

## **An empirical investigation of the customer Knowledge creation impact on NPD Performance**

### **Abstract**

*New product development (NPD) projects require efficient strategies for reducing time to market and responding faster and better to the customer needs. While these strategies were mostly technology driven at the early stages, nowadays firms are adopting more and more a knowledge management approach based on the use of knowledge management system (KMS) that enhance the creation of new customer knowledge and NPD performance. Despite these significant benefits, there is a variance that occurs concerning the variety in the extent of efforts that firm deploy for customer knowledge creation to achieve NPD performance. This is because not all the firms can put together the right resources to achieve NPD performance. In this study, the authors develop a research model that identifies (1) the impact of the KMS factors on customer knowledge creation process and NPD performance, (2) the elements that interconnects KMS factors (such as enablers), customer knowledge creation process, and NPD performance (3) the outcomes that are generated by this approach.*

### **1 Introduction**

In many industries, the survival of firms is increasingly determined by their success in new product development (Cooper, 2001; Schilling and Hill, 1998). On average, more than one-third of corporation's revenue comes from products that did not exist five years ago (Nambisan, 2003). In the case of technology driven firms, whom competition lies on the New Product Development (NPD) cycle time, the performing firms are the ones that are able to manage efficiently their NPD processes in getting to their markets faster, and responding to the customers needs and expectations. NPD processes involve continuous information acquisition, sharing and utilization (Griffin and Hauser, 1992; Hutt et al., 1988), which is crucial for customer-driven companies to harness their capabilities and their customer knowledge (Baker, 2000; Davenport and Klahr, 1998). Customer knowledge can sustain the development of attractive new product concept which is a critical success factors for NPD (Lester, 1998). This new customer knowledge requires in depth customer knowledge and experience in particular technologies and market applications necessary for customer knowledge creation. Despite

the acknowledged importance of the customer knowledge creation that satisfy expressed and latent customer needs through better products and services (Slater and Narver 1995), there is a variance that occurs concerning the variety in the extent of efforts that firms deploy for customer knowledge creation to achieve NPD performance. In this research, we identify the underlying reasons for this variance.

We observed three key limitations in prior literature on customer knowledge creation in NPD projects.

First, there is an understanding that the effective management of customer knowledge creation enhances the NPD performance by generating and integrating information about specific customers which are key prerequisite for new product success (Cooper and Kleinschmidt, 1995, 1996). This understanding need a formalization in a theoretical construct to build a body of knowledge dealing with the impact of customer knowledge creation on NPD performance supported by a KMS. This theoretical model is based on previous studies that have focused on the relationship between enablers and processes (Appleyard, 1996; Hansen, 1999; Szulanski, 1996; Zander et al. 1995), whereas others have put the emphasis on the relationship between enablers and NPD performance (Filippini et al., 2004; Montoya et al., 1994). This study develops a framework that interconnects in a theoretical model two KMS factors: organizational culture and organizational structure (Graham et al., 1996; Chase, 1997; Davenport et al., 1998; O'Dell et al., 1999; Long, 1997) with customer knowledge creation process (Nonaka and Takeuchi, 1995), and NPD performance (Rosenau, 1988; Clark et al., 1991; Dyer et al., 1995; Cohen, 1996).

The second limitation of prior studies, focuses on the KMS factors having a direct impact on the customer knowledge creation and an indirect one on NPD performance which have not being identified to the best of our knowledge. This lack of attention towards the interrelated impact of the KMS factors on new product development activities is also considered as a general limitation in the NPD literature (Henard and Szymanski, 2001).

That why our theoretical model is composed by several enablers that are fostering customer knowledge creation (Ichijo, 1998): centralization, formalization, collaboration and trust. Each of these enablers stimulates the customer knowledge creation process, protect customer knowledge, and facilitate the sharing of customer knowledge that occurs during the product

development. (Stonehouse et al., 1999). The customer knowledge creation process supported by a KMS adopt the SECI model proposed by Nonaka and Takeuchi (1995) that is based on socialization, externalization, combination, and internalization. Concerning the impact of customer knowledge creation process on NPD performance, we concentrate on the degree to reduce time to market and increase profit margins (Rosenau, 1988, Clark et al., 1991, Dyer et al., 1995, Cohen 1996).

