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Full Length Research Paper

The effects of a project's social capital, leadership style, modularity, and diversification on new product development performance

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Due to the rapid advances in information technology and the dynamic business environment, firms are facing more and more competitive challenges. To overcome this, many companies are trying to create new products to maintain their competitiveness. This study aims to explore the key success factors of New Product Development (NPD) performance from the perspectives of social capital, leadership, modularity and diversification of project team members. Therefore, the major research objective of this study is to develop a comprehensive research framework to integrate the effects of social capital, project leadership style, modularity, team member diversification, and NPD performance. Interviewing 500 senior leaders of NPD teams from different manufacturing firms in Taiwan, this study found that: (1) a higher level of participating and selling style of leaderships with a higher level of social capital generate better NPD performance, (2) a higher modularity level of a new product results in better NPD performance, and (3) team member diversification, however, does not have significant impacts on NPD performance. The managerial implications, limitations and future research directions of this work are also provided.

Key words: NPD performance, modularity, leadership style, social capital, project team diversity.

INTRODUCTION

In a dynamic business environment, firms should efficiently create new products or new processes to fit market demands. In many cases, new products can be viewed as a direct result of firm innovation. Higgins (1995) contends that innovation will create tremendous organizational value and be the secret to enhancing a firm's competitive advantage. Although New Product Development (NPD) seems to be one of the most important ways for firms to become competitive, it is a risky undertaking. Hill and Jones (2009, p131) indicate that "the failure rate of innovative new products is high. Research evidence suggested that only 10% to 20% of major R&D project give rise to commercial products." Stevens and Burkey (2003) further argue that the failure rate of new products is estimated to be 40% to 75%. Thus, Thus, the NPD process will become difficult when there is less synergy between the needs of the NPD project and the existing skills and available resources of the firm (Song and Montoya-Weiss, 2001).

Based on the results of previous studies (Edmondson and Nembhard, 2009; Song and Montoya-Weiss, 2001; Yli-Renko et al., 2001), several factors have been identified as essential for the success of NPD, such as the project leaders' leadership style and skills, and the team members' readiness and experience. More specifically, a firm may get different performances from the same team if the leader adopts different leadership styles (Thompson, 2010). In addition, NPD teams with members that have more diverse backgrounds and experiences could produce more different ideas and thus increase the probability of success (Edmondson and Nembhard, 2009). Yli-Renko et al. (2001) further indicated that social capital can accelerate the probability of NPD success through increasing the freedom of knowledge- sharing, stimulating different ideas through team members'

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interactions. Different ideas may thus be used to create different components of a new product. If a new product is designed to be composed of separate components and each component can be separately upgraded, maintained, repaired, and disposed of to meet different functions and forms, then it is a more modular product (Dahmus et al. 2001). Different modular component need different kinds of expertise and specialized production processes, so NPD team members require a diversity of knowledge. Therefore, NPD leadership style, social capital, modularity and team member diversity are all likely to influence NPD performance, but to what extent and how requires further investigation.

Although plenty of studies argue for the importance of project leadership, social capital, modularity, and team member diversity in relation to NPD performance (Thompson, 2010; Edmondson and Nembhard, 2009; Dakhli and Clercq, 2004; Lane and Wallis, 2009), they basically follow a piece-meal approach in that none of them have tried to integrate these variables into a more comprehensive framework, and thus the interaction and synergistic effects of these variables have been neglected in the current literature. This study thus aims to develop a comprehensive research model to integrate the influences of social capital, project leadership style, modularity levels, and team member diversity on NPD performance.

LITERATURE REVIEW

Project leadership style

Bardach (2001; p. 157) refers to leadership as "a means for diagnosing and implementing improvements in the operating subsystem of the inter-organizational collaborative capacity, inducing resource contribution, nurturing an ethos of interpersonal trust and organizational pragmatism". According to Hersey, Blanchard and Johnson (1996), leadership behaviors can be classified into task and relationship behaviors. Hersey (1984, p.31~p. 32) defined task behavior "as the extent to which the leader engages in spelling out the duties and responsibilities of an individual or group", while the relationship behavior is defined "as the extent to which the leader engages in two-way or multi-way communication. The behaviors include listening, facilitating, and supportive behaviors". Task behavior is implemented to help followers achieve their goals through clear instructions, whereas relationship behavior is implemented to help followers buy into the decisions. In practice, project leadership style can be classified by four styles: participating, selling, telling, and delegating style (Andi et al., 2004; Kao, 2006). The participating-style leader and followers share the decision-making process, so the leadership style reflects low task but high relationship behavior. The selling-style leader usually encourages two-way communications and is good at motivating followers to achieve goals. Thus, the selling leadership style reflects high task and relationship behavior. The telling-style leader provides clear instructions and specific directions, belonging to high task but low relationship style. The delegating-style leader and followers are both competent and motivated to take full responsibility for a particular task, so the leadership style can reflect low task and relationship behavior.

