ABSTRACT
The paper investigates the relationship between new product introduction rate, customization, and IT systems supporting knowledge management processes. The methodology used is a multiple case study. The results of a cross-case analysis highlight how product customization impacts in the knowledge management processes of knowledge acquisition, creation, sharing and transfer, on which KM literature offers little evidence. Concerning the use of centralized IT knowledge management systems, the cases illustrate that the companies decide for an higher formalization in the R&D processes and select IT system with a high centralization in knowledge storing to better manage the new knowledge created.

Keywords: Knowledge management, Product customization, Multiple Case study.

1. INTRODUCTION
The topic of knowledge has a primary importance in managerial studies. Since 60ties, the resource based theory has been stressing the value of knowledge as pre-requisite for the firms’ success (Penrose, 1959; Spender, 1996). In the last decades Knowledge Management (KM) originated from the knowledge based view of the firm as a new independent research stream. As compared with previous research, KM focuses on the impact of the knowledge management processes on the firm performances from a far more practical perspective. As a matter of fact, knowledge management is defined as: “…the systematic, explicit, and deliberate building, renewal, and application of knowledge to maximize an enterprise’s knowledge-related effectiveness and returns from its knowledge assets” (Wiig, 1993).

The topic of product customization is directly connected to KM. Product customization represents a very important and increasingly diffused firm strategic choice. Customer focusing appears to firms as an alternative to differentiation in highly competitive and segmented market, making unique and hard to imitate its own products. At the same time the sophistication in customers’ requirements and their fast preference changing, makes needs’ satisfaction very hard to be achieved through a standard product. Furthermore the strong development of ICT tools makes the product customization process more efficient facilitating the management of both external and internal information useful for the New Product Development (NPD) process.

Another topic strongly linked to KM is the NPD. A new product development strategy is an important activity that helps enterprises to survive and make continuous increase in the market share. Thus product innovation is a crucial element to maintain market competitiveness. The rapid
introduction of new products and services enables organizations to adapt and to change in order to meet new customer demands. It enables firms to be in touch or develop new technologies. As a matter of fact most enterprises have now placed great emphasis on shortening the new products’ time to market (Liu et al., 2005).

The paper is organized in five sections. The section 2 is focused on definition and explanation of KM processes and their relationship with product customization and new product development are presented. Literature gaps are highlighted and research questions are formulated. The methodology used to investigate research questions, a multiple-case study, and the firms selection are expounded in section 3. Section 4 contains the description of KM practices in the case studies. Firms’ knowledge management practices are compared through a cross-case analysis in section 5 and some hypothesis emerged from case studies description are formulated. Conclusions and implications for management actions are finally discussed in section 6.

2. THEORETICAL BACKGROUND AND RESEARCH QUESTIONS

“Knowledge management is largely regarded as a process involving various activities. Slight discrepancies in the delineation of the processes appear in the literature, namely in terms of the number and labeling of processes rather than the underlying concepts” (Alavi, 2001, p. 114). According to the literature the fundamental KM processes are the following:

- **Knowledge Acquisition** which refers to firm's capability to identify and acquire externally generated knowledge critical to its core processes (Zahra and Gorge, 2002). Firms could acquire knowledge, information and capabilities from customers, suppliers, partners, universities, research laboratories, communities of practice...

- **Knowledge Creation** which involves developing new contents or replacing existing one within the organization's tacit and explicit knowledge (Pentland, 1995).

- **Knowledge Storing** which consists in the storing, organization and retrieval of organizational knowledge (Alavi, 2001).

- **Knowledge Sharing** which consists in the dyadic exchange of knowledge between source and receiver (Shin et al., 2001); therefore it concerns the possibility of transfer and sharing knowledge within the organization.

- **Knowledge Application/ Transfer** consists in the knowledge exploitation to create value and competitive advantage (Tonchia and Tramontano, 2004). The exploitation can occur through knowledge transfer across organizational boundaries (towards suppliers, direct clients...), through knowledge application to new product and services (Spender, 1996), through process innovation (Zahra and Gorge, 2002) or through patent registration.