Third, an empirical analysis that gives more credibility to our study is needed because much of the knowledge about customers is grounded in case studies, and the large scale empirical evidence for its antecedents, moderators and effects on NPD performance is lacking (Joshi et al., 2004). In our case, we have conducted a structural equation modeling analysis using PLS, that has provided a decomposition of the major insights into the KMS factors that improves customer knowledge creation and NPD performance, using participants from the software development industry of the Silicon Valley.

Accordingly, our objectives in this research are to:

1. Develop a theoretical model to reflect the impact of KMS factors on the customer knowledge creation process, and NPD performance;
2. Develop the interconnected model that comprises the antecedents, moderators and outcomes of customer knowledge creation; and
3. Provide an empirical assessment for this interconnected model in the context of the Silicon Valley.

The paper is structured as follow. We begin by defining the customer knowledge creation and by articulating our conceptual framework by defining all the variables (factors, enablers, processes, performance). We then discuss the methods and measures we used to test our research model. Following a presentation of the results, we close with a discussion of the results in terms of their theoretical, managerial, and further research implications.

## **2. Conceptual Framework**

### **2.1 Customer Knowledge Creation**

Due to competitive pressures, limited resources, and accelerating costs that characterize most NPD projects (Cooper & Kleinschmidt, 1986), firms increasingly use formalized and structured processes (Griffin, 1997), that correspond to conceptual and operational roadmaps for moving a new product project from idea to launch (Cooper 1994). Each stage of the NPD process requires the combination of customer knowledge and skills to perform useful actions to solve

ill-structured problems. This places a premium on the ability to effectively capture the customer knowledge created during the process so that it can be re-used in the next generation of products to reduce development time (Belbaly et al. 2006).

Traditionally, market research was used to shed light on what the customer knew and thought about the product, which resulted in enormous customer relationship management (CRM) databases (Galbreath and Rogers, 1999; Wilkestrom, 1996; Woodruff, 1997). Even if the data about customers are readily available through existing CRM database software packages, they have a lot of difficulties to integrate disparate data sources or provide the right kind of information to the right people (Bose et al., 2003). In fact, CRM databases do not allow knowing more about customers (Davenport et al., 2001), because data alone do not lead to customer knowledge (Benbya et al. 2004). Indeed, managers need to transform data into customer information and to integrate this information throughout the firm to develop customer knowledge (Campbell, 2003) and especially in NPD projects. Thus, a new generation of CRM systems supported by KMS is able to help the organization understand its customers as well as serve and learn from them (Gibbert et al, 2002).

On the basis of the preceding, we can define customer knowledge management as the need of a firm to manage the knowledge about customers (in order to address them), knowledge for customers (for their interactions) and knowledge from customers (to improve products and services) (Bueren et al., 2004). The management of the customer knowledge is supported mainly by the customer knowledge process that enables the creation, analysis, and dissemination of customer-related information (Li and Calantone 1998; Kohli and Jaworski 1990) for the purpose of improving firm's ability to identify customer needs.

In our case, we will concentrate on the customer knowledge creation process built on the conceptualization referred to with the acronym SECI where customer knowledge is created and expanded through social interaction between tacit and explicit knowledge (Nonaka, 1994; Nonaka et al., 1994; Nonaka et al., 1995; Nonaka et al., 2000). These authors specify four customer knowledge creation modes as the processes of interplay between tacit and explicit knowledge that lead to the creation of new customer knowledge: socialization (tacit to tacit), externalization (tacit to explicit), combination (explicit to explicit), and internalization (explicit to tacit). They are explained hereafter:

Socialization yields new tacit knowledge that is built through informal interaction between individuals,

usually through an exchange of tacit knowledge that occurs during joint activities rather than written or verbal instructions (Hedlund, 1994; Walsh, 1995; Weick et al., 1993; Nonaka, 1994; Nonaka and Konno, 1998; Nonaka and Takeuchi, 1995). *Externalization* involves the expression of tacit knowledge and its conversion into comprehensible forms that are easier to understand; it's an act of codifying or converting tacit knowledge into explicit knowledge, characterized by more formal interactions such as expert interviews or the sharing of lessons learned in a previous project (Raelin, 1997; Nonaka, 1994; Nonaka and Konno, 1998; Nonaka and Takeuchi, 1995). Combination involves the conversion of explicit knowledge into more complex sets of explicit knowledge (Nonaka, 1994). Focusing on communication, diffusion, integration, and systemization of knowledge, combination contributes to knowledge at the group level as well as at the organizational level (Nonaka and Takeuchi, 1995). And finally, internalization is the conversion of explicit knowledge into the organization's tacit knowledge. This requires the individual to identify the knowledge relevant to oneself within the organization's explicit knowledge. Learning by doing, on the job training, learning by observation, and face to face meetings are some of the internalization processes by which individuals acquire knowledge (Nonaka, 1994; Nonaka and Takeuchi, 1995; Kale and Singh, 1999).

The customer knowledge creation process is supported by KMS that have been defined as a line of systems which target professional and managerial activities by focusing on creating, gathering, organizing and disseminating an organization's 'knowledge' as opposed to 'information' or 'data' (Becerra-Fernandez, 2000). In order to manage individual customer relationships, customer information and knowledge should be available everywhere and to everyone in an organization dealing with customers and everyone who uses customer knowledge in decision making (Davenport et al., 2001; Foss et al., 2002; Rigby et al., 2002). While most companies started developing this type of customer knowledge by creating data warehouses or customer information files, not many have gained many true insights. "They may know more about their customers but they don't know the customers themselves or how to attract new ones" (Davenport et al., 2001). To create useful knowledge about customers, companies need more than transaction data. To be *used*, this knowledge must also be integrated across processes, information and technology. Few companies have yet achieved either goal (McKeen and Smith, 2003). So the development of KMS demands that knowledge be obtained,

produced, shared, regulated and leveraged by a steady conglomeration of individuals, processes and IT (Benbya et al., 2005), but still to be effective KMS should fit the overall organizational culture and structure. That why, the choice towards integrating KMS in CRM systems is the solution for managing effectively the customer knowledge creation, because KMS have the capability to manage the customer knowledge embedded in the NPD processes by supporting the creation of new customer knowledge necessary to improve NPD performance and reduce time to market.

Given that the customer knowledge creation occurs in an organizational context, the KMS challenge for NPD projects is to recognize the different contexts that have a significant influence on NPD performance. Once this realization has been achieved, the next challenge is concerned with ensuring that the sources of the customer knowledge creation are available to the NPD teams in order to be able to measure NPD performance (Rosenau, 1988; Lambkin, 1988). In the following discussion, we identify factors in each context that explain the variance in the extent to which customer knowledge creation is practiced.

## 2.2 Antecedents of Customer Knowledge Creation

Each of the three defining characteristics of the customer knowledge creation process described previously creates requirements that need to be fulfilled for enhancing the NPD performance. These requirements are examined throughout the influence of KMS factors that explain the variance of the customer knowledge creation process on NPD performance.

Organizational culture as a concept is considered as a key element of managing organizational change and renewal (Pettigrew, 1990) and remains the most important and studied factor for successful knowledge management (Chase, 1997; Davenport et al., 1998). When supported by KMS, organizational culture acts as influencing factors of the customer knowledge creation process by facilitating the leverage across uses and users (Quinn, 1992; Quinn et al., 1996). In reality, culture defines not only what customer knowledge is valued, but also what customer knowledge must be kept inside the organization for sustaining innovative advantage and NPD performance (Long, 1997). A culture of collaboration and trust is required to encourage the application and development of customer knowledge within an organization (Scarborough et al., 1999; Nahapiet, 1998; Miller, 1996) and as a consequence enhance the NPD performance.

The organizational structure institutionalizes how people interact with each other, how communication

flows, and how power relationships are defined (Hall, 1987). The structure of an organization reflects the value-based choices made by the company (Quinn, 1988); it refers to how job tasks are formally divided, grouped, and coordinated. When supported by a KMS in a NPD context, the organizational structure within an organization may encourage customer knowledge creation (Gold et al., 2001; Hedlund, 1994) by avoiding double invention, achieving economies of scale and scope, contributing to the co-location of knowledge and tasks (Jensen and Meckling, 1992), and reducing costs of searching and transforming available knowledge for local use (Hedlund, 1994). Our study includes two key structural enablers that influence the customer knowledge creation process for the organizational structure: centralization and formalization (Menon et al., 1992). They are recognized as key variables underlying the structural construct that impact customer knowledge creation (Eppler et al., 2000; Jarvenpaa et al., 2000).

We draw on prior research to identify specific actions that organizations can undertake to fulfill each of these requirements for customer knowledge creation to occur in NPD projects. The championing of the organizational culture and organizational structure are the antecedent constructs in our research model (Figure 1) that enable the customer knowledge creation process to meet NPD performance. Each of these antecedents creates the necessary conditions for customer knowledge creation to enhance the NPD performance. However, we argue that not all organizations that undertake such actions are equally successful at fostering customer knowledge creation in their new product development projects. The effectiveness of these antecedent's actions depends on project complexity and project risks characteristics that can moderate the impact of these actions on customer knowledge creation.

### 2.3 Hypotheses

**Collaboration:** Collaboration may be defined as the degree to which people in a group actively help one another in their work (Hurley et al., 1998). Collaborative culture affects customer knowledge creation through increasing knowledge exchange (Krogh, 1998; Nahapiet, 1998).

Exchanging knowledge among different members is a prerequisite for customer knowledge creation through a KMS platform. Collaborative culture fosters this type of exchange by reducing fear and increasing openness to other members in NPD projects. Collaboration between NPD team members also tightens individual differences (Leonard-Barton, 1995).

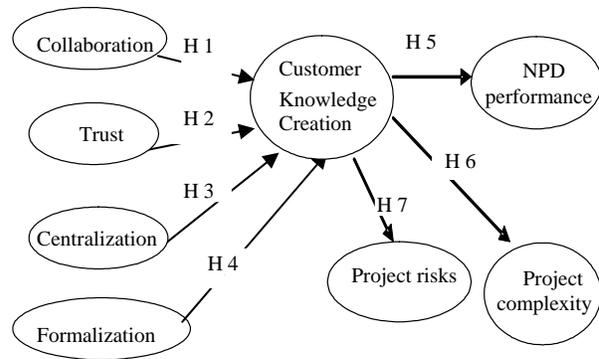


Figure 1. Research Model

It can help people develop a shared understanding about an organization's external and internal environments through supportive and reflective communication. Without shared understanding among organizational members, little customer knowledge is ever created (Fahey et al., 1998).

*H1: Collaboration will have a positive effect on customer knowledge creation process.*

**Trust:** Trust can be defined as maintaining reciprocal faith in each other in terms of intention and behaviors (Kreitner et al., 1992). Trust may facilitate open, substantive, and influential knowledge exchange (Nelson et al., 1996; O'Dell et al., 1999). When their relationships are high in trust, people are more willing to participate in knowledge exchange (Nahapiet et al., 1998) supported by a KMS. Szulanski (1996) empirically found that the lack of trust among employees is one of the key barriers against knowledge exchange. The increase in knowledge exchange in NPD projects brought on by mutual trust results in customer knowledge creation. Trust also encourages a climate conducive to better customer knowledge creation by alleviating the fear of risk. The presence of a high level of trust can reduce this risk (Nelson et al., 1996; Robert, 2000; Scott, 2000). Trust is also critical in a cross-functional or inter-organizational team because withholding information because of a lack of trust can be especially harmful to customer knowledge creation (Hedlund, 1994; Jarvenpaa, 2000).