Social capital

The definition of social capital offered by Bourdieu (1986) is that "Social capital is an attribute of an individual in a social context. One can acquire social capital through purposeful actions and can transform social into conventional economic gains. The ability to do so, however, depends on the nature of the social obligations, connections and networks available to you." Tsai and Ghoshal (1998) further indicated that "social capital is a set of social resources embedded in relationships." Social capital facilitates the combination and exchange of intellectual capital (Field, 2008), and this is critical to the creation of all new products, and especially intellectual capital.

NPD performance

Although NPD performance lacks a standard definition in the literature, it is usually referred to based on two constructs: product concept effectiveness and process performance (Blindenbach-Driessen et al. 2005). Product concept effectiveness can be viewed as the fit with market demands, while process performance can be labeled as the fit with time constraints. The fit with market demands is measured by the degree of market acceptance of the new product. On the other hand, the fit with time constraints is measured by the speed/throughput time of the development process. Millson and Wilemon (2009) further claimed that design/prototype time and level of conformity are two main indicators that should be used to evaluate improvements in NPD performance. Sherman, Berkowitz, and Souder (2005) suggest that NPD performance can be measured by product prototype development and launch proficiency, technological core competency, market forecast accuracy, design change frequency, product development cycle time, and innovation level.

Modularity level

Product modularity is "the practice of using standardized product modules so they can be easily reassembled/ rearranged into different functional forms, or shared

across different product lines" (Tu et al., 2004, p. 151). Modularity can add value by creating options that enable the evolution of designs and industries (Baldwin and Clark, 2000). Potential benefits of modularity include: economies of scale, increased feasibility of product/ component change, increase product variety, reduce order lead-time, decoupling tasks, and the ease of product upgrade, maintenance, repair, and disposal (Gershenson, 2003; Corbett et al., 1991). According to Schilling (2000; p. 312), the level of modularity refers to "the degree to which a system's components can be separated and recombined". Chen and Liu (2004) and Huang et al. (2000) indicated that a modular architectural approach is very important in product innovation. New products with higher levels of modularity mean that a component can be independently operate without affecting others.

Team member diversification

Ruggles (1998) indicates that many organizations are successfully use teams to deal with complex NPD tasks. In different NPD activities, different team members may use different ways to collaborate on work, because an individual team member may have his/her own ideas, disciplines, experiences and ways of work. In the NPD process, team members must combine their diverse backgrounds, knowledge, beliefs, skills and so on to produce new products or services. Triandis, Kurowski, and Gelfanc (1994) defined diversification as the explicit characteristics of team members, which may be indifferent, arbitrary or random. Team member diversification can refer to the diversity of age, gender, education, specialty, ability, skill, training, knowledge, characteristics and value among team member (Hsu et al., 2008). In this way, the diversity of team members can more or less influence NPD project outcomes (Oke et al., 2008).

HYPOTHESES DEVELOPMENT

The influences of social capital and project leadership styles on NPD performance

Thompson (2010) indicates that true leadership involves much more than effectively managing a group performing a task. The leader plays a key role in an NPD team, using his/her knowledge, leadership, empathy, and ability to persuade members to devote themselves to achieving certain goals. Optimal leadership in an NPD team should not only encourage team members to work in the context of diverse member expertise, limited resources and time pressure, but also be able to handle both technical and behavioral issues (Edmondson and Nembhard, 2009). Based on the above discussions, this study suggests that leadership style has a significant impact NPD performance, and thus the following hypothesis is proposed:

H_1: Team leader's leadership style has a significant effect on NPD performance

Many scholars have claimed that social capital can facilitate inter-unit resource exchange (Makela and Brewster, 2009), product innovation (Dakhli and Clercq, 2004; Tsai and Ghoshal, 1998) and cross-functional team effectiveness (Brookes et al., 2007). This study tries to view social capital from the perspectives of relational and informational flow. In the process of NPD, the project team requires a great number of different information sources, as "social interactions among team members who are strongly tied to each other are likely to develop a shared understanding of the utility of certain behavior" (Gulati 1998, p.297). In a high social capital environment, team members can share different knowledge, emotions, values, and information by formal or informal interactions. According to Laumann, Galaskiewicz, and Marsden (1978; p. 458), network position is defined as "a set of nodes (e.g., persons, organizations) linked by a set of social relationships (e.g., friendship, overlapping membership) of a specified type." If an NPD project team stands at a core network position, this project team is able to interact with outsiders to get more information. In the NPD process, the team should integrate many factors (e.g. different objects, knowledge, information, and team member skills) to create a successful new product (Dustdar, 2002). Based on the above discussion, the following hypothesis is developed:

H_2: The social capital of the NPD team has a significant effect on NPD performance