Many strategic initiatives impact positively or negatively in the knowledge management: one is product customization. As competitive pressures intensify, product customization is becoming an increasingly important strategic initiative (Vickery et al., 1999). Customization encompasses the ability to provide individually designed products and services to customers in the mass-market economy (Da Silveira et al., 2000). Numerous books and papers have posited that we are witnessing the dawn of a new age of customization, an age in which new technologies, increased competition, and more assertive customers are leading firms towards customization of their products and services (Coates, 1995; Kodia, 1995). Thus it seems important to understand the relationships existing between product customization and KM in order to manage information and criticalities efficiently.

Many authors have studied customization and KM in broad terms, but without focusing on the five processes addressed above. Ghosh et al. (2006) studied the relationship among vendor and consumers in product customization. As customizing complex products requires decisions about specifying product attributes, the authors highlight some factors (product modularity, technological unpredictability, customer knowledge, vendor’s customer knowledge mobilization resources) influencing the vendor control over the composition of the customized products. Da Silveira et al. (2001) studied the impact of customization on the development of production systems listing the
knowledge sharing among success factors. As a matter of fact, in order to better perform the customization activity, companies must pursue a culture that emphasizes knowledge creation and distribution inside organization and across the value chain. Yassine et al. (2004) investigated the role of IT in customized product design in particular underscoring the importance of these tools to enhance knowledge sharing in new product development. Drodge et al. (2003) linked customization with knowledge application focalizing mainly on production processes. Manufacturers using more routine production processes have more opportunities to apply their collective knowledge to their processes.

As we have seen, current literature on product customization seems to lack of an explicit link with the five processes of KM. Consequently, the first research question is “How does product customization impact on KM processes within an organization?”.

Another strategic organizational process strongly involves the management of knowledge: the new product development. Due to the advances in science and technology and the rapid changes in the market, a product’s life cycle has become much shorter than before (Liu et al., 2005). The introduction of new products and services is a critical determinant of organizational performance and survival (Damanpour, 1991) and so new products are becoming the nexus of competition for many firms (Clark and Fujimoto, 1991).

The relationship between NPD and KM has been already studied in the literature. Li and Calantone (1998) studied the effects of customer knowledge process, marketing and R&D interface, competitor knowledge process and R&D strength on new product advantage. Brown and Eisenhardt (1995) gather and organize literature on NPD highlighting the importance of communications and synergies across different functions, high internal team communication, cross functional teams, supplier involvement, frequent external communication, disciplined problem solving.

Even the relationship between NPD and KM stages has been already studied. Liu et al. (2005) assert that the effectiveness of the knowledge management method plays an important role in new product development strategy. Smith et al.,(2005) assert that the knowledge creation capability of a firm is positively associated with the number of new products or services it introduces. Su et al. (2006) study KM techniques and IT systems useful to NPD to acquire data and information from customer (CRM, data mining...). Sherman et al. (2005) show how cross functional communication between R&D and marketing and knowledge sharing facilitate NPD.

As we have seen, current literature has studied the relation between NPD, KM and IT tool, but it doesn’t investigate which should be the Knowledge Management System (KMS) structure, in terms of centralization (decentralization) and formalization (not formalization), suitable to improve NPD processes.

We consider a “decentralized KMS structure” as a peer-to-peer systems. These are “distributed systems consisting of interconnected nodes able to selforganize into network topologies with the purpose of sharing resources such as content, storage [...] without requiring the intermediation or support of a global centralized server or authority” (Androutsellis-Theotokis and Spinellis, 2004, p. 337). Peers are autonomous, dynamic and heterogeneous and exchange data and services in a decentralized and distributed manner (Liu and Zhuge, 2006). On the contrary, we refer to a “centralized KMS structure” as an architecture generally characterized by the sharing of computer resources (storage, content) through the intermediation of a centralized and common server in the intra organizational network.

We consider “formalized KMS” as systems in which processes are systematized and formalized through rules, procedures and management practices (Hall, 1982) and produce data appropriate to their decision and control processes (Ein-dor and Segev, 1978). On the contrary, we refer to “not formalized KMS” as systems in which knowledge isn’t completely codified or stored through clear, fixed and compulsory rules.

Our objective is to understand if the structure regarding the knowledge and information storing tend to be centralized or decentralized, and if the KMS tend to be formalized or not formalized, when the
products portfolio is enriched by new products. These characteristics are very important because they influence knowledge visibility and activities such as knowledge search, knowledge retrieval, knowledge updating and knowledge contribution. Therefore, the second research question is “How does new product introduction rate, and consequently the product life-cycle stage, influence the Knowledge Management System structure?”

3. RESEARCH METHODOLOGY
As the outset of the study it was decided that a multiple case study would be taken with multiple data collection methods. This approach is particularly appropriate when the research question focuses on “why/how” observed phenomena occur and when there is no control over behavioural events (Yin, 2003). The multiple case study offers the possibility to provide in-depth understanding and identification of the patterns that link variables, as in the case of this paper. The aim was to study in depth the link among knowledge management processes and the product customization level and how new product introduction rate, and consequently the product life-cycle stage, influence the Knowledge Management System structure. In fact, the literature review has highlighted that this topics has been weakly studied both in theory and in practice and the case is particularly appropriate for shaping hypotheses in well-described specific situations (Meredith, 1998).

The research involved two case studies. The choice of the cases was theoretical. To pursue the research objective, we selected and analysed two exemplar case studies with an opposite approach to the market in terms of product customization. Case A concerns an Italian leading firm in the advanced planning systems market, strongly oriented to customization and continuous product innovation. Case B regards an Italian leading company in the coffee business, therefore one selling a standard product. Case B illustrates how the company changed strategy towards increasing the new product introduction rate and reducing product life-cycle stage because of competitors’ pressure and how, as a consequence, the company needed to select new IT systems for KM.

All data was gathered through company visits run in the 2006. To ensure research reliability, we triangulate data by gathering the same piece of information from different sources. The data came primarily from two sources: semi-structured interviews and internal documents. Data analysis included within-case and cross-case analysis. In the within-case analysis, we examined each knowledge management processes of the two companies and the knowledge management system adopted. Then, in the cross-case analysis, we go beyond the single case and compare the KM approaches in the different cases.

4. CASE STUDIES DESCRIPTION

4.1 Case A
Established in 1991 the company A develops and offers software solutions and consulting services for the production planning and scheduling. It employs 31 people in three different locations. In 2005 the total turnover has been 3.000.000 of euros.

In the first ten years of activity the company has designed and developed an APS (Advanced Planning System), which can be now considered a mature product in a niche market. In the last years the company has diversified its offer proposing forecasting and demand planning systems, order promising systems, and SCM consulting services. All the solutions offered by the firm are customizable, because they can be integrated with other software-house ERP, MES (manufacturing execution system) or business intelligence systems. Below follows the description of the five the KM phases in the company A.

Knowledge acquisition: Company A strongly involves customers in the product customization process. A lot of useful information are acquired through direct contacts with them (also some years after product delivery) and then made available for all the company employees by shared reports and documents. The information don’t regard only the product development, but also knowledge
about managerial and organizational practices. As a matter of fact Kaizen Week, which is one of the seven lean manufacturing tools, has been learned from a customer. It hasn’t been implemented a CRM tool yet, but it is one of the priority objectives of the company for the future. Moreover the firm is particularly active in training its personnel, scheduling the 3% of the total hours/person in a year for educational programs.

Knowledge creation: Considering the knowledge creation process, company A is particularly oriented to develop problem solving capabilities. As a matter of fact, since 2003 company has been adopting the Kaizen Week. Kaizen is a Japanese word generally translated as continuous improvement. Such a practice derives from the lean manufacturing approach and aims to solve emerging criticalities. It is usually adopted in large manufacturing firms, where the relative weight of the costs to be borne in order to implement a week is low if compared to the company A. Moreover, differently from the traditional lean manufacturing tool, Kaizen Week is used not only to improve but also to create and design new processes and knowledge. As a matter of fact the most of the Kaizen Week developed (38% of the applications) concerns the R&D area. The technique consists of a micro project in which 2 or 3 people work full time to solve a definite problem in a week. There is a preparatory phase in which choosing the team and defining the objectives, an executive phase in which new ideas and knowledge are developed, and a final phase in which presenting the results to all the company and designing the follow-up.

Knowledge storing: The company uses a version control system, called Subversion®, to store and manage source codes and technical documentation. It is a centralized system which manages files and directories changes over time. There are two different repositories: one for the code developers and one for the delivery area.

Knowledge sharing: Company A has ever been strongly oriented to team working and knowledge sharing. Kaizen Week results are shared between all the company members, even if they aren’t directly interested in the criticality or process considered. In such a way the technique is also a knowledge socialization practice. Besides, some ICT tools are used to support the interfunctional communication. Documents and files are shared through the version control system. Moreover the personal agendas are shared between the organization members by Outlook® (also in remote access).

Knowledge transfer: Company A develops educational programs to transfer knowledge to its customers, but they are usually about the use of the software sold or included in the consulting service. The firm isn’t interested in patenting process, they prefer to embody the knowledge created in their products.

Finally it is interesting to note that after the rejuvenating of the product portfolio, there haven’t been particular changes in the knowledge management system. As a matter of fact the KMS were and is centralized and formalized. The introduction of some ICT tools and Kaizen Week practice, has reinforced something already in use.

4.2 Case B
Established in Trieste (Italy) in 1933, the company B is a coffee company. It employs over 600 people, 400 of whom at the Trieste headquarters, where the production plant is located. Company B could be considered a standard mono-product company, selling a single blend of 100% Arabica coffee, even if the product is differentiated in multiple forms, roasts and packages creating nearly 400 different versions. The firm has tripled its turnover over the last ten years. In 2005 total turnover was 227 million euros.

The product life cycle shortening, occurred in the coffee market in the last years, leaded the company to a strategic change resulting in a rejuvenating of the product portfolio. As a matter of fact besides the traditional blend, now the firm offers other standard products such as, for instance,
easy service espresso (ESE) pods, chocolates and coffee machines. According to this objective, in 2005 the group acquired a company which produces espresso machines, widening its activity to the mechanical sector. For the next years the company is going to achieve the 30% of total turnover by selling new products. Such a strategic choice leaded to a change in the knowledge management too. The faster new product introduction involved an innovation process renewal, which has been based on a formalization of the KMS which allowed a better knowledge creation and sharing. Below follows the description of the five the KM phases in the company B.

Knowledge acquisition: Considering the knowledge acquisition process, there aren’t initiatives to underline, because the product specifications are usually defined by the R&D function basing on market analysis.

Knowledge creation: At the beginning of 2004 the company B adopted KEEx, a peer to peer tool for distributed knowledge management. KEEx is a decentralized KMS based on the principle that multiple perspectives foster creativity and innovation. At the present time the software has been implemented only in R&D area, even if initially the company considered the idea of widening its use to other functions. After few months by the KEEx implementation, an innovation process re-engineering began, thus leading to the development of the Product Lifecycle Management (PLM) project at the end of 2004. The project wanted to formalize every step of the innovation process, from the single ideas emerging from the employees, to the concept development, till the possible product launch on the market.

Knowledge storing: The company uses the ERP system database to store and manage all the technical, administrative and commercial documentation. It is a centralized system which manages files and directories changes over time.

Knowledge sharing: Till the beginning of 2001 the firm used a common server where documents could be shared initially in optional way. Different methods (e.g. based on organizational function, product coding, subject...) were used to classify the documents thus comporting a difficult information searching and retrieval. Afterwards PLM implementation all the documents and materials about a project must be gathered in shared and formalized files in the centralized server. Moreover PLM project has allowed a real information sharing between the different functions involved in a project, because the firm passed from a sequential product development (the involved function works on a previous part of the R&D project and then passes it to the following one) to a parallel one (every function is involved and interact since the beginning).

Knowledge transfer: the company manages a proper patents portfolio and registers nearly 6/7 patents for year. Patents are usually referred to products and not processes. As a matter of fact, products freely circulating on the market have to be protected by competitors’ imitation, making the knowledge explicit and exploitable by property rights. On the other side, tacit knowledge related to processes is hidden (and consequently not patented) in order to avoid competitors’ imitation.

The company is valuating some softwares to manage intellectual properties, because it sells in 120-130 countries worldwide, each of them with different patents’ costs and benefits.

The company believes that the opening to the actors of its supply network is a pre-condition to spread the coffee culture and to achieve qualitative excellence. Consequently the company transfers its knowledge across its supply network from upstream to downstream, with some educational programs for green coffee suppliers and an University of Coffee (in Trieste) for customers. The company has developed a collaborative relationship with the green coffee growers, who are educated through programs based on company’s know-how, helping to improve cultivation, purchasing the coffee and rewarding a commitment to quality. The University of Coffee is a knowledge transfer and training project addressed to barmen, employees and coffee lovers. Courses combine theoretical and practice knowledge with technical elements of coffee culture.
5. CROSS-CASE ANALYSIS AND HYPOTHESIS

The within and cross-case analysis has allowed to formulate some hypothesis linked to how customization and new product introduction rate impact in the knowledge management practices and in the KMS. In table 1 the knowledge management processes and systems of the two case studies are briefly resumed.

Table 1 – KM processes and systems in case A and case B

<table>
<thead>
<tr>
<th>KM processes and systems</th>
<th>CASE A</th>
<th>CASE B</th>
</tr>
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<tbody>
<tr>
<td>Knowledge Acquisition</td>
<td>• Customer involvement in the customization process.</td>
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<td></td>
<td>• Codification in reports and documents.</td>
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<tr>
<td>Knowledge Creation</td>
<td>• Kaizen, team working</td>
<td>• KEEx, Product Lifecycle Management</td>
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<tr>
<td>Knowledge Storing</td>
<td>• Subversion</td>
<td>• Centralized database</td>
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<tr>
<td>Knowledge Sharing</td>
<td>• Server, subversion, shared agenda, team working, kaizen week</td>
<td>• Server, Product Lifecycle Management</td>
</tr>
<tr>
<td>Knowledge Transfer</td>
<td>• Educational programs for customer</td>
<td>• Patents, educational programs for supplier, University of Coffee</td>
</tr>
<tr>
<td></td>
<td>• No patents</td>
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<tr>
<td>Knowledge Management System</td>
<td>• Centralized and formalized</td>
<td>• Centralized and formalized</td>
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5.1 Impact of customized/product services on KM processes

Organizations offering customized products/services must acquire and manage information from customers to perform their business, they need to develop a thorough customer analysis. These companies acquire data, information and tacit knowledge from customers and articulate and externalize them, in order to assimilate and store explicit knowledge. Strong knowledge sharing activities and problem solving capabilities allow to combine the new acquired knowledge with the company one, materializing the two into something tangible: new products. So the knowledge created is embodied in products with a low degree of explicitness.

Instead firms offering standard products don’t necessarily need a so thorough customer analysis to create new products. They could have a technology-push approach that allows them to focalize on product research and development and to define the product functionalities autonomously. This knowledge created has usually a high degree of explicitness being frequently protected by patents, or transferred to other companies within their supply network. Concerning product/service customization, the analysis of the case studies allows us to formulate the following hypothesis:

**H1**: increasing product/service customization level the conversion of tacit knowledge into explicit knowledge within organizational boundaries increases, whereas the transfer of explicit knowledge across organizational boundaries decreases.

A critical activity for organizations offering customized product/service is the customer relationship management. Sales staff should be able to understand customers’ requirements, their needs and expectations and to define the main products functionalities. These information lie in the client’s mind and consequently they are available only in tacit form. An important sales staff objective is to convert the implicit knowledge acquired into explicit one by articulating it into product specifications useful and manageable by the organization. As a matter of fact, sales staff is the interface between firm and client and usually is technically qualified on the products. As we have seen, at Company A customers are strongly involved in the product development. Sales staff has to realize a thorough client analysis to better understand their operational processes and the systems to
be integrated with.. All the information acquired are recorded in shared documents, reports and file which make them explicit. Moreover team working strengthens their spreading within the company. Customer relationship is a less complex activity for low level product/service customization firms. In fact the product characteristics are defined mainly by internal R&D. In the company B, as highlighted above, sales staff has to manage only its proper client portfolio. Its main activities are gathering the client order and passing it to firms, stimulating the purchase of new products and deals. They don’t formalize client needs in something useful for R&D. Based on our findings about the conversion of customer implicit knowledge in explicit, we can therefore confirm hypothesis 1 and refine it as follows:

**H1.1:** The higher the product/service customization level, the higher the conversion of customer implicit knowledge into explicit knowledge useful for the organization.

Organizations offering customized products have to face ever new specific and different realities, in which every customer can suggest new features corresponding to new knowledge creation to be developed in a short time. In such a context, organizations have to orient the knowledge creation process to a clear objective and so they need to develop a strong problem solving attitude. Differently, organizations offering standard products can develop a technology push approach in which R&D function usually proposes new products on the market. Moreover, time is a less important factor if compared to the case of customized products, where a client is already waiting for a result. As we have seen company A needs to face the integration with different information technology systems, to develop new ad hoc software code, in order to optimize the product functionalities. These problems have to be solved rapidly, so the company has been oriented to the continuous improvement of its own problem solving capabilities. The adoption of kaizen week as a specifically problem solving practice is the first proof of such an orientation. The fact that the practice has been implemented even if is usually adopted only by companies bigger than company A shows further this will. Instead company B doesn’t need to face such a large number of problems in a short time and its knowledge creation process is not strictly dictated by the market but can be spread over time. Consequently the focus of management commitment is on the research activity and the development of new ideas, supported by KEEx® and PLM project, and not on the problem solving capability. Based on our findings about problem solving capabilities of the firms, we can therefore confirm hypothesis 1 and refine it as follows:

**H1.2:** The higher the product/service customization level, the higher the company problem solving capabilities.

Organizations with a high product/service customization level tend to adopt tools and practices facilitating the communication between sales and R&D function. A right communication of all the product specifications is fundamental to satisfy customer requests. As highlighted above, at company A every project is performed by an interfunctional team to accelerate the communication and reduce lack of comprehension and alignment. Team working allows to share contexts, to facilitate interaction between individuals and fusion of different perspectives in order to implement the product desired by the customer. Team working is supported by ICT tools. File sharing and Subversion® allow the team members to have complete visibility on documents and information. Since preliminary stages, the sales staff can contact the R&D function through e-mail, phone, Netmeeting®. Organizations with a low product/service customization level present a less close interaction between sales and R&D function, because the product characteristics are market driven and not defined by a single customer. The only flow of information is about hypothesized market needs, but it’s very fitful.

Based on our findings about the practices for knowledge sharing, we can therefore confirm hypothesis 1 and refine it as follows:
**H1.3:** The higher the product/service customization level, the higher the adoption of practices and ICT facilitating interfunctional communication.

Highly customized products show ever different characteristics and their use is restricted to customers expressing explicit requirements. Consequently, products are less subject to imitation and organizations are less interested in patenting processes, which defend the firm from imitation and at the same time make knowledge explicit. As we have seen, company A isn’t interesting in patenting. Rather, they are focalized on creating value embodying the knowledge, developed through customization activity, in products. In such a way the most of the knowledge transferred remains tacit.

On the contrary, standard products have the same fixed characteristics for every customer and can circulate freely in the market. Firms have to articulate knowledge into explicit form in order to exploit the intellectual propriety rights reducing or delaying the chance of imitation. As we said, the company B follows a patent policy. Furthermore, being sure to be protected, it carries out also two important activities oriented to knowledge transfer: the training of coffee suppliers and the University of Coffee. Their objective is to create and maintain the value of its products and processes transferring explicit knowledge across its network.

Based on our findings about patenting approach, we can therefore confirm hypothesis 1 and refine it as follows:

**H1.4:** As the product/service customization level increases, company efforts towards patenting process decrease, whereas tacit knowledge embodied in products increases.

5.2 Impact of new product introduction rate on centralization of knowledge management systems

Many companies have product portfolios mostly composed by mature products, nevertheless today market imposes a higher innovative level, so even these organizations have to insert new products in their portfolios to search unexplored market niches. Companies who have chosen such a strategic pattern have to fit their organization to the change by an efficient management of the early product life cycle stages. Consequently, they tend to adopt a more centralized and formalized KMS in order to gather and have at one’s disposal all the information about product, specifications, possible criticalities and its development. Moreover, with a centralized system all users can have a fast and sure visibility on information to solve problems and promote improvements. From this point of view a decentralized system is less effective because it leads to a more likely replication of the efforts for product development. Previous propositions make it clear that the shift from a product portfolio mainly mature to one in which products in the early stages of life cycle exist, involves changes in KMSs. On the other hand, we have seen that product characteristics (custom vs standard) influence the stages of knowledge management process. It’s natural wondering if differences in changes required by KMS exist for firms shifting from a product portfolio composed mainly by mature products to one composed by new products, respectively in high and low customized contexts.

Concerning the adoption of centralized knowledge management systems, the analysis of the case studies allows us to formulate the following hypothesis:

**H2:** As the weight of new products in company product portfolio grows, knowledge management systems tend to be more centralized and formalized.

Firms offering mature standard products can manage knowledge in any way, through centralized, decentralized, formalized or not formalized system. This is possible because characteristics, routines and information about products are well-established and known by everyone in the company and changes are few and distributed over time.

However, if firms are inclined to increase the new product introduction rate, they have to face changes, new ideas, problems and new information. If they aren’t organized the process can result slow and complex. So firms should adopt a formalized and centralized KMS useful to manage,
create and share information and knowledge allowing product development. As a matter of fact, before focusing on the introduction of new products in its portfolio the company B chose KEEX®, a decentralized system, to make research, and the product development process was centralized but barely formalized, so that it lacked efficiency. Once company B has decided to rejuvenate its product portfolio, they implemented a PLM project in order to formalize every project development stage and its full documentation. After PLM introduction all the documents and materials about a project must be gathered in a shared file accessible to the team working members in the centralized server. This allows a real information sharing which enables an effective knowledge creation. Firms offering mature custom products should already have a formalised and centralized knowledge management system to manage all the different product versions. Consequently firms are usually already correctly equipped to shift to a faster new product introduction and at most can reinforce its system with new tools or adopting new procedures for new product development process. As we have seen at company A the strategy change hasn’t involved substantial modifications in the knowledge management if compared to the ones happened in the company B. As a matter of fact they already had a version control system which has been changed in another (Subversion®) more efficient.

Based on our findings about customization level, we can therefore confirm hypothesis 2 and refine it as follows:

**H2.1:** In context where customization level is low, companies seeking to rejuvenating their product portfolio by introducing new standard products, tend to adopt centralized and formalized knowledge management system to better cope with the early product life cycle stages.

**H2.2:** In context where customization level is high, companies seeking to rejuvenating their product portfolio by introducing new custom products introduction tend to maintain and/or reinforce their centralized and formalized knowledge management systems to better cope with the early product life cycle stages.

### 6. CONCLUSIONS AND MANAGERIAL IMPLICATIONS

The paper focused on a cross-case analysis of KM managerial practices in two exemplar cases highlighting how product customization impacts in the knowledge management processes of knowledge acquisition, sharing and transfer, on which KM literature offers little evidence. As a matter of fact customization needs a careful acquisition of information about each customer, which has to be managed and shared in the organization. The relationships between sales, R&D and production functions have to be strengthen and the KM system has to support such a need. As regards knowledge transfer, a customization approach impacts on the patent policy, because a standard product has to be defended against the competitors in a stronger way in comparison with a customized product.

Furthermore, the cases helped to develop new understanding on how an increase in new product introduction frequency impact the choice of IT system for KM. In particular the cases illustrate that the companies decided for an higher formalization in the R&D processes and selected IT system with a high centralization in knowledge storing to better manage the new knowledge created. From this point of view the result is new in comparison with previous researches.

### REFERENCES

Available upon request