*H2: Trust will have a positive effect on customer knowledge creation process.*

**Centralization:** Centralized structure inhibits interdepartmental communication and frequent sharing of ideas (Woodman et al., 1993) because of time-consuming communication channels (Bierly et al., 1996); and the distortion and discontinuousness of ideas (Stonehouse et al., 1999). Concentrated power

arrangements tend to prevent imaginative solutions to problems since centralized decision-making often translates into processes that run counter to the requirements of a creative environment (Argyris 1964; Deal and Kennedy 1982; Thompson 1965). The constant flow of communication and ideas necessary supported by KMS to enhance the customer knowledge creation does not occur in centralized structure but in decentralized organizational structure that facilitates an environment where employees participate in knowledge building process more spontaneously (Hooper, 1990). Therefore, decreased centralization in the form of locus of authority can lead to increased creation of customer knowledge (Starbuck, 1992; Stonehouse et al., 1999; Teece, 2000) in NPD projects.

*H3: Decreased centralization will have a negative effect on customer knowledge creation process.*

*Formalization:* Formalization refers to the existence of formal rules and regulations that correspond also to the degree to which decisions and working relationships are governed by standard policies, and procedures (Holsapple et al., 2001; Rapert et al., 1998). Formalization may increase the level of certain types of information processing (Galbraith 1973) and information use (Daft and Lengel 1986), without facilitating the creation of new customer knowledge. However, Formalization using less flexibility and less emphasis on work rules usually restricts new ideas and inhibits customer knowledge creation (Ichijo et al., 1998; Lusch et al., 1998). In NPD projects, this formal situation asphyxiates the communication and interaction necessary to create customer knowledge. That why lack of formal structure using KMS in NPD team tends to enable NPD members to communicate and interact with one another to create customer knowledge (Jarvenpaa et al., 2000).

*H4: Lack of formalization will have a negative effect on customer knowledge creation process.*

## **2.4 Consequences of Customer Knowledge Creation**

As NPD performance is the output of the customer knowledge creation process, we will use time to market as measuring variables. Time-to-market reduction is considered as a competitive advantage for NPD projects. Reduction of the time to market is sustained by customer knowledge which requires in depth knowledge and experience in particular technologies and market applications. This places a premium on the ability to use a KMS to effectively capture the customer knowledge created during the process so that it can be re-used in the next generation of products to reduce development time (Belbaly et al. 2006). Thus time plays a central role in these two ways

of generating profit: reducing delay can reduce the cost by the reduction of the financial immobilization (Rosenau, 1988), and can also, based on an economic analysis of first mover advantage (Lambkin, 1988), create value in markets where obsolescence is central.

*H5: The customer knowledge creation process will have a positive effect on NPD performance.*

## **2.5 Controls**

In addition to KMS factors, firms may be motivated to engage in customer knowledge creation as a strategic response to environmental turbulence. Prior research has identified two sources of environmental turbulence in NPD projects: (1) Project complexity; (2) Project risks. Previous research suggests that the breadth of project complexity, project risks of NPD projects can have significant influence on the NPD performance (Ancona and Caldwell, 1992). Similarly, others (Narver and Slater, 1990; McKee, 1992; Moorman, 1995) have suggested that risk-taking is related to creativity in organizations. Therefore, to ensure that the effects uncovered in our analysis are due to the relationships of interest alone, we control for the extraneous variance attributable to these NPD projects characteristic variables. Specifically, we control for the complexity and risk of the NPD projects.

*H6: The customer knowledge creation process will have a positive effect on project complexity.*

*H7: The customer knowledge creation process will have a positive effect on project risks.*

## **3. Method**

### **3.1 Data Collection**

A questionnaire based survey was conducted. Questionnaires were sent to a total of 225 middle managers in 16 organizations. Depending on each individual firm's size, two to fifteen middle managers were surveyed from each firm. Middle managers were reached through their VP of product development, Director of product development or Senior product managers. A typical job title of a middle manager was product manager. Middle managers were surveyed because they played key roles in managing customer knowledge. Middle managers are positioned at the intersection of the vertical and horizontal flows of knowledge. Thus, they can synthesize the tacit customer knowledge of both top managers and frontline employees, make it explicit, and incorporate it into new products and services (Nonaka and Takeuchi, 1995).

The individual new product development process is the unit of analysis in this study. There are notable limitations associated with investigations on the impact of the customer knowledge creation on time to market

reduction using a KMS (e.g. firm level). Considerable variations in the effect of individual factors upon time to market reduction often exist across various new product ventures and product group of the same firm. It is unrealistic to expect that the same elements will be responsible for reducing time in all product cases. Consequently investigation of the time to market reduction at aggregate level (i.e. the level of the overall firm or a level higher than an individual new product development process) will result in amalgamated finding and misleading interpretation. Therefore the position taken in this research is that individual new product development process must be selected as the unit of the study, to obtain a more precise measurement of the factors affecting the time to market reduction supported by a KMS and potentials effects upon NPD performance. This stance is in line with majority of research in NPD Montoya-Weiss and Calantone, (1994) and Mascarenhas (1992) work.

A multiple-item method was used to construct the questionnaires. Each item was based on five-point Likert scale that has gathered the response of the product managers ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). A pilot study was carried out initially. The number of respondent to the survey was 36, where 4 have been eliminated because they were incomplete responses. The usable sample contained 32 data points, indicating a response rate of 16 percent, which is an acceptable rate of response according to the principles of survey design. In this dataset 17 data where missing and have been replaced by the Maximum Likelihood techniques.

### 3.2 Measurement

Research constructs were operationalized on the basis of related studies and pilot tests. Most of the research constructs have already been validated and used for other studies on knowledge management, organizational design, marketing, learning, NPD or IT management (Table1).

### 3.3 Data Analysis

This measurement model was estimated using PLS that have incorporated the model, parameters, and estimation summary in one hand, and on the other hand the model assessment as a whole. PLS allows to both specify the relationships among the conceptual factors of interest and the measures underlying each construct, resulting in a simultaneous analysis of (1) how well the measures relate to each construct and (2) whether the hypothesized relationships at the theoretical level are empirically true. PLS was used because it is more appropriate than alternatives, such as LISREL and AMOS, when sample size are small and models are complex, the goal of the research is explaining the variance, and measures are not well

established (Formell and Bookstein, 1982; Gefen et al. 2000). The properties of the measurement model are summarized in Table 2.

## 4 Results

Following the two-step analytical procedures (Hair et al. 1998), we first examined the measurement model, the structural model. The rationale of this two-step approach was to ensure that our conclusion on structural relationship was drawn from a set of measurement instruments with desirable properties.

**Table 1: Constructs used in the study**

Variable	Related literature
Centralization	Caruana et al. (1998); Damanpour (1991) Ein-Dor et al. (1982); Hedlund (1994).
Formalization	Caruana et al. (1998); Glynn (1996); Rapert et al. (1998).
Collaboration	Huemer et al. (1998); Kreitner et al. (1992); O'Dell et al. (1999).
Trust	Davenport et al. (1998); Ichijo et al. (1998); Kozlowski et al.1998.
Socialization	Nonaka and Takeuchi (1995); Nonaka et al. (1994).
Externalization	Nonaka and Takeuchi (1995); Nonaka et al. (1994).
Combination	Nonaka and Takeuchi (1995); Nonaka et al. (1994).
Internalization	Nonaka and Takeuchi (1995); Nonaka et al. (1994).
NPD performance	Rosenau (1988); Clark et al. (1991) Dyer et al. (1995); Cohen (1996)

## 4.1 The measurement Model

### 4.1.1 Instruments Reliability

One measure of reliability using confirmatory factor analysis used here is the composite reliability (Fornell and Larcker, 1981). This measure has frequently been used to test model reliability (e.g., Raghunathan et al., 1999). The composite reliability is also called Cronbach alpha (Cronbach, 1951). The Cronbach Alpha which reflects the internal consistency of the indicators ranges from 0.62 to 0.90 for the 11 constructs, indicating a high internal consistency. These statistics are shown in Table 2.

### 4.1.2 Instruments Validity

A recommended method to examine the validity of constructs is by assessing the convergent validity, which can be established at the multi-method level of analysis by measuring the degree of agreement in responses of the informants to different survey items (Phillips and Bagozzi, 1986). Convergent validity of an indicator is used to assess whether individual scale items are related. A confirmatory factor analysis was performed to test for validity (Bagozzi, 1980). The t values for all of the standard factor loadings exceeded the critical value of 3.29, at a p level of 0.01. Thus the

measures support convergent validity (Anderson and Gerbing, 1988).

#### 4.2 The Structural Model

While the factor analysis results provide evidence of convergent validity, in the PLS methodology (see Agarwal and Karahanna 2000), divergent validity is also assessed using the average variance extracted (i.e., the average variance shared between a construct and its measures, AVE). The square root of this measure should be greater than the variance shared between the construct and other constructs in the model (Fornell 1981). You can find the results in Table 2.

The results of the PLS analysis are shown in Figure 2 and Table 3. To allow for the possibility of effects other than those hypothesized, we tested a saturated model, including paths from all independent variables to each of the measures of effectiveness. To present an uncluttered picture, the non significant relationships have been omitted from the figure. The coefficients for all variables and paths are displayed in Table 3. Table 4 summarizes the results of all hypothesis tests.

As shown in Figure 2, all the determinants of the customer knowledge creation (collaboration, trust, centralization, formalization) have significant effects on customer knowledge creation, with path coefficient of -0.193, 0.281, -0.128, 0.864 respectively. Even if for collaboration and centralization are found to be negatively moderate the impact on customer knowledge creation. All the KMS enablers explain 86 percents of the variance for customer knowledge creation. Regarding NPD performance, it is found to be statically significant with the customer knowledge creation and project risks with path coefficient of 0.239 and 0.189 respectively. The customer knowledge creation and the project risks explain 86 percent of NPD performance. Finally, the determinant of the control variables which is the customer knowledge creation variable have a significant effect on both project complexity and projects risks, with path coefficients of 0.389, 0.583. In this case, the customer knowledge creation process explains 28 percent of project risks and 40 percent of project complexity.

#### 5. Discussion

Motivated by the need to better understand the impact of customer knowledge creation process on NPD performance, this study develop an interconnected theoretical model that reflect the impact of KMS factors on the customer knowledge creation process, and NPD performance. The findings present a strong support to the existing theoretical links between KMS

Construct Name	Construct identifier	AVE	Initial number of items	Cronbach Alpha
Collaboration	CO	0,67	5	0,87
Trust	TU	0,64	6	0,81
Centralization	CE	0,62	5	0,85
Formalization	FO	0,77	5	0,85
Knowledge Socialization	KS	0,63	5	0,85
Knowledge Externalization	KE	0,71	5	0,90
Knowledge Combination	KC	0,61	5	0,84
Knowledge Internalization	KI	0,72	4	0,80
Time to Market	TM	0,71	4	0,81
Project Risk	PR	0,52	4	0,61
Project Complexity	PC	0,54	5	0,70

factors, customer knowledge creation and NPD performance. These results have several implications for theory and practice.

**Table 2: Summary of Constructs**

#### 5.1 Limitations of this study

During the development of this study, we recognized some limitations that are related to the focus, sample size, and model assessment of the research.

First the focus, this research is focusing on the specific software development industry in the silicon valley, that are following specific standards for software development that are shared by the majority of these companies. Several research questions still need to be raised because they weren't taken in consideration in this study: What should be the result in another industry which doesn't share the same standards as the competitors?, What is the impact of the location where the companies are implemented, what happen in the case of a decentralized new product development team, is the face to face contact have an impact on the NPD performance ?, Even if we consider the product as a unit of analysis is there a difference in the impact between services and products, and between complex and simple services and products on NPD performance ?, What is the real impact of the storage, retrieval, and usage on NPD performance ? Is our research model the solution that will assess adequately the problem of NPD performance? Is the market influence the NPD performance and the way it's organized? Is the level of implementation and mastering the NPD process has an impact on NPD performance?

Second limitation of this research is related to the sample size that has to be raised in order to improve the existing result and also in order to be able to use other type of data analysis like LISREL and AMOS. In our case due to the timeframe that was very court, it was also very difficult to get more respondent to our survey due to the fact that we have launched this Final survey during a vacation period, so when the potential respondents came back to work, the backlog of waiting emails was huge and sometimes they didn't find time to respond.

	Path Coef-ficients		Path Coef-ficients
<b>Customer Knowledge Creation</b> ( $R^2 = 0.87$ )		<b>NPD performance</b> ( $R^2 = 0.86$ )	
Collaboration	-0.193	Collaboration	0.810
Trust	0.281	Trust	0.337
Centralization	-0,128	Centralization	0,084
Formalization	0.889	Formalization	-0.002
Project complexity	0,583	Project complexity	-0.034
Project risks	0.389	Project risks	0,189
NPD performance	0.239	CKC	0.239
	Path Coef-ficients		Path Coef-ficients
<b>Project complexity</b> ( $R^2 = 0.41$ )		<b>Project risks</b> ( $R^2 = 0.28$ )	
Collaboration	0.082	Collaboration	-0.128
Trust	0.410	Trust	0.549
Centralization	0.061	Centralization	0,180
Formalization	-0.042	Formalization	-0.038
CKC	0,583	CKC	0,389
NPD performance	-0.034	NPD performance	0.189

**Table 3: Structural Model**

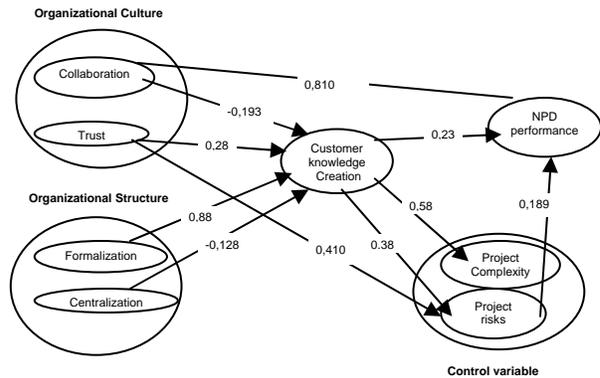
Final limitation, this research should have done better result if we will have conducted a longitudinal study and see the evolution during a period of 5 to 10 years of their knowledge management strategies and see their impact on NPD performance and more precisely on Time to market.

**5.2 Implications for theory and research**

Thus theoretically, a framework is proposed for empirical studies to link KMS enablers and customer knowledge creation process with NPD performance. In our case, our findings confirm that customer knowledge creation is associated with organizational factors such as collaboration and trust. For instance, groups are most creative when their members collaborate; members stop holding back when they have mutual trust.

Hypothesis	Supported?
H1: Collaboration will have a positive effect on customer knowledge creation process.	Yes
H2: Trust will have a positive effect on customer knowledge creation process.	Yes
H3: Decreased centralization will have a negative effect on customer knowledge creation process	Yes
H4: Lack of formalization will have a negative effect on customer knowledge creation process.	Yes
H5: The customer knowledge creation process will have a positive effect on NPD performance.	Yes
H6: The customer knowledge creation process will have a positive effect on project complexity..	Yes
H7: The customer knowledge creation process will have a positive effect on project risks.	Yes

**Table 4: Results of the hypothesis test**



**Figure 2. Structural Model**

Shaping organizational factors is crucial for a firm's ability to manage its knowledge effectively. However, many knowledge management projects, in reality, focus on IT. An organization may face difficulties in building its customer knowledge creating environment due to the lack of adequate culture despite its well-constructed IT because successful information systems should be conditioned by a number of cultural factors such as organizational values and appropriate learning methods. Our research framework supports also the relationship between the organizational structure that comprise centralization and formalization and the customer knowledge creation process. That means that firms should adopt a flexible organizational structure strategy that will enhance the customer knowledge creation process. Our analysis finally supports the relationship between the customer knowledge creation process (supported by KMS) and the NPD performance.

### 5.2 Implications for practice

At the practical level, the research provides a NPD performance framework that allows research areas, such as knowledge management systems to be brought together in a single practical system managing efficiently the customer knowledge of the company. This framework can be applied as a tool by managers to assess the performance of their NPD activity, adapt and change them following the specific NPD strategy that they want to implement in order to enhance the customer knowledge creation process and reduce time to market.

Another major managerial implication is based on the capability of the firms to compare themselves with the direct competitors and the one in the same sectors. This study is giving the possibility to the NPD manager to compare themselves with the others. If this research is transformed in an efficient simulation tool, it can be transformed in a benchmarking tool that will assess the way that a specific company is managing its customer knowledge managing factors in order to reduce time to market.

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