According to the contingency approach of leadership, an effective leadership style should be contingent upon several environmental factors, such as support from the superiors, the cooperation from the subordinates, and the routine of the task (Garner, 2002). Today, NPD is viewed as a high-risk and potentially high-return activity, and the leadership styles of an NPD team play a critical role in the outcome. According to Hill (2006), the NPD team should be led by a "heavyweight" project manager who has high status within the organization and who has power and authority required to get the financial and human resources the team needs to succeed. More importantly, since the team members are composed of representatives from different functional departments, the project manager should not only have enough technological skills to develop new products but also have enough managerial expertise to integrate different ideas to implement the NPD tasks. The optimal leadership style should emphasize the importance of accumulating social capital (Lane and Wallis, 2009). In such cases, the project leaders can not only encourage team members to work under the constraint of time and resources, but also expedite integration through the synthesis of the diversity of team member expertise

(Bardach, 2001). Leaders emphasizing social capital can enhance the cohesiveness among NPD members, which can further accelerate the flow of information and knowledge sharing (Edmondson and Nembhard, 2009). Based on the above discussion, it is proposed that the interaction effects between leadership styles and the level of emphasis on the accumulation of social capital will result in significantly higher NPD performance. Therefore, the following hypothesis is developed.

H_3: The interaction effects of leadership style and social capital have a significant effect on NPD performance.

The influences of modularity level and team member diversity on NPD performance

Since an NPD project team needs to integrate many detailed processes to efficiently create value, it could be very complicated if the products need to be modified to fit changes in customer needs (Luo et al., 2005). The change of one component or feature may require extensive redesign of the whole product, and thus the use of modular components can be very helpful in saving a lot of cross-functional communication and coordination and simplifying the NPD process (Agrawal, 2009). In addition, a product prototype with a modular design will significantly increase product variety and thus meet the needs of a wider range of consumers, enabling economies of scale and reducing production costs (Yassine and Wissmann, 2007). Therefore, the following hypothesis is proposed:

H_4: The level of the new product has a significant effect on NPD performance

As mentioned earlier, information and knowledge are very important in promoting new product development. In any NPD project, multiple sources of information are needed to create value. NPD project member diversity will aid the production of different ideas, cognitions, and views in the development process (Bierly et al., 2009), and thus the following hypothesis is proposed:

H_5: Team member diversification has a significant effect on NPD performance

As discussed in the previous sections, this study believes that team member diversification will increase the level of modularity in an NPD project because of multiple sources of information and knowledge. The interaction of team member diversification and the application of modularity will accelerate NPD performance, and so the following hypothesis is proposed:

H_6: The interaction of team member diversity and product modularity has a significant influence on NPD Performance

DESIGN AND METHODOLOGY

Research framework

Based on the above literature review and hypotheses development, the research framework is developed including five major constructs and their corresponding interrelationships as shown in Figure 1. This research framework is used for further empirical validations in the later sections.

Measurement and questionnaire design

In this study, the questionnaire is composed of five sections: 1) social capital, 2) NPD project modularity level, 3) NPD project leadership style, 4) NPD performance and 4) team member diversification, and 5) team member diversity. Except for the team member diversification, each questionnaire item is measured using a seven-point Likert scale (1=strongly disagree to 7=strongly agree). However, this study uses the formula (Diversity=-ΣPi*(lnPi); Pi= Proportion of diversity category; ΣPi=1) proposed by Teachman (1980) to measure the degree of team member diversity. This work summarizes the diversity values of gender and nationality to represent team member social category diversity, and then summarizes the diversity values of education level and background, department, and seniority to represent team member knowledge diversification. If the diversity value of category is high, it represents the project team is more diversified than other teams in this category.

A preliminary version of this questionnaire is adopted from previous studies with some modifications based on the specific requirements of this work. Inter-judge reliability is obtained through the judgment of one professor and two Ph.D. students of a major University in Taiwan. Questionnaire items with low inter-judge reliability (i.e., items for which two of the three judges disagree with the content) were deleted from the questionnaire. The formal questionnaire with 55 items is listed in the Appendix.

Sampling plan

This study selects 500 senior leaders of NPD teams from different manufacturing companies in Taiwan. The sampling frame is obtained from “The manager directory in Taiwan (2006)” published by *China Credit Information Service Inc.* As this study chooses senior NPD leaders who have participated in a successful NPD project, they are highly likely to be the most knowledgeable people to answer the questionnaire. The respondents were asked to express their perceptions on NPD performance, social capital, team member diversity, modularity level, and project leadership styles based on a specific NPD project that they had participated in. SPSS 13.0 was used to analyze the data and to test the hypotheses.

RESULTS AND DISCUSSION

Descriptive analyses

Descriptive analyses are conducted to provide information about the characteristics of respondents. Table 1 show the basic attributes of the sample firms. Approximately 51% of the firms belong to the information and mechanical industry, and 84 % of them have operated for more than 10 years. About 39% of the firms have more than 1 billion NTD capital and 57 % of the firms have annual sales of more than 1 billion NTD (1US$=

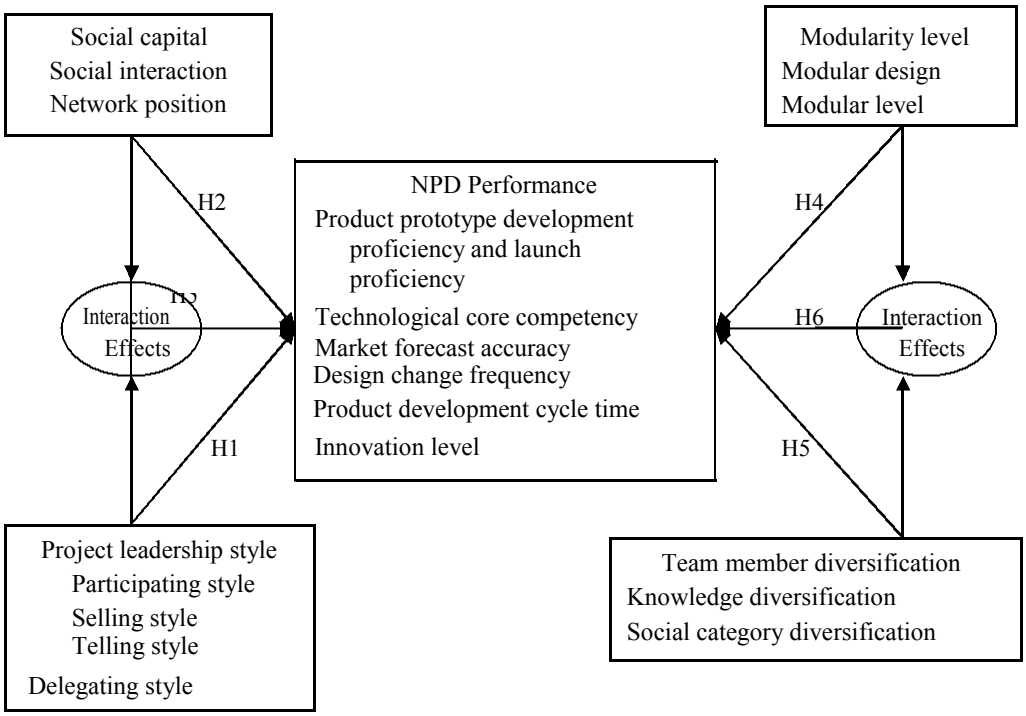

Figure 1. The research model.

32NTD$). Approximately 34% of the sample firms have employees between 1499 and 501, and about 49.5% have less than 500.

Reliability of the research constructs

The effects of project leadership style on NPD performance

In order to test hypothesis 1, regressions with the Ordinary Least Squares (OLS) estimation method are employed on the full sample data. Table 2 presents the results of the regression using six factors of NPD performance as the dependent variables. The regression results suggest that the performance of product prototype development and launch proficiency (regression model M1-1) is significantly influenced by participating style (β=0.388, p<0.001) and delegating type (β=0.166, p<0.05). While the performance of technological core competency (regression model M1-2) is significantly influenced by participating style (β=0.300, p<0.01), and selling style (β=0.225, p<0.001).

The performance of design change frequency (regression model M1-4) is significantly influenced by telling style (β=-0.404, p<0.001), while the performance of product development cycle time (regression model 1-5) is significantly influenced by participating style (β=0.309, p<0.01), and the performance of innovation level (regression model M1-6) is significantly influenced by telling style (β=0.207, p<0.01). These results seem to suggest that different leadership styles to result in different categories of NPD performance. NPD teams with participating leadership style tend to have higher performance in the aspects of product prototype development, technological core competency and product development cycle time; while those with selling leadership style tend to have higher technological competency performance. NPD teams with telling leadership style tend to have higher performance with regard to design changes frequency and innovation; while those with delegating leadership style tend to have higher performance in product prototype development and launch proficiency. Based on these results, hypothesis H_1 is partially supported.

The effects of modularity on NPD performance

Table 3 presents the effects of the modularity on NPD performance, it is suggested that NPD performance is significantly influenced by modular design (β=0.229, p<0.01) and modular level (β=0.226, p<0.01). In addition, modular design influences the NPD performance in the aspects of product prototype development, technological core competency and product development cycle time. Modular level has positive effects on market forecast accuracy (β=0.186, p<0.05) and innovation level (β=0.239, p<0.01), but negatively influences the design change frequency (β=-0.315, p<0.001). These results

Table 1. Characteristics of samples.

Characteristic of sample firms	n (%)
Industry	
Information and Electrical Industry	28(29.5)
Mechanical Industry	21(22.1)
Chemical and Pharmaceutical Industry	8(8.4)
Others	38(40.0)
History (year)	
Less than 10	38(40.0)
11-20	15(15.8)
21-30	27(28.4)
31-40	18(18.9)
Longer than 40	16(16.8)
Capital (million NTD)	
Less than 80	14(14.7)
81 - 200	10(10.5)
201 - 500	18(18.9)
501 - 1000	16(16.8)
Greater than 1000	37(38.9)
Annual sales (million NTD)	
Less than 100	10(10.5)
101 - 500	17(17.9)
501 - 1000	14(14.7)
1000 – 10,000	34(35.8)
Greater than 10,000	20(21.1)
Number of employees	
Less than 500	12(12.6)
501 - 1500	24(25.3)
1501 - 3000	47(49.5)
3001 - 5000	5(5.3)
5001 - 10000	3(3.2)
Greater than 10000	4(4.2)

Table 2. The effect of project leadership style on NPD performance.

Dependent variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
Independent variable	**M1-1**	**M1-2**	**M1-3**	**M1-4**	**M1-5**	**M1-6**
Participating style (lsf1)	0.388***	0.3**	0.153	-0.165	.309**	0.166
Selling type (lsf2)	0.131	0.225***	0.180	0.069	0.054	0.071
Telling type (lsf3)	0.094	-0.089	-0.055	-.404***	0.075	.207**
Delegating type (lsf4)	0.166*	0.019	-0.019	0.066	0.030	0.075
R^2	0.289	0.251	0.099	0.165	0.126	0.098
Adj-R^2	0.258	0.217	0.059	0.128	0.087	0.058
F	9.163	7.527	2.462	4.443	3.230	2.452
D-W	2.111	2.117	1.485	1.874	1.781	2.015

Note: * represents p<0.05; ** represents p<0.01; *** represents p<0.001

Table 3. The effects of modularity on NPD performance.

Dependent variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
Independent variable	**M2-1**	**M2-2**	**M2-3**	**M2-4**	**M2-5**	**M2-6**
Modular design (mlf1)	0.229**	0.357***	0.176	0.050	0.26**	-0.095
Modular level (mlf2)	0.226**	-0.051	0.186*	-0.315***	0.211**	0.239**
R^2	0.145	0.116	0.092	0.090	0.155	0.048
Adj-R^2	0.126	0.096	0.072	0.070	0.137	0.028
F	7.774	6.015	4.649	4.522	8.442	2.339
D-W	2.048	1.886	1.600	1.657	1.930	1.905

Table 4. The effects of social capital on NPD performance.

Dependent variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
Independent variable	**M3-1**	**M3-2**	**M3-3**	**M3-4**	**M3-5**	**M3-6**
Social interaction (scf1)	0.391***	0.387***	0.368***	0.056	0.078	0.182
Network position (scf2)	0.312***	0.118	0.016	-0.368***	0.228**	0.37***
R^2	0.366	0.207	0.141	0.119	0.075	0.234
Adj-R^2	0.352	0.190	0.123	0.100	0.055	0.217
F	26.509	12.018	7.511	6.205	3.734	14.052
D-W	2.238	1.928	0.151	1.749	1.673	2.175

Note: * represents p<0.05; ** represents p<0.01; *** represents p<0.001

suggest that different levels of modularity influence different categories of NPD performance. Therefore, H_4 is partially supported.

The effects of social capital on NPD performance

The performance of product prototype development and launch proficiency (regression model M3-1) is significantly influenced by social interaction (β=0.391, p<0.001) and network position (β=0.312, p<0.001), while the performance of technological core competency (regression model 3-2; β=0.387, p<0.001), and the performance of market forecast accuracy (regression model M3-3; β=0.368, p<0.001) are significantly influenced by the social interaction as shown in Table 4. Furthermore, network position is positively related to product prototype development and launch proficiency (β=0.312, p<0.001), product development cycle time (β=0.228, p<0.01) and innovation level (β=0.37, p<0.001), but negatively related to design change frequency (β=-0.368, p<0.001). Obviously, different kinds of social capitals influence different categories of NPD performance. Therefore, H_2 is partially supported.

The effects of team member diversification on NPD performance

Table 5 presents the influences of NPD team diversity on NPD performance. The results indicate that for all six regression models (M4-1~M4-6), neither knowledge diversification nor social category diversification has a significant impact on NPD performance, including product prototype development and launch proficiency, technological core competency, market forecast accuracy, design change frequency, product development cycle time and innovation level, and thus, H5 is not supported. Since previous research (Bierly et al., 2009) has shown a significant relationship between teams member diversification and NPD performance, this issue may be subject to further validation.

The influences of different leadership styles and different levels of social capital on NPD performance

To test hypothesis H3, this study uses K-means method analysis to divide different leadership styles (participating, selling, telling and delegating) into high and low levels. Simultaneously, social capital is divided into two groups

Table 5. The effects of team member diversification on NPD performance.

Dependent variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
Independent variable	**M4-1**	**M4-2**	**M4-3**	**M4-4**	**M4-5**	**M4-6**
Knowledge diversification	0.100	-0.049	0.089	0.024	-0.020	0.007
Social category diversification	0.014	-0.053	0.050	0.067	0.152	-0.076
R^2	0.011	0.007	0.013	0.006	0.022	0.005
Adj-R^2	0.000	0.000	0.000	0.000	0.000	0.000
F	0.515	0.314	0.622	0.285	1.015	0.254
D-W	2.044	1.826	1.514	1.548	1.514	1.935

Note: * represents p<0.05; ** represents p<0.01; *** represents p<0.001.

(high vs. low) by using the mean value of social capital as the cutoff point. As shown in Table 6, only the design change frequency (F=0.78, p≥0.05) performs indifferently in different levels of participating leadership style and social capital. Different levels of selling leadership style and social capital achieve different performances of product prototype development (F=14.85, p<0.001), technological core competency (F=8.24, p<0.001), market forecast accuracy (F=2.69, p<0.05) and innovation level (F=0.78, p<0.05). As shown in Table 6, NPD teams with high social capital but low telling leadership style tend to achieve better performance, while NPD teams with high social capital and selling leadership style tend to perform better.

Furthermore, the product prototype development and launch proficiency (F=15.02, p<0.001), technological core competency (F=8.24, p<0.001), and innovation level (F=5.03, p<0.01) perform differently with different levels of telling leadership style and social capital, while the performances of product prototype development and launch proficiency (F=13.84, p<0.001), technological core competency (F=5.11, p<0.01), product development cycle time (F=2.90, p<0.05), and innovation level (F=5.46, p<0.01) are different with different levels of delegating leadership style and social capital as shown in Table 6. Generally, NPD teams with high social capital and low telling style tend to achieve better performance, while NPD teams with high delegating leadership style and social capital tend to perform better. We can thus conclude that different leadership styles and different levels of social capital have different impacts on NPD performance. Based on these results, H_3 is partially supported.

The influences of different levels of team member diversity and modularity on NPD performance

To test H_6, the K-means method is used to divide modularity and team member background into high and low clusters.

In order to discriminate between high or low diversification of team members, this study summed up the diversity value of knowledge diversification and social category diversification and then used the value to classify team member diversification by two groups (high vs. low). As shown in Table 7, only the performance of product prototype development and launch proficiency (F=4.7, p<0.01) is influenced by the levels of modular design and team member diversification. NPD teams with high modular design and member diversification tend to achieve higher NPD performance. Furthermore, different levels of modularity and team member diversification have impacts on the performances of market forecast accuracy (F=2.8, p<0.05) and design change frequency (F=3.32, p<0.05). NPD teams with high team member diversity but a low modular level tend to achieve higher NPD performance, but for the design change frequency, higher modular levels tend to have better performance. Thus, different levels of team member diversity and modularity have significant influences on NPD Performance. Based on these results, H6 is supported.

CONCLUSIONS AND SUGGESTION

Based on the results of this study, several conclusions and implications are drawn, as below. First, higher levels of participating style leadership and social capital will achieve better NPD performance. That is, NPD leaders who adopt a participative leadership style will see better performance in product prototype development and launch proficiency, technological core competency, market forecast accuracy, cycle time, and innovation if the NPD members are willing to interact with other However, selling leadership style does not significantly influence the design change frequency and the product development cycle time. It is suggested that the leader should adopt the selling leadership style if the team members have no ability and willingness to engage in the members. Participating style, however, has no effect on

Table 6. Variations in NPD performance by leadership style and social capital.

	Participating Style							Selling Style						
	High	High	Low	Low				High	High	Low	Low			
	Social Capital				F	P	Duncan	Social Capital				F	P	Duncan
	High (n=51)	Low (n=17)	High (n=8)	Low (n=19)				High (n=50)	Low (n=19)	High (n=9)	Low (n=17)			
Product prototype development and launch proficiency	5.46	4.92	5.25	4.17	18.15	0***	(4,23,31)	5.45	4.76	5.32	4.26	14.85	0***	(4,2,31)
Technological core competency	5.53	5.33	5.40	4.65	8.54	0***	(4,231)	5.50	5.28	5.53	4.62	8.24	0***	(4,213)
Market forecast accuracy	4.93	4.59	4.31	4.26	2.49	0.065*	(4321)	4.91	4.68	4.50	4.12	2.69	0.05*	(432,321)
Design change frequency	3.23	3.50	3.25	3.68	0.78	0.51	(1324)	3.23	3.82	3.22	3.35	1.16	0.33	(3142)
Product development cycle time	5.06	4.47	4.25	3.95	3.09	0.031**	(4321)	4.92	4.21	5.11	4.18	1.97	0.12	(4213)
Innovation level	5.00	4.04	4.58	4.10	4.67	0.004***	(243,31)	4.95	4.09	4.93	4.05	4.32	0.007**	(42,31)
	Phillai's Trace=0.544 (F=3.25)							Phillai's Trace=0.487 (F=2.839)						
	Wilk's λ=0.498 (F=3.781)							Wilk's λ=0.551 (F=3.174)						

	Telling style							Delegating style						
	High	High	Low	Low				High	High	Low	Low			
	Social capital				F	P	Duncan	Social capital				F	P	Duncan
	High (n=40)	Low (n=21)	High (n=19)	Low (n=15)				High (n=34)	Low (n=15)	High (n=25)	Low (n=21)			
Product prototype development and launch proficiency	5.30	4.44	5.71	4.65	15.02	0***	(24,13)	5.55	4.64	5.27	4.44	13.84	0***	(42,31)
Technological core competency	5.45	4.68	5.64	5.39	9.27	0***	(2,413)	5.51	5.12	5.50	4.87	5.11	0.003**	(42,231)
Market forecast accuracy	4.75	4.29	5.05	4.60	1.96	0.13	(241,413)	4.84	4.60	4.86	4.29	1.57	0.20	(4213)
Design change frequency	3.06	3.38	3.58	3.90	2.14	0.10	(123,234)	3.15	3.67	3.34	3.55	0.86	0.47	(1342)
Product development cycle time	4.93	4.14	5.00	4.27	1.96	0.13	(2413)	4.91	4.67	5.00	3.86	2.90	0.039*	(42,213)
Innovation level	5.07	3.97	4.68	4.20	5.03	0.003**	(243,31)	5.15	4.21	4.67	3.97	5.46	0.002**	(423,31)
	Phillai's Trace=0.569 (F=3.431)							Phillai's Trace=0.45 (F=2.588)						
	Wilk's λ=0.505 (F=3.694)							Wilk's λ=0.572 (F=2.952)						

Note: * represents p<0.05; ** represents p<0.01; *** represents p<0.001.

reducing product design change from product prototype to volume production. It is possible that a participating leadership style allows team members to share a greater variety of opinions. When members have a divergence of opinions, this could result in product design continuously changing to fit the different opinions of individuals. It is thus suggested that NPD leaders should try to enhance team-member interactions and share multiple sources of information in an NPD project.

Secondly, higher levels of selling style leadership and social capital will lead to better NPD performance.

However, selling leadership style does not significantly influence the design change frequency

Table 7. Variations in NPD performance by modularity and team member diversification.

	Modular design							Modular level						
	High	High	Low	Low	F	P	Duncan	High	High	Low	Low	F	P	Duncan
	Diversification							Diversification						
	High (n=13)	Low (n=13)	High (n=13)	Low (n=12)				High (n=17)	Low (n=15)	High (n=27)	Low (n=36)			
Product prototype development and launch proficiency	5.38	5.14	4.58	4.70	4.29	0.007**	(34,42,21)	4.87	4.82	5.31	5.13	1.66	0.18	(2143)
Technological core competency	5.43	5.41	4.91	5.07	2.48	0.066	(34,421)	5.18	5.31	5.34	5.34	0.23	0.88	(1243)
Market forecast accuracy	4.84	4.74	4.65	4.13	1.45	0.24	(4321)	4.41	4.17	5.02	4.78	2.80	0.045*	(214,143)
Design change frequency	3.47	3.15	3.85	3.29	1.21	0.31	(2413)	3.74	3.83	3.48	2.92	3.32	0.023*	(43,312)
Product development cycle time	4.94	4.82	4.08	4.08	1.77	0.16	(3421)	4.18	4.13	5.00	4.86	1.92	0.13	(2143)
Innovation level	4.55	4.73	4.60	4.42	0.24	0.87	(4132)	4.25	4.58	4.77	4.69	0.71	0.55	(1243)
	Phillai's Trace=.268 (F=1.436) Wilk's λ=.748 (F=1.461)							Phillai's Trace=.275 (F=1.483) Wilk's λ=.741 (F=1.513)						

Note: * represents p<0.05; ** represents p<0.01; *** represents p<0.001.

and the product development cycle time. It is suggested that the leader should adopt the selling leadership style if the team members have no ability and willingness to engage in the project. Simultaneously, leaders should encourage member to interact with each other and share multiple source of information in the NPD project to obtain better performance. These results are consistent with Belbaly et al. (2007) and Olson et al. (2001).

Thirdly, higher levels of telling leadership style and social capital will lead to better performance in design change frequency and innovation, but worse performance in product prototype development and launch proficiency and technological core competency. According to Hersey, Blanchard, and Johnson (1996), the project leader should use a telling leadership style to lead project members to attain better performance if they are unwilling and not capable of working. Based on these results, project leaders who adopt higher levels of telling leadership style in an NPD project may cause bad feelings among team members, and this may further result in bad performance in product prototype development and proficiency and technological core competency. In the process of innovation, telling leadership style has a significant effect on NPD performance, although the variance explained is small. It is possible that there are other factors that have been neglected from the model. In fact, there are many factors that will influence innovation. In the process from prototype design to volume production, multiple source of information can help employees to

make fewer mistakes and decrease the frequency of design change. Consistent with the results of Howell and Higgins (1990) and Romero et al. (2008), a leader who adopts the senior leadership style with a more close-ended project will lead see better performance in NPD.

Fourthly, higher levels of delegating leadership style and social capital will bring better performance in product prototype development and launch proficiency, technological core competency, and innovation. Hersey, Blanchard, and Johnson (1996) suggested that when team members have both the ability and willingness to work, leaders should adopt a delegating leadership style. Leaders should also increase social capital when they dealing with project members who have a high readiness level. In the early stage of NPD, leaders delegating authority to team member who have the ability and willingness to reach a goal will satisfy their achievement-oriented performance. These results are consistent with Kodama (2009), which found that greater social capital can increase network processes and effectiveness, and thus speed up NPD performance from a structurationist perspective.

Fifthly, NPD with a modular design will lead to higher performance on prototype product development and launch proficiency, technological core competency, market forecast accuracy, and product development cycle time, so NPD project leaders could try and use modular design in developing new products. If a project team has some previous successful experience, it may consider just changing some modular components to generate a brand new product. Because of its past experience, the project team will have a better under-standing of the market and be able to reduce product cycle time. In addition, the key to successful product modularization is the product architecture, a scheme by which the functional elements of a product are allocated to structurally independent physical components (Sanchez, 2000). In the process of designing the product architecture, project team members must know the core functions of a product in order to acquire the necessary competencies with a diverse range of functions.

Surprisingly, the analytical results of this study did not confirm that team member diversification has a significant effect on NPD performance. This study divides team diversification into two aspects: knowledge and social category. Different aspect leads to different results. Team member characteristics, team cohesion, and environment will affect performance via member interaction (Jordan and Lawrence, 2006). In the process of team member interaction, the characteristics of team members and tasks interact with those of the overall job and team, and thus only considering personal characteristics is not sufficient (Morgeson, 2005). Instead, the diversification should also include task and personal characteristic. Team members with different backgrounds may result in various unproductive conflicts that reduce team performance.

Limitations and future directions

Although the results of this study may contribute to the existing literature for further validation, several suggestions could be made for academics and business practitioners. First, the model test is conducted using firms from the manufacturing industry in Taiwan. Although this approach enables us to conduct an in-depth study and controls for a considerable amount of environmental 'noise' in an important industry, it might limit our ability to generalize the findings.

Second, this study collects sample data through a mail survey. It takes considerable time and effort to get data in this way, especially when the respondents have no obligation to fill out the questionnaires. Thus, future research can use in-depth interviews or focus groups to further examine the validity of the study.

Third, since the research framework as developed in this study has been empirically tested, future studies may use experimental research to confirm the results of this work. For example, business simulations could be adopted to reflect a real environment and to manipulate different situations of team members.

Fourth, Hersey, Blanchard, and Johnson (1996) proposed the situational leadership model and indicated that a successful leadership style should consider the ability and willingness of followers. Thus, further studies may consider measuring the maturity of followers with regard to suitable leadership. Further studies should try to find the best leadership model among leadership style, social capital, and team member's characteristics with regard to improved NPD performance.

Finally, the results study show that team member diversification has no effect on NPD performance, and this may be because this work used the arithmetic average of the diversity value to represent diversification. Future research may develop a more suitable formula to find out the appropriate weight for the measurement items of team member diversification.

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APPENDIX: QUESTIONNAIRE ITEMS

SOCIAL CAPITAL (7-POINT SCALE) (BURT, 1992; LOURY, 1997; BOURDIEU, 1986; TSAI AND GHOSHAL, 1998; HARGADON AND SUTTON, 1997)

Social interaction

NPD project member often share each other's experience by informal interaction.
NPD project member have frequent informal interaction, EX: dinner party, societies, et al.
NPD project member often have talk/conversation in an informal setting, EX: pantry, lounge, et al. NPD project member have very deep feelings.

Network position

NPD project's relative knowledge sources flow outside the units or organizations.
Many other organizations must tie NPD project task to carry out a very close interaction.
NPD project member could contact another organization which have related NPD project.

NPD PROJECT MODULARITY LEVEL (7-POINT SCALE) (TU, VONDEREMBSE, AND RAGU-NATHAN, 2004)

Modular design

Our NPD project use modularized design.
Our NPD project share common modules.
Our new product features are designed around a standard base unit.
Our new products can be customized by adding feature modules as requested.
Our new Product feature modules can be added to a standard base unit.

Modular level

Our new Product modules can be rearranged by end-users to suit their needs.
Our new product could partially upgrade, conveniently wear and tear or adapt new components.
Our new Product modules can be reassembled into different forms.

NPD PROJECT LEADERSHIP STYLE (7-POINT SCALