TEAM VISION IN PRODUCT DEVELOPMENT: HOW KNOWLEDGE STRATEGY MATTERS?”

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ABSTRACT

In today’s more complex multinational and technologically sophisticated environment, the group has re-emerged in importance as the project team. Work teams are important to organizations in general, but are especially critical in product development because they span many functional areas including engineering, marketing, manufacturing, finance, etc, and new product teams must frequently be composed of individuals from different backgrounds and perspectives. In these circumstances, this paper addresses the contingency role that knowledge strategy plays in explaining the relationship between team vision and product development performance. After studying the team vision on 78 new product developments from a wide variety of firms, we found that effective team vision varies depending on the knowledge strategy -defined in terms of punctuated equilibrium in explorative cycle, low ambidexterity and high ambidexterity. Our results demonstrate that while trade-off is positively associated with success in all strategies, clarity is only associated with low ambidexterity strategies and strategy-fit is only associated with high ambidexterity strategies.

Keywords: Team vision, product development, knowledge strategy

INTRODUCTION

Corporate emphasis on knowledge and knowledge-based capabilities as a means to create value and achieve superior performance, demands the development of a steady stream of new products that generates new knowledge faster than competitors and rapidly translates it into new products (Mallick and Schroeder, 2005; Song et al., 2006). Product development has evolved as the major focus of emphasis for companies today (Fliess and Becker, 2006; Handfield and Nichols, 2002). Its role within organisations is to create new knowledge or recombine existing knowledge, developing new products and, therefore, providing a competitive advantage to the firm. It is thus fundamental for the continual prosperity of the firm.

Recent empirical research shows that most firms have implemented cross-functional teams for the majority of new product developments projects undertaken (Hong et al, 2005). Consequently, product development is becoming multidisciplinary and technologically complex and occurs at intersections of different fields. Therefore, it is not surprising that the effectiveness of product development is contingent upon the integration of different specialized capabilities, strong functional groups, large numbers of people and multiple pressures (Perry-Smith and Vicent, 2008; Nellore and Balachandra, 2001). Clark and wheelright (1993) and Coopers (1999) ,among many other researchers, also suggest that the success of product development is determined by the integration of abilities of both upstream (e.g. research and development, marketing and design engineering) and downstream activities (e.g. manufacturing engineering, operations and quality control).

However despite the virtues of cross-functional teams being widely extolled and the increasing attention being devoted to understanding its integration process, different perspectives and backgrounds may lead to conflict and result in negative outcomes (Keller, 2001). In the light of the conflicting literature, there is still a relative dearth of studies investigating team-level factors influencing such integration among all of the functions involved in product development and their effects on performance (Hoegl and Parboteeah, 2007). Literature in the area of innovation has suggested that performance can be affected by two sets of factors -the characteristics of the team and the contextual influence of the team (Sethi, 2000 and Lynn and Akgün, 2001). Accordingly, this paper considered variables related to these two sets of factors. Regarding team characteristics, it focuses on team vision because this concept is considered important to minimize the effects of the functional diversity in the group and to promote better performance. In this paper, team vision refers to the existence of a common background, a clear set of goals, priorities, trade-offs and a good understanding of the overall goals of the firm and of the project itself. As Brown and Eisenhartd (1995) state, although this aspect of the team is considered critical, our understanding of exactly what team vision is and its link with product development performance is very weak. Crawford and Di Benedetto (2000) also point out that there is surprisingly little research on vision at the product development level.

Although team vision may be able to influence product development performance, by itself it may not be sufficient to exp lain product development performance. The ability of team vision to produces better performance can be helped or harmed by contextual influences of the team (Olso et al.,1995; Lynn and Akgün, 2001). The growing importance of knowledge as a critical resource has encouraged managers to pay greater attention to product development knowledge strategy (Choi, et al., 2008). This p aper draws o n a knowledge strategy to examine how knowledge exploration and exploitation actions influence the relationship of tea m vision and product development performance.

The conceptual distinction between exploration and exploitation (March, 1991) has emerged as an underlying theme in research on organization al learning and strategy (Levinthal and March, 1993; Bierly and Chakrabarti, 1996; Vera and Crossan, 2004), innovation (Rothaermel and Deeds, 2004), and organization theory (Holmqvist, 2004). Exploration is a manifestation of o rganizational learning that entails activities such as search, variation, experimentation, challenging existing ideas, and research and development. It is thus about improving and renewing the organization's expertise and competences to compete in changing markets by introducing the variations needed to provide a sufficient amount of choice to solve problems (March, 1991). Exploitation is a different manifestation of organizational learning that involves efficiency, selection, implementation, control, refining and extending existing skills and capabilities. It reflects how the firm harvests and incorporates existing expertise and competences into its operations, not just for economizing the efficiency of existing resource combinations (Levinthal and March, 1993), but also for creating new ones.

According to these differences between exploration and exploitation, it is expected that team vision will have different effects on product development performance depending on the pr oduct development knowledge strategy –defined in terms of exploration and exploitation-. Thus, focusing on team level analysis, the purpose of this article is to define team vision as a means to integrate different functional areas, discuss its components and to understand how the impact of each team visioning component may vary depending on the knowledge strategy type.

Studying the extent to which these team-related factors affect product development performance, this paper makes several contributions. From a practical point of view, this study focuses on understanding factors that explain product development success. Although this paper is somewhat exploratory in nature; it considers variables that can be influenced by managers, the findings of the study should provide useful recommendations for enhancing product development performance. In terms of theory, an important contribution of this study is the extension of the existing research on team vision, which so far has focused primarily on organizational level, to tea level. Relatedly, another major contribution of this study is its examination of how some apparently conflicting demands that are placed on product development teams affect performance. For example, this study supports that product development does not involve a trade off between exploration and exploitation in such away that one occurs at the expense of the other. On the contrary, product development efforts simultaneously develop both knowledge activities.

In order to do this, this paper, first, discusses the concept of team vision, followed by how a vision may be developed and help the integration of the different groups and tasks, thus leading to success in product development. Next, it characterizes the product development knowledge strategy and associates it with team vision components. Then, we test the hypothesis on the basis of data generated from a questionnaire survey accomplished in a sample of product developments. Such test can give a snapshot of where differences exist and how team vision can contribute to success in product development. A discussion of the implications, limitations and future research directions concludes our research paper.

TEAM VISION: COMPONENTS AND IMPACT ON PRODUCT DEVELOPMENT

The product development literature states that effective innovation in new products relies on inputs from different functions and that for innovation to cross the domain from the individual to the team domain, it needs the right mix of individuals from a variety of functional areas such as marketing, research and development, manufacturing and purchasing (Tang, 1998). The path to technology commercialization requires the combination of many different knowledge sets (Perry-Smith and Vicent, 2008). Accordingly, knowledge necessary for product development is usually codified and structured differently in the various functional areas (Carlile, 2002; Madhavan and Grover, 1998). One of the primary benefits of working in teams is that, as a unit, the team is more likely to have access to the necessary information and expertise to solve problems (Willians and O'Really, 1998). While this type of team has great potential, it is simultaneously one of the more difficult types of team to manage successfully. Functional backgrounds differences are the key source of task conflict that can undermine group functioning. (Pelled et all, 1999; DeDreu and Weingart, 2003). While greater diversity in the functional background of team members is linked to a higher number of innovations the group proposes (Bantel and Jackson, 1989; Milliken and Martins, 1996), the cross-functional team has been noted as having difficulties in reconciling ideas and moving from wildly different perspectives towards consensus (Dougherty, 1992). Task conflict includes disagreements and debates regarding task content that revolve around what actions are necessary to complete the task. In this situation, process losses that jeopardize the final product development result may come about (Ancona and Caldwell, 1992).

In order to minimize the effects of functional diversity in the group and to promote better performance, it is important to develop a common view among team members (Imai et al.,1985; Hayes et al.,1988). Because individuals from various functional areas often have different ideas about the product to be developed, without effective team vision these individuals generally pull the project in different directions and thereby adversely affect the performance of new product (Sethi, 2000).

Kotter (1995) describes vision in terms of something that helps clarify the direction in which to proceed. Similarly, Crawford and Di Benedetto (2000) describe vision in terms of team direction, goals and objectives. From the perspective of the new product teams, Brown and Eisenhardt (1995) define vision as the meshing of an organization's competence and strategies with the needs of the market to create an effective concept. In this same line, team vision is seen as a shared purpose and plan of action that clarifies mission, strategic fit and sets of project targets and priorities that are consistent with the firn's internal capabilities and the market place realities (Clark and Wheelright, (1993).

The concept of vision becomes one of the tools or means to engender meaning to a project. Karl Weick (2001) has discussed how systems of sense-making are vitally important when specialization and decentralization results in segregation of people and differentiation of processes in undertaking an activity. Because product development requires coordination and aligns all functions involved, all team members must be able to make sense of project goals so that they can support them and internalize them as being aligned with their own. Furthermore, given the interrelation and dependence between the functional areas, there needs to be a clear understanding of the cause and effect relationships that exists so that the impact of adverse actions that some team member may have on others can be traced. This requires the project members to undertake a sense-making exercise focusing on what the end point should be, so that the weavings of seemingly unconnected actions can be clarified to understand how the parts form the whole (Christenson and Walker, 2004). When this occurs, product developments members might better see the logic of mutual adjustment and enacting coping mechanisms to provide the required flexibility for the projects.

According to the above, this study identifies three components in the concept of vision. It should be clear, align the goal of the project with the company strategy and support the strategy offering an understandable trade off of projects goals.

The first component, *clarity*, refers to the extent of communication, understanding, and acceptance of a set of project goals that guide development efforts (Hong, 2004). It must create a clear image of what product development is trying to do and provide direction to its members. It has been demonstrated that goals are associated with enhanced performance and strategy development at both individual and team levels (Locke and Latham, 1990). However, the mere existence of those goals is not enough to influence performance. The product development goals must be well articulated and clearly understood and shared among team members. Project goals should be able to help members to determine what actions are consistent or inconsistent with the overall product development goal. Creating a clear vision requires excellent communication, unambiguous definitions and a deep understanding of project goals (Cooper and Slagmulder, 1999). It means that it must be based on realistic customer requirements (Rosenau, 1989) and good understanding of competitive situation and technical risk (Clark and Wheelright, 1993).

Thus, developing a common understanding about the product goals is expected to help in bringing functional knowledge and expertise together while important product development-related decisions are being made. When diverse knowledge is brought together, teams come up with better ideas, make connections between seemingly unrelated pieces of information and consider a variety of approaches. As result, the team has extraordinary potential to achieve superior results.

The second vision component, *strategic fit*, is defined as the alignment between the projects targets and goals and the company's strategies. It is the extent to which a firm's strategy guides the product development. Strategy fit helps in creating consistency among various decisions, generating ideas for satisfying customer needs in a superior manner and building synergistically on the firm's existing technology and manufacturing process, which in turn facilitates the development of successful products.

Accordingly, strategic fit has been showed to be related to team performance and new product development efforts (Shum and Lin, 2007). To have compatible goals allow "the same vision" to be shared, suggesting a deeper understanding of how product development supports the company strategy. Product developments that have a high degree of strategic fit tend to receive quicker top management support and get easier access to internal resources (Hong, 2000). If not, others on and off the product development team, will continually question its direction and will try to change the vision as the project progresses.

The third component, *trade-off*, refers to the extent to which the relative priority of the goal of each project is clear. This is especially important given that product development teams consist of functional specialist with different priorities. Additionally, as more firms engage in time-based competition, defining, communicating and understanding the trade-offs between cost, quality and time come more critical (Hong, 2000). High time pressure creates a need for cognitive closure and can make it difficult for team members to develop a common understanding about the product (Karau and Kelly, 1992). Because of time-based competition, team members may be forced to consider a narrow range of decision alternatives and may be not able to think deeply about the various ways to build superior products. As such, the ability to make quick trade-off decisions is expected to increase the product development performance.

Additionally, having clear trade-offs reduces confusion about what product development members are supposed to do and subjectivity in operational decision making. More subtly, understanding the trade-offs also builds team cohesion which is generally viewed as a desirable quality of high-performing teams (Perry-Smith and Vincent, 2008). On the contrary, unspoken and ambiguous trade-offs can generate confusion and frustrate team members. Moreover, it cuts misunderstanding and barriers to interchange so that the amount of information conveyed is increased. Similarly, the desire to satisfy too many goals can lead to loss of cohesiveness and sense of direction within the product development. Teams with unclear trade-offs often experience more difficulties than teams with clear tread-offs in defining how key issues should be valued or how to proceed with the product development

For the purpose of this study, product development performance is measured by teamwork. Teamwork is a process outcome that measures the effectiveness of the product development process and the degree of collaborative teamwork (Zirger and Maidique, 1990). When cooperation and shared knowledge exist, the members of product development get work done quickly, reduce cost and also reduce design and engineering hours. They have a general sense of creativity, productivity and timely conflict resolution as well as effective decision implementation and communication (Hong, 2004).

KNOWLEDGE STRATEGIES

The idea of the "knowledge strategy" has been recently developed by authors in the field of organizational learning and organizational knowledge. For example, Bierly and Chakrabarti (1996) define the knowledge strategy as the set of strategic choices that shape and direct the organization's learning processes and determine the firm's knowledge base. Zack's (1999) defines knowledge strategy as "the overall approach an organization intends to take to align its knowledge resources and capabilities to the intellectual requirements of its strategy (p.135)". Through the knowledge strategy, it is possible to identify the strategic knowledge gaps to take decisions regarding the creation, development, and use of a firm's knowledge in alignment with the requirements of the business strategy.

A knowledge strategy can be viewed as a firm's set of strategy choices regarding two knowledge domains: (1) the creation of new knowledge (exploration) and (2) the combination of existing knowledge to create new products that have value in the marketplace (Bierly and Daly; 2007). These decisions concern the managerial choices on how to balance knowledge exploration and knowledge exploitation, together with choices on the use of internal and external knowledge (Vera and Crossan, 2003). More specifically, knowledge strategy decides the degree to which the product development focuses its resources on either generating new knowledge or incrementally enhancing the existing knowledge body. Researchers in the field of management technology have discussed these differences in terms of radical and incremental innovation (Damanpour, 1991), which can be viewed as outputs of exploration and exploitation, respectively.

Following Gupta et al. (2006), there are two different yet both logical mechanisms to achieve a balance between exploration and exploitation: punctuated equilibrium and ambidexterity. The punctuated equilibrium mechanism describes a knowledge strategy as long cycling through periods of exploration and exploitation. The ambidexterity mechanism describes a knowledge strategy based on the synchronous excel of both exploration and exploitation. Existing literature is silent on the question of whether these two mechanisms are equally viable and whether exogenous and endogenous contextual factors should drive the choice between them. In spite of the need for further elucidations, it is possible to presume that the choice of a knowledge strategy may be made by combining exploration and exploitation in terms of addressing punctuated equilibrium or ambidexterity (see Figure 1).

Figure 1. Knowledge strategies

EXPLORATION		Low EXPLOITATION	High EXPLOITATION
	High	**Punctuated equilibrium in explorative cycle**	**High Ambidexterity**
	Low	**Low Ambidexterity**	**Punctuated equilibrium in exploitative cycle**

Hypothesis

Just knowing that product development may have different knowledge strategies is not particularly compelling. What makes this of interest is that these divergences significantly and differently affect the relationship of team vision and product development performance. Lynn and Akgün (2001) argued that although the components of team vision (clarity of vision, strategy fit and trade-off) appear compelling at a product development level, there are greater questions regarding their importance and applicability. Hence, what is important is to find out the potential implications of these differences in terms of performance. This study assumes that the way product development pursues exploration and exploitation determines the impact of each component of team vision on product development performance.

This assumption can be articulated as hypothesis to be tested empirically:

H1. Differences in the knowledge strategy, in terms of exploration and exploitation, lead to differences in the impact of team vision components on performance.

Now that this general hypothesis has been proposed, this research empirically tests the impact of team vision on product development depending on the specific knowledge strategy. The arguments used are based on the importance of team collaboration to face product development. Exploitation and exploration activities emerge throughout a problem resolution process aimed to create new products (Mohrman et al, 2003). Exploitation occurs with the utilization of existing knowledge for innovative problem solving. Exploration occurs when existing knowledge is not sufficient to solve the problem identified, so new knowledge needs to be constructed and acquired to contribute to the existing body of knowledge.

Accordingly, exploration involves unfamiliar situations and a lack of prior knowledge regarding how the problem should be solved. There is ambiguity regarding the tasks to be completed and the problems that need to be addressed. As such, exploration requires that the team members collaborate to a higher degree in order to deal with such a volatile and unpredictable situation. Additionally, it is very seldom that the exploration requires a complex set of knowledge and skills. Exploration increases the organizational dependency among the diverse functional knowledge areas involved in product development. Since each intellectual field uses different instruments, concepts and approaches, exploration will make the development of such effective coordination mechanisms necessary within any product development initiative. It increases the need of connecting people so they can think together and achieve convergence of ideas and views within the team (Hoegl and Parboteeah, 2007). However, due to differences in language, norms and mental models, exploration is also related to difficulties in communication and the need for strong feedback between functional areas. Bierly and Daily (2007) argued that exploration may result in product development without a definite focus, pursuing too many directions at once. This may severely stain the product development's resources and may not allow appropriate development of the project.

Clearly, the need for more diversity of knowledge raises coordination costs. In these circumstances, team vision is expected to allow team members to be more aware of relevant project information and coordinate their individual task. It helps the team to be in a better position to evaluate problems with different perspectives and come to a higher quality solution. In summary, team vision probably provides a more coherent front as product development faces higher levels of exploration.

On the contrary, exploitation exhibits an experience effect that includes the application of past experience and competences with of the firm. Repeatedly using the same knowledge reduces the likelihood of errors and false starts and facilitates the development of familiar routines (Levinthal and March, 1993) that allow the decomposition of sequenced activities in an efficient order where unnecessary steps can be eliminated (Eisenhardt et al., 1995). It also leads to a deeper understanding of concepts, booting the firm's ability to identify valuable knowledge within them, developing connections between knowledge and combining it in many different ways (Katila and Ahuja, 2002). However, a strong commitment to an exploitation strategy also entails trade-offs. The higher the amount of different knowledge involved in the development of a product focussed on exploitation, the higher the need for integration. When this happens, it is important that team vision can help members to work together and increase cohesion in the team. Thus, when exploitation intensifies, team vision is expected to be more positively associated to performance

Compared to less innovative products (exploitation), more innovative products (exploration) may require major changes in the existing technology and manufacturing process and thereby disturb the balance among product, technology and manufacturing systems (Clark and Fujimoto, 1991). Exploration moves farther away from current organizational routines and knowledge bases than does exploitation (March, 1991). Exploration introduces more variations than exploitation and as such, needs to provide a greater number of choices to solve problems (March, 1991). In this way, exploration has more possibilities of engendering new ideas, creating new knowledge combinations and allowing obsolete knowledge substitution than exploitation. Exploitation does not demand so much need for collaboration and as such it does not gain as much as exploration from the increased cross-functional exchange of ideas and information. When the need for integration of knowledge and the seeking of consensus across different or divergent viewpoints diminishes, it is expected that team vision has less influence on performance. As result, this paper found that team vision has more impact on product performance when exploration has been the focus point on the product being developed The benefit from team vision efforts on less innovative product development is likely to be lower

Based on these initial observations and categories concerning knowledge strategy of product development the following hypotheses are developed:

H2. The positive effect of team vision on performance will be enhanced the higher the level of exploration and exploitation comprised in the product development (higher ambidexterity).

Hypothesis 3.The positive effect of team vision on performance in punctuated equilibrium will be higher in the explorative cycle than in the exploitative cycle.

RESEARCH METHODOLOGY

Sample characteristics and data collection

Survey methodology has been used for the empirical analysis. The questionnaire was designed and developed from a thorough literature review and simplified by us in some indicators. The questionnaire was next validated through a pre-test that was carried out through several personal interviews with product development executives. These interviews allowed us to purify our survey items and rectify any potential deficiency. Minor adjustments were made on the basis of specific suggestions.

After the pilot study, a mailing list was obtained from Madri+d. Madri+d is a society that groups firms and public research organizations located in Madrid[1] with the aim of improving

[1] Madrid is the region that concentrated the biggest number of firms in Spain. It is also the most developed area in Spain

competitiveness through research, development, innovation and knowledge transfer. Innovation interests of these firms make them a suitable focus group for the purpose of this research. The Madrid area was chosen because it locates the most visible and important firms in Spain. By tapping into this area, this study can gain a better insight into the effectiveness of various practices and be able to develop more credible nomological constructs (Koufkeros, et al., 2007).

Since not all the firms that integrate Madri+d develop new products (no way to know which firms do and which do not), sending out questionnaires randomly was not considered. Respondents were product development managers selected according to a representative population approach. As a result, sample characteristics were not significantly different from the corresponding population parameters of the original sample provided by Madri+d[2]. Those who agreed to participate in the study received the questionnaire by e-mail or by accessing a web page where they could find the questionnaire. They had to answer questions concerning a specific product development project. A researcher involved in the study personally helped the product development managers to solve any question on the survey.

Since a single response was solicited from each product development, single informant bias in data collection may stem as a result. However, the presence of common method bias was tested by following one of the procedures described in Podsakoff et al. (2003). More precisely, Harman's single factor procedure was applied, in such a way that all items from the main constructors were included into an exploratory factor analysis to determine whether the majority of the variance could be accounted for one general factor. In this analysis, no single factor emerged and no general factor accounted for the majority of the covariance among the measures. Therefore, common method bias does not seem to be a problem.

As a result, 78 product development managers provided responses. In terms of industry type, answers covered a wide range of industries, mostly the food industry (20%), chemical (11,3 %), electric systems and electronics (10,1%), computing systems (7,5%), equipment manufacturing (5%) and transport (5%). Table 1 shows the profile of the participating companies and their responses. The majority of the respondents were product development managers from firms with less than 500 employees, i.e., small firms. To assess control variable bias, the influence of firm size, age and nationality – national versus multinational- on the constructs was controlled by means of Anova tests. Results show that the null hypothesis of equal means could not be rejected and therefore, firm size did not affect team vision dimensions, knowledge exploration or exploitation and teamwork.

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[2] See http://www.madrimasd.org

Table 1. Profile of participating companies

	Percent
Sector	
Industrial	75,7
Service	24,3
Number of employees	
<= 499	65.8
500-999	9.6
1000-4999	12.3
5000-9999	6.8
>=10000	5.5
Age of the firm	
1-10 years	24,4
11-50 years	60,0
>50 years	15,6
Nationality	
Spanish	71,4
Multinational	25,7

As the survey was quite long, only the questions that helped investigate the hypotheses detailed above were chosen. In our particular case, a set of questions was related in order to define team vision dimensions. A second set of items was associated to knowledge strategy and the last one to product development performance (teamwork).

Description of Measures

The measurement of the analysis variables was built on a multiple-item method, which enhances confidence about the accuracy and consistency of the assessment. Each item was based on a five point Likert scale and all of them are perceptual variables. Table 2 displays items used to measure the analysis variables.

Table 2. Description of Items and Constructors and Factorial Analysis Results

	Construct	Measurement items	Mean	S.D.	Factor Loading	% variance exp.	Reliability
KNOWLEDGE STRATEY	**Knowledge Exploration**	Project produces many new novel and useful ideas.	3.5	0.8	0.62	33.5	0.84
		Project does an outstanding job uncovering product problem areas with which customer were dissatisfied.	3.2	1.0	0.81		
		Project does an outstanding job correcting product problem areas with which customer were dissatisfied.	3.2	0.9	0.82		
		Project incorporates new knowledge, methods and inventions	3.6	0.8	0.65		
	Knowledge Exploitation	Project integrates new and existing ways of doing things without stifling their efficiency	4.0	0.7	0.72	28.9	0.73
		Project puts in operation lessons learned in other areas of the organization.	3.8	0.9	0.69		
		Project makes use of existing (technical and market) competences related to products/services that are currently being offered.	3.9	0.8	0.43		
		Project is able to identify valuable knowledge elements, connect and combine them.	3.9	0.7	0.52		
TEAM VISION	**Trade-off**	Project targets clearly specified trade-offs between performance and cost.	3.4	0.7	0.69	22.7	0.82
		The relative priority of each project target was clear.	3.6	0.7	0.66		
		Project targets clearly specified trade-offs between time and cost.	3.3	0.8	0.79		
		Project targets clearly specified trade-offs between quality and cost.	3.5	0.8	0.84		
	Strategic Fit	Project targets were consistent with our firm's overall business strategy.	4.0	0.7	0.75		
		Project targets reflected the competitive situation.	3.8	0.8	0.81		
		Our firm's overall product strategy guided the setting of project targets.	3.6	0.8	0.78	19.3	0.71
		A clear set of project targets guided development	3.7	0.8	0.58		

		efforts.					
	Clarity	This product development team had a well defined Mission.	4.2	0.7	0.78		
		The project Mission was well understood by the entire team.	4.1	0.6	0.71		
		The project goals we re well understood by the entire team	3.9	0.7	0.74		
PERFORMANCE	**Teamwork**	The team used all product development resources	3.6	0.7	0.79	61.8	0.89
		The team implemented decisions effectively	4.0	0.7	0.84		
		The team used product engineering hours efficiently	3.6	0.9	0.84		
		The team coordinated activities well	3.8	0.8	0.81		
		The team used financial resources sensibly	3.5	0.9	0.68		
		The team worked well together	4.1	0.7	0.75		
		The team was productive	3.9	0.7	0.78		

Team vision was measured with 9 items corresponding to clarity of product development mission and targets, the trade off of product development targets and the strategic fit of the product development s goals with the firm's strategy (Hong, 2000). The clarity of the product development measures the extent the communication, understanding, and acceptance of a set o f product development missions and goals that guide development efforts (Clark and wheelwright, 1993; McDonough III, 2000; Bonner et al, 2002. Trade-off of product development expresses the project target specification of performance, cost, time and quality (Ghosh and Wells, 1995; Babu and Suresh, 1996). Strategic fit is the alignment of the product development goals with the product development's competitive situation (e.g., customer expectations and competitive offerings) and the product development resources available (e.g., internal design and manufacturing capabilities as we ll as suppliers' design and manufacturing capabilities). Product development team members discuss customer expectations, competitors' offerings, product lines, and internal and suppliers capabilities (Rosenthal and Tatikonda, 1993; Englund and Graham, 1999).

Knowledge strategy has been modelled in product development as a multidimensional construct where exploration and exploitation are considered as representative dimensions. As state d by Crossan et al. (199 9), exploration takes place when product development generates new knowledge. Likewise, exploitation encompasses processes that take and transmit embedded knowledge that has been learnt from the past down to product development. Accordingly, and based on Lee and Choi (2003), Mohrman et al. (2003) and Katila and Ahuja (2002), knowledge strategy was measured by using 8 items, four items concerning exploration and four items concerning exploitation. The first four items measured the degree in which product development introduces new ideas and new knowledge covering problematic areas where customers were unsatisfied. The last four items measured the degree in which product development introduces lessons learnt in the past, existing competences and the combination and integration of diverse knowledge.

Performance was measured through teamwork. Specifically, in order to capture teamwork, product development managers indicated the extent to which the product development team was able to work well together, coordinate activities, implement decisions effectively, act productively, use financial resources sensibly, use product development's resources rationally and efficiently use product engineering hours. These items were previously used by Hong et al. (2005), who drew them from Ali et al. (1995), Crawford (1992), and Tersine and Hummingbird, (1995).

ANALYSIS AND RESULTS

Data analysis involved several steps. First, since our research variables are measured through multiple-item constructs, we had to verify that the items tapped into their stipulated construct. Thus, we conducted three independent factorial analyses by using SPSS 15.0 for Windows: one for knowledge strategy items, another for team vision items and finally, one for the teamwork constructor. In all cases we applied principal component with varimax rotation as method of factor extraction, retaining factors with eigenvalue greater than 1. Results obtained were factors that condense the original nominal variable information while providing continuous variables for each group of variables. The internal consistency measures (Cronbach's alpha) were also considered in order to assess the reliability of the measurement instruments. Table 2 summarizes the results, where it is possible to observe that all items load on their appropriate scales. The proportion of variance retained and the measure of internal consistency of multi-item scales (Crobach's alpha) also adequately meet the statistical threshold in exploratory research.

*Table 3. Analysis of agglomeration coefficients**

Number of cluster	Agglomeration Coefficient	Change in coefficient in the next level (%)
6	29,03	31,68%
5	38,23	30,04%
4	49,71	36,39%
3	67,80	57,17%
2	106,57	46,39%
1	156,00	

*Hierarchical cluster based on Ward method and Euclidean distance

Second, the scatter graph of exploration and exploitation suggested the possibility of identifying some meaningful clusters, and therefore a cluster analysis was undertaken to facilitate the specification of groups and define different knowledge strategies in terms of knowledge exploration and knowledge exploitation. Specifically, Ward's hierarchical method using the Euclidean distance as an agglomeration schedule was applied to determine both the number of clusters and the initial seeds (centres of the groups) that were next introduced in a second K-means no hierarchical analysis, which provided the final categorization of firms.

The decision on the number of clusters was guided by an agglomeration coefficient, which displayed the squared Euclidean distance between each case or group of cases (see Table 3). The agglomeration coefficient shows quite large increases from clusters 4 to 3, which in terms of the percentage change in the clustering coefficient, lead us to determine that the appropriate number of clusters was 3.

Table 4. Results of Cluster Analysis (K-means) for knowledge strategy

	Low ambidexterity	Punctuated equilibrium in explorative cycle	High ambidexterity	TOTAL	F-statistic
Exploration	2.79 (0.6)	1.66 (0.7)	4.13 (0.6)	2.80 (1.0)	63.96*
Exploitation	2.52 (0.7)	3.88 (0.8)	3.84 (0.7)	3.02 (1.0)	29.92*
N	46	17	15	78	

*In brackets standard deviation. *p<0.01*

The characterization of clusters, based on the final centres of K-means analysis is displayed in Table 4. Cluster 1, including 46 product development projects with low exploration and exploitation, represents a *low ambidexterity strategy*. Cluster 2, comprising 17 product developments characterized by high exploitation but very low exploration, presents a *punctuated equilibrium in explorative cycle* strategy. Cluster 3, formed by 15 product developments, shows a high exploration and exploitation. It clearly represents a *high ambidexterity strategy*. Table 4 also shows the non-existence of product developments with *punctuated equilibrium in exploration cycle*, which does not let test H3. This result illustrates the strong cumulative nature of scientific knowledge. The F-statistics also let us conclude that both dimensions have discriminatory power.

Table 5. Regressions results: vision components for teamwork for different knowledge strategies

	Low ambidexterity		**Punctuated equilibrium in explorative cycle**		**High ambidexterity**	
Variables	Beta	t	Beta	t	Beta	t
Trade-off	0.37	2.89*	0.64	1.88**	0.64	1.94**
Strategic Fit	0.03	0.28	0.05	0.19 0	.81	2.16*
Clarity	0.31	2.35*	0.51	1.57	-0.06	-0.28
R^2_{adj}	0.20		0.11		0.26	
F-statistic	4.72*		1.67		2.57**	
Sample Size	46		17		15	

**p<0.05, **p<0.1 Dependent variable: teamwork*

Third, product development was split according to the knowledge strategy adopted (clusters) and regressed teamwork on the visioning constructs. Results of the three regressions are presented in Table 5. From this table, it can be observed that the coefficient of determination (R^2_{adj}) was different for each group of product development. 20% teamwork can be explained by the three components of team vision in the case of low ambidexterity strategies; 26% in the case of high ambidexterity strategies and only 11% in the case of punctuated equilibrium in explorative cycle strategies. The analysis of the regressions equations also indicates that in low ambidexterity strategies trade-off and clarity dimensions are significantly associated with teamwork [t=2.89 p<0.05; t=0.31 p<0.1], being the impact of trade-off slightly greater [beta=0.37; beta=0.31]. In the case of punctuated equilibrium in explorative cycle strategies, the fit is clearly worse and only trade-off has a marginal significant effect on product development performance [t=1.88 p<0.1]. Finally, in high ambidexterity strategies, trade-off and strategic-fit are statistically significant [t=1.94 p<0.1; t=2.16 p<0.05]. In this last case, the effect of strategic fit on performance is much greater than the effect of trade-off [beta=0.81; beta=0.64]. Hence, H1 and H2 were supported.

DISCUSSION

This study contributes to research on product development success –a central issue to researchers and managers alike. The research question guiding this study was: How does the confluence of knowledge strategy and team vision dimensions relate to product development performance? Successful competition requires aligning the components of team vision –clarity, strategy fit and trade-off- to knowledge strategy. Research on knowledge strategy based on the concepts of knowledge exploration and knowledge exploitation is quite emergent and the understanding of whether the choice of the knowledge strategy determines managerial decisions remains fairly unclear. Using this novel view, the study analyzed the role of team vision in the success of product development and found that an effective team vision varies depending of the knowledge strategy -defined in terms of punctuated equilibrium in explorative cycle, low ambidexterity and high ambidexterity.

First of all, this article shows that product development does not involve a trade-off between exploration and exploitation in such away that one would occur at the expense of the other. On the contrary, product development efforts simultaneously develop both knowledge activities. Conversely, this study found strong evidence that exploration and exploitation should be understood in terms of duality, mutual interdependence, continual change, harmony and balance.

The quantitative analysis found that regardless of the type of knowledge strategy, trade-off was always significantly associated with teamwork. These findings suggest that being able to make trade-off decisions helps to solve problems and minimize conflict in product developments. Understanding the trade-offs between cost, quality and time as well as quality and cost permits a team to act rapidly and more sensitively to products development requirements. Product development goals should not be judged on how precisely the goal are set but, rather, on whether they are set in such way that they help to resolve problems and take decisions in the development of products(Hong, 2004). However, to assess the relative magnitude of the importance of this team vision component, this paper conducted an additional analysis. Table 6 shows descriptive statistics of each vision component (mean value) and ANOVA test for the different knowledge strategy. The ANOVA F-test for trade-off was highly significant and indicated that the null hypothesis (all three groups have the same performance level [F=3,55, p<0.05] could be rejected. High ambidexterity strategies show the highest trade-off values (highest mean value), followed by exploitation-based and low-intensity balanced. This result provided additional support for our framework, suggesting that the ability to make trade-off decisions is perceived as an important predictor of performance in high ambidexterity strategies.

Table 6. Mean of vision components in different knowledge strategies (ANOVA test)

	Low ambidexterity	Punctuated equilibrium in explorative cycle	High ambidexterity	Overall	F-Statistic	Main** Group diff
Trade-off	2,55	2,80	3,29	2,74	3.55*	1-3
Strategic Ft	2,84	3,24	3,25	3,01	1.57	
Clarity	2,83	3,18	3,20	2,97	1.29	

p<0.05. Based on Tuckey test and Duncan test (p<0.05).*

Table 6 also indicates that the mean value for each vision dimension is the highest in the high ambidexterity strategies implying that, under certain circumstances, successful projects will likely need greater vision clarity, more trade-offs and more strategy fit. An explanation for this observation may be that under more ambitious strategies the vision is perceived as more needed.

Furthermore, results indicate that for high ambidexterity strategies, strategy fit was also significantly associated with performance. This finding is consistent with the work by Song and Montoya-Weis (1998) who found that for successful radical innovations, strategic planning, which they related to vision, is positively associated with new product success. If a vision is determined at the beginning of a these product developments, given the high degree of uncertainty and ambiguity present, the project vision will likely experience changes and corrections. Under these circumstances, a clear strategy that guides product development allows the project team to analyze implications of each new alternative and select that one to which the organization is committed.

This study did not find any direct or significant association between vision clarity and performance for high ambidexterity product development. This finding is somewhat contradictory to the Lynn and Akgün (2001). Perhaps what is happening here is that for this type of product development, teams normally move away from current organizational routines and knowledge bases and having clear project goals is not valued positively.. What is more important is the extent to which a firm's strategy guides the product development in unknown and conflicting situations by encouraging the agreement between team members about the strategic priorities along with the specific objectives and courses of action required for the coordination between product development goals and company strategy. Strategic guidance must lead to articulate a common vision so t hat team members have a common understanding of how product development supports the firm's strategy.

In contrast to high ambidexterity strategies, low ambidexterity strategies exhibit a different profile. The strategic fit was not found significant. Since in these less ambitious situations the p roject vision does not experiment many changes and its direction is not continuously questioned, the role of strategy fit does not seem to be as important as in high ambidexterity product development. On the contrary, here, clarit y of vision was found to be po sitively associated with teamwork. The interpretation of this finding is that for the project to succeed, it is important for a team to know what the product development goals are. In these less ambitious strategies, project vision should be clearly articulated and any change in the vision is badly admitted. A rob ust and shared vision is required to finish the development of a product successfully. It becomes critical to get to market with the initially envisioned product. The lack of clear and shared vision is perceived as a major reason for disappointing performance. Clear project goals that are well-communicated, understood and accepted improve overall teamwork because team members engage in goal-related functions (Hong et al, 2004).

All results must be viewed in the light of the limitations of the sudy. Each limitation serves as an avenue for future research. First, the scope of this study was limited to firms located in the Madrid area. In addition, the sample size was not large. Broadening the study to other geographic areas may lead to conceptual refinement and insight. As a second limitation, this article tried to define the constructs as precisely as possible by drawing on relevant literature and by closely linking our measures to the theoretical underpinnings through a care ful process of item generation and refinement. Evidently, this measurement effort represents an advance for research but, nonetheless, the items are far from being perfect as long as they measure facts that are neither fully nor easily measurable. Third, all of the data were collected from the same respondent using the same perceptual measurement technique. Although the presence of common method was tested and the results showed that common method bias should not be a problem, multiple respondents should be considered in future research to rule out potential drawbacks. Finally, it is also important to note that both the external environment and the organization's internal characteristics naturally interfere with product development efforts therefore amplifying or attenuating the organization's tendency to explore and/or exploit. This work is obviously only a preliminary step towards a better understanding of the impact of team vision on performance. Hopefully, it can serve as the starting point for future research in this important area of inquiry.

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