who was in charge of daily project administration and monitoring the various tasks.

- Two users (the so-called "expert users") who were legal editors trained in knowledge management.

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- Users whose usage was observed from time to time via user workshops.

Based upon presentation of a prototype, the specifications were formulated in a much more precise way than on the PressPro project and were very useful in improving the software in cooperation with user groups.

To begin with, a prototype was developed by Temis and Mondeca and presented to the Exinis innovation architect and two expert users. User workshops were then set up, involving:

- At Exinis: users, the innovation architect, the expert users and the project manager.

- At the supplier end: the Temis and Mondeca project managers, experts (as in the PressPro project) and the 4D Concept project manager.

After this, the expert users worked continuously on the various tasks with the suppliers, the Temis project manager, the IDE/ITM coupling manager and the Mondeca and 4D Concept project managers. Their support proved to be decisive in terms of the precise uses that Exinis' editors would expect of the solution. In addition, their initial skills and work with the various suppliers enabled them to develop new skills, the acquisition of which allowed them to make suggestions regarding the IDE/ITM coupling that, in turn, required new developments on the part of Mondeca.

User involvement varied in the following manner according to the three project phases:

- First phase: user workshops were organized, which helped the supplier understand the legal editors' working methods.
- Second phase: several users were invited to various meetings, which up to this point in the project had only involved the two expert users, innovation architect and Exinis project manager. Two or three alternative proposals concerning solution-design choices were presented to these users.
- Third phase: pre-production, during which user groups were mobilized to test the complete solution and give feedback to project managers.

The Exinis innovation architect supervised the overall project and closely followed the work of the Exinis project manager, who coordinated and monitored daily progress of the various tasks in close collaboration with the supplier project managers. This innovation architect took a number of initiatives throughout the project:

- At the beginning of the project, he supervised the development of the IDE/ITM coupling, which brought to the fore problems linked to access time to the ITM knowledge base and the slow transfer of information between IDE and ITM. Mondeca then had to improve the ITM software.

- He asked for specific modifications to the knowledge bases, solely for pedagogic reasons. The objective was to show top managers at Exinis in particular the future benefits of adopting the new software platform.

- He redirected the project and redefined tasks to be carried out within the project as it progressed. Some tasks turned out to take longer or be more complex than initially forecast, which led to revision of some contract elements, including a reduction in the number of tasks to be carried out by suppliers and an increase in the budget allocated to the project.

The Exinis project manager's role was considered essential by project members at Temis, Mondeca and 4D Concept. He facilitated coordination among software publishers Temis, Mondeca and 4D Concept, played a decisive role in coordinating their work and established a permanent link between personnel involved in the project at Exinis and them. His database skills enabled him to work with the Mondeca actors and those responsible for the 4D Concept user interface.

Finally, coordination between Temis and Mondeca on personalisation of the OntoPop bridge (see fig. 4) and the IDE and ITM software coupling was improved compared to the PressPro project, thanks to their development of a fresh methodology. The "OntoPop" methodology established during the second part of the Exinis project defines and plans the various tasks and interaction methods among project members (Temis, Mondeca and the customer) so as to achieve such personalisation.
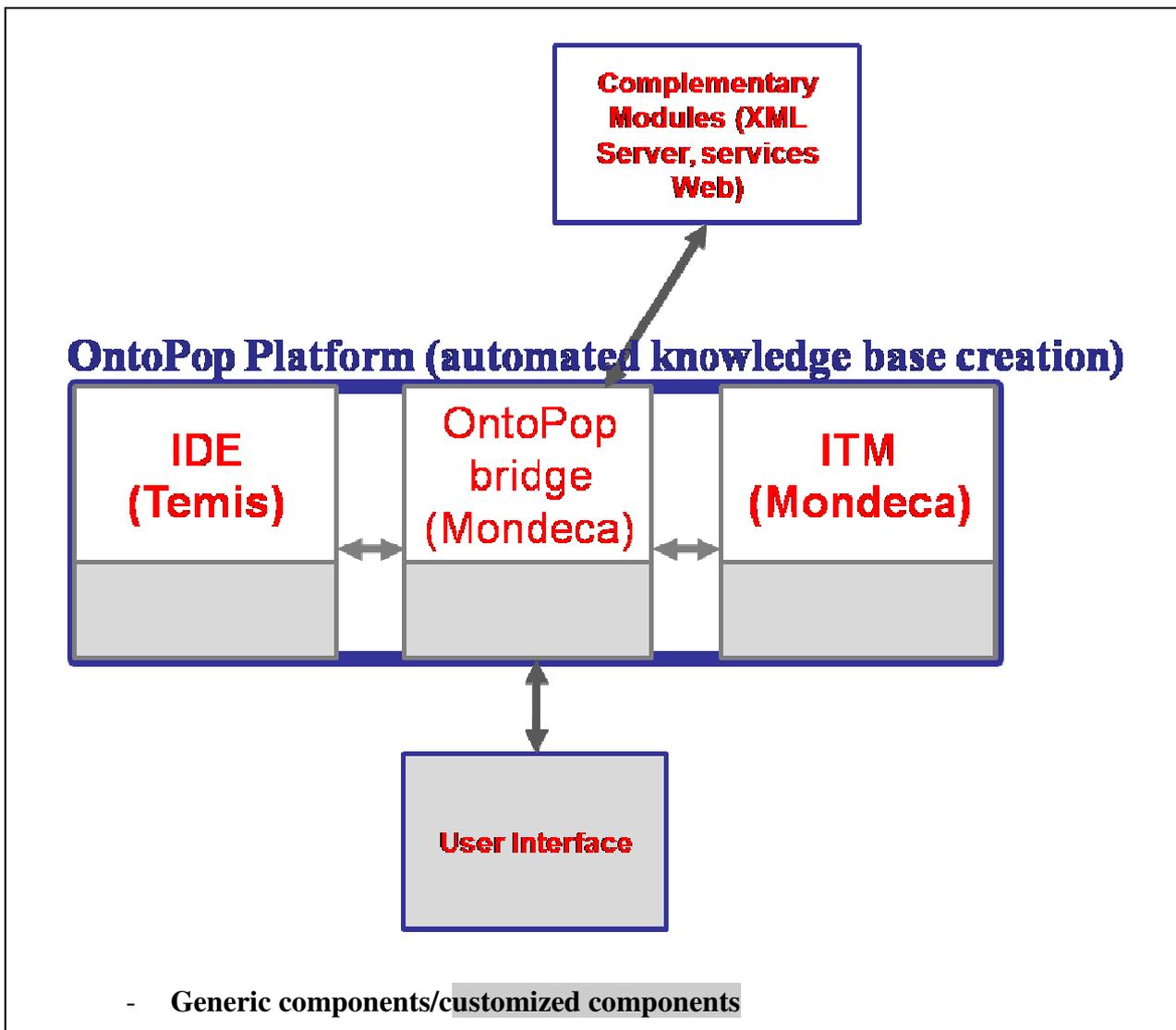
Fig. 4: OntoPop platform and connected modules

V.   Discussion

V.1 Characterisation of an original modularisation process

The process we have studied goes through the following successive stages:

1. The first customer defines the innovation architecture.
2. The first customer finances the project and collaboration between suppliers.
3. Design rules are defined by suppliers.
4. Knowledge capitalisation is achieved by suppliers (software coupling, operational project management and customisation).
5. Suppliers partially transfer this capitalisation to their next customers.
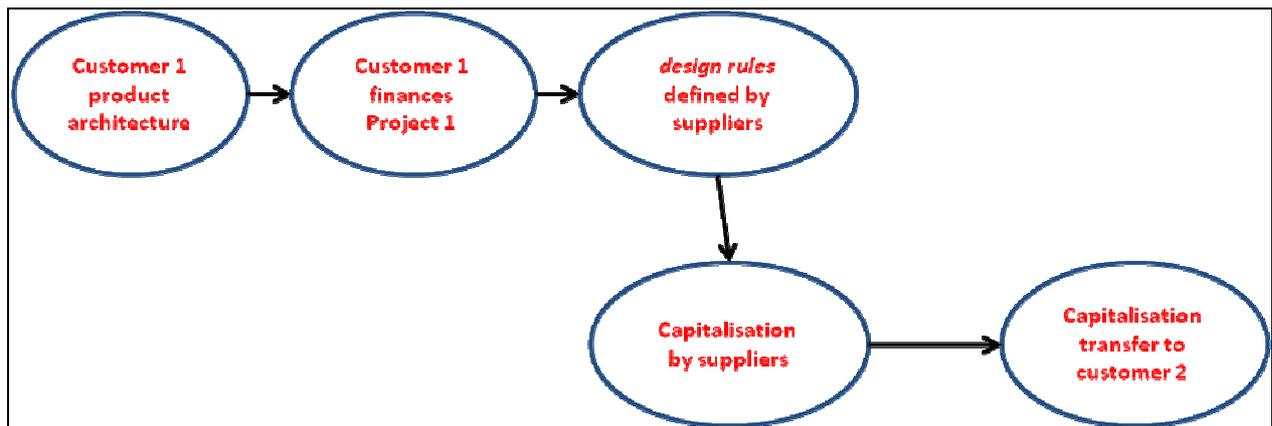
Fig. 5: an original modularisation process

The innovation process starts with the initiative of the first customer, who has the illusion of modularity in use, since he thinks software companies may easily combine their core products to build a solution. The first customer finances the project and asks the companies to cooperate with each other. In the beginning, they are very reluctant to do so, because it is risky for them: they don't know the potential market for such a new solution, and they are always lacking resources, time and money, so they prefer to keep focusing on their own technology in order to become recognized actors in an emerging market of a "winner takes all" industry (Cusumano, 2004). By imagining the new software architecture and financing the project, the first customer thus plays the role of catalyst in the innovation process.

The software publishers must then couple their core software, which requires them to build new competencies based on specific skills each has developed. This is why the customer is unable to build such competencies and why suppliers are the only ones that can define the design rules (software development and project engineering [the role and coordination of actors and personalization of the solution]) for the first projects. During these projects, suppliers capitalize on knowledge related to core-software coupling, personalization and project management.

In the end, this capitalization may then be progressively transferred to the customer in order to allow the latter operational management of the project (a task the latter must carry out, as we shall see) and to maintain its own solution after it's been implemented.

This process requires specific supplier/customer interaction and cooperation wherein customers play different roles, which we will analyse in the following section.

V.2   Enrichment of the lead-user notion

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It may be observed that customers demonstrate lead-user characteristics. First of all, customers look for solutions to their own specific problems. By meeting their needs, innovation should bring them advantages like productivity gains, task enrichment for PressPro project users and an improved offering for the Exinis project, bringing added value to the company's customers. The customers went so far as to define the outlines of the offering that suited them and engage several software producers, requesting that they work together for the occasion. After the software-producer selection period, a close relationship formed between the customer, involving both its users and computer department, and the software producers. The latter put an organisation in place, enabling them to work in an organised, consistent manner with both groups of future users and the customer's information-systems management. For these reasons, we may consider these clients to have taken part in the design process on this innovative solution.

In addition, we should point out that user needs are precise as well as being at the edge of a market that may be predicted in terms of automated analysis of free text (linked to the development of the semantic web). In fact, the increasing volume of information that individuals and organisations may have access to leads us to predict a growing need for automated analysis of free text, the growth of which could reflect that of the data-mining market, which covers the analysis and treatment of formatted information stored in databases.

However, we must note that the customer does not have expertise in the technology brought by the innovation (statistical and linguistic analysis combined) or the capacity to integrate a project including several software producers that should supply a common offering. Text-mining is a new technology, even a new concept, and is thus not well known by firms, so it seems reasonable that the first customers cannot relate to its potential, limits or means of implementation. This naturally helps limit their ability to assimilate it. The direct interaction between innovative software producers and users has, moreover, the aim of "evangelising" the latter, i.e. of convincing them of the concept's relevance while simultaneously trying to understand how they perceive it. It is true that PressPro, the first customer, had the idea of associating the software of different producers, but they could not really control the project or perceive its limits. PressPro does not follow through on the innovation-development process to the end and is unable to build a complete solution that satisfies their own needs, but their actions do contribute to the creation of a finalised offering. In contrast, Exinis actively

participates in the project and is being trained to develop its own "skill cartridges" as quickly as possible.

In conclusion, we feel that this multiple-participant innovation process cannot be achieved if the first customers, which must be lead users, are not able to play different roles corresponding to various kinds of knowledge mobilized in the process, which means here in the first implementation projects.

1. *Design of the innovation's architecture*

For the PressPro project, the new product-architecture design is up to the documentation department manager, who is involved in the innovation architecture (i.e. choice of the kind of software that must be combined) and its implementation within a very demanding context. We suggest that the person who takes on this new product-architecture design at the customer end be called the **lead-user architect**. We feel that definition of such product architecture reverts to the lead-user customer, as only the latter can convince and even compel various software start-ups to collaborate when their priorities are in fact their own technology. This customer also plays the role of catalyst, which is essential for starting the innovation process, and manages to convince software start-ups to take part in the innovation process via two arguments:

- Project financing, which is usually a godsend for start-ups, which see their resources swallowed up in software development while they have only a few customers.

- The existence of a market for the software platform combining their respective software. As von Hippel (1986) points out, lead-user customers have specific needs that no supplier is in a position to understand anywhere near as well as themselves. The customer that imagines the new architecture thus demonstrates the possibilities of a new market, even though it is not sure whether the market is of significant size. Start-ups need this sort of market information, because they do not have the cross-functional knowledge of the technologies or precise idea of their needs that would enable them to imagine such platforms, or, in any event, the potential market for such aggregate platforms. In our view, the customer contribution in these circumstances is absolutely essential.

This lead-user architect is positioned to assume the role of HWPM (heavyweight project manager – Clark and Fujimoto, 1991; Clark and Wheelwright, 1992), which was, for the Exinis project, mainly taken on by the innovation architect (IT department web manager), who was given considerable authority by head office and had much more power than the project manager. The Exinis innovation architect was in an ideal situation to assume HWPM responsibilities for various reasons:

- Since he designed the innovation architecture, he had internal and external legitimacy.
- He knew how to convince his own management of this innovation's importance.

This legitimacy and capacity to create a new architecture led him quite logically to take on the essential role of HWPM, who directs, supervises, assumes internal and external project coordination and reports to management on the project's progress. This task requires cross-disciplinary skills, resources and time, which explains why the Exinis innovation architect was in a much better position to take on the role than the PressPro innovation architect.

To conclude on this point, we feel that first customers of the type of innovation studied should play the role of HWPM; otherwise, a project to implement a multiple-participant innovation is headed for failure. In fact, since it concerns a new type of software application, there is uncertainty regarding the complexity of its adaptability to specific customer requirements, user acceptance and the performance level it might achieve. The application's personalization complexity and the newness of the tasks it involves mean that initial specifications cannot be adhered to and tasks and budgets will have to be redefined. The customer needs an actor with the skills to direct this development and whose legitimacy is accepted internally and by his company's management; he must also have external legitimacy so that his choices during the project are accepted by the various suppliers. He must also be able to organize various types of end-user participation by devising an action plan that makes such participation possible without generating user rejection. In our opinion, this is why an HWPM is needed to direct such a project and why the role cannot be held by an actor at the supplier end.

2. *Operational project management*

For the Exinis project, the Exinis computer-integration project manager has managed the project in operational terms and has therefore been obliged to allocate, monitor and control

the various tasks. For the most part, he plays the role of operational project manager (Charue-Duboc, 1997), responsible for seeing the work to completion and implementing necessary technical means as defined beforehand, so his role is essential to the project's smooth day-to-day operation. As a project manager, his status is much weaker than that of the HWPM, so it is logical for him to be located at the customer end for various reasons. The various software suppliers are not strongly interlinked and, in addition, are more focused on their own technology dedicated to specific applications; as a result, the customer is *a priori* best placed to interact with each supplier, coordinate their actions and ensure the various contributions' coherence.

As initially there is no standard implementation methodology for this new type of application and it is necessary to encourage the software publishers to work together (which they are not used to doing), the project's operational management may become difficult and uncertain. The person in charge needs to have credibility in the eyes of the suppliers with whom he must work, the ability to work closely with the HWPM and the capacity to interact with user groups. (As was the case with the innovation we studied, the first implementation may then make it possible to define a methodology, which may help reduce the operations manager's involvement during future projects.) We may therefore make the point that the essential role of operational project manager should be undertaken by someone at the customer end; we call this actor the **lead-user project manager**. The skills required for such a role are less extensive than those for the lead-user architect, in that it is not a question of creating new solutions or directing the project but of understanding it and ensuring its proper progress under the supervision of the HWPM. The lead-user project manager must have the ability to interact with every project member, which in turn means having cross-disciplinary skills and operational skills in information-systems project management.

3. *Development of personalised components with individual lead users*

For the Exinis project, development took place via collaboration involving Temis and Mondeca experts and users with a certain level of expertise in the technology being used. This collaboration was steady and consistent, and the users who took part were dedicated to the task. This project involved users who already had knowledge-management skills, which made their collaboration with Temis, Mondeca or 4D Concept easier in terms of designing various personalised components. In addition, it involved users with lead-user characteristics who

were in some way "at the leading edge" of the text-mining trend, in part because of their interest and training and also because they realised what this technology might contribute to their activities. In the PressPro project, collaboration involved two users (after user workshops were suspended) who initially had neither experience nor specific skills. Their regular collaboration with the Mondeca and Xyleme participants represented an apprenticeship for them, which in turn gradually enabled them to interact better with suppliers.

We must therefore emphasise the major role played by users with skills and motivation, which distinguishes them from ordinary users in the innovation process. Such skills facilitate the transmission of "sticky" information to the actors responsible for innovation development and, more generally, allow fruitful dialogue to be established between users and actors. We may also say that such users display the characteristics of key users, whose role they play in the innovation's application. However, contrary to what is described in the literature on information-systems management, this does not involve applying a standard type of software, so there is thus an exploratory aspect linked to the innovation application that results in a more intensive, less structured collaboration than in the case of mature software like ERP. This type of collaboration is certainly more demanding in terms of user skills and motivation at the customer end. We propose calling users with skills relating to the technology used by the innovation and lead-user characteristics **lead-user experts**. These competent users may also play an interface role between actors and "ordinary" users with no specific skills in text mining or knowledge management. Lead-user experts may be compared to key users described in information-systems management literature, but their role is different because they contribute to the innovation design process and not just to software integration and deployment.

4. *User contribution: taking account of the multiplicity of uses*

At the start of both projects studied were user workshops, during which Temis and Mondeca participants tried to understand how "ordinary" users (those with neither specific skills nor motivation concerning the innovation) worked, and how they might adapt to the software solution created. The issue involved ensuring that a large number of users contributed, mainly with the aim of observing the greatest number of usages, and having them react to concrete proposals about the application being developed. By analysing these usages and reactions, personalised software components were developed and software parametering was completed.

This vital user contribution goes back to the "sticky" nature of the information they had on their own activities, the marked extent of which is shown in the projects we have studied, thus confirming one of the founding hypotheses of the user-innovation approach (von Hippel, 1994). We suggest calling these customer-based users with lead-user characteristics **lead-user non-experts,** whose contribution to user workshops thus seems to be essential. The role they play in the design process studied cannot be completely assumed by a few users with expert-user profiles; in fact, the issue of observing the maximum number of possible uses during such development is of primary importance. As a result, having large user numbers involved is a key element, particularly in order to convince as many users as possible of the innovation's importance. The first point (taking a maximum number of usages into account) refers in part to the role of user communities, whether with regard to proprietary or open-source software (Raymond, 1999; Franke and von Hippel, 2003; von Krogh and von Hippel, 2003). The second point refers to user doubts when faced with usages being put in question by the adoption of new software (Markus and Keil, 1994; Markus and Mao, 2004). However, this interaction with users is much more difficult for software publishers to manage, as was shown in the failure of the PressPro user workshops. Likewise, the absence of this type of interaction for the entire second half of the Exinis project may be explained by the Exinis innovation architect's fear that the software publishers did not know how to manage it. This is why the plan he sets up involves, above all, making users interact with lead-user experts, who in fact play an interface role, facilitating understanding and appropriation of the innovation by the majority of non-expert users.

V.3 Conclusion on the customer contribution to the innovation process

In this paper, we have tried to highlight how first customers are involved in an innovation process. Von Hippel (2005) has shown that some customers are lead users upon whom the company may rely, to the extent that they are capable of supplying an initial description of their needs and of collaborating with the supplier to develop solutions, hence the search for such lead users as first customers who will enable the innovation to be designed. We have also detailed the roles of the various participants relative to these first customers. Such customers are clearly lead users (von Hippel, 1986), but their role goes beyond what is described in the literature on user innovation. Our work has confirmed the relevance of the lead-user notion, but has also succeeded in boosting this notion by crediting it with a multi-dimensional character, while the literature on innovation by users describes lead users as

mono-dimensional. In fact, various customer participants – innovation architects, project managers, expert users and non-expert users – play different roles in the innovation process. No participant is in a position to hold all these roles at the same time. In addition, the contribution of lead users to the innovation process emerges through longstanding supplier/customer interactions. In our view, these two points might enhance the vision of user innovation developed by the literature (von Hippel, 2005). Our work might also lead to further research on multiple-participant innovation processes.

V.4 Lessons concerning multiple-participant innovation-project management

The two projects studied have not only enabled us to determine the various roles played by lead-user customers, but have also taught us several lessons about multiple-participant innovation-project management.

1. Project management by the lead-user customer

The lead-user customer cannot assume all the tasks in the innovation process alone, but must manage the project with an HWPM and operational project manager, as we have seen. This means that suppliers should not take on this task unless they want to see the project fail. However, a responsibility of this nature demands the cross-functional skills of an HWPM and the ability to redirect the project and defend it to his hierarchy when inevitable failures and delays occur. Nonetheless, the task of linking two innovative pieces of software must be managed by the respective software publishers, who are alone in the position to develop new skills based on their own existing expertise.

2. The danger of direct interaction between suppliers and users as a whole

First of all, direct, unsupervised interaction between lead-user non-experts and suppliers may be counterproductive and even dangerous for the continuation of the project. The reasons are that dialogue between suppliers who do not know the usages and lead-user non-experts who do not feel particularly positive about adopting an innovation that disturbs their working habits is difficult and indeed unwanted by these users. On the other hand, supervised interaction like that seen on the Exinis project makes it possible to encourage project development, first through observation of usage multiplicity and second via an array of solution tests. Such observation takes place at the beginning and end of the project

respectively. During intermediate phases, interaction ends up going through lead-user experts, who serve as an interface between suppliers and the mass of lead-user non-experts.

3. Organization of interactions between suppliers and lead-user experts

Lead-user experts must participate on the teams in charge of designing the software link and personalizing the platform. This means that the software publishers must set up a structure that accommodates them, train them and take into account their contributions in terms of innovation usage.

4. The development of a methodology and then gradually of toolkits

The very first projects are carried out without any precise methodology, but analysis of such projects must make it possible to define one. To achieve this, the suppliers must include this task in the projects in question. In addition, the employment of user toolkits requires a certain appropriation of technologies used by the customers, which is not the case with users during the initial projects that implement the innovation. Nonetheless, during such projects the software publishers must, among their various tasks, integrate the development of a toolkit to enable customers to appropriate the maintenance of their solution (i.e. its marginal modification) and thus become familiar with the technology before attempting to use the toolkit to completely personalize their own solution.

VI   Conclusion

Two recent trends have been stressed in the literature on innovative software development. One is the increase in open-source solutions, in which individual software developers design new software that answers some of their needs and thus exhibit various lead-user characteristics (von Krogh and von Hippel, 2003). Coordination among these software developers is often seen as being emergent and self-organized, contrary to the traditional organization methods of new-product development as highlighted in project management. A second trend is modularisation, involving modular architecture that comprises independent modules with specified interfaces. Once such an architecture is stabilized, it allows innovation within each module without any coordination among developers of the various modules. Here again, organisational modes with very limited coordination among the companies involved are emphasized.

The software-industry projects analysed exhibit lead users and modularisation, but also the need for coordination as tackled by a project organization.

In bridging the literature on lead users and that on project management, we propose to unpack the notion of lead-user and differentiate several roles, identified according to the case analysis.

Our research brings to the fore the first lead-user role, that of innovation architect, involving the overall architecture design of the complete solution and the heavyweight project manager of the innovative solution's implementation. This actor initiates the project, authors the concept and champions the project within his company. This result in the field of proprietary software is quite different from work on open-source software, which underlines the lead user's role in writing the code for innovative software (von Krogh and von Hippel, 2003).

Aside from this first role of lead user, we underline how other actors were involved in designing the solution in its entirety. The formulation of platform design rules was split between two actors: the innovation architect, who asked several companies to work together, and the companies in question, which adapted their modules and designed the interfaces to make them interconnected.

We also stress the role of end users and how they participate to the development process, giving feedback on prototype application and proposing materials to test the efficiency of the software. Some lessons may be learned from this case regarding the management of multiple-participant software-platform projects. These concern the importance of leaving responsibility for the project to the customer and ways of bringing together expert and non-expert users in the platform implementation project.

The second area highlighted in our work relates to the formulation of design rules that make modularisation of systems and their design possible. The trend in the computer industry has been toward vertical disintegration and modularisation. We show a different process that requires combining specialized components in an integrated overall offering. We thus emphasise the work needed to connect the various software pieces in a platform and transform them into independent but easily connectable modules. We show how a project that involved developing a specific, tailored software also led to the definition of a platform's structure and detailed design at the core of this personalised offering, with specific interfaces for allowing easy plug-in of additional modules to the solution.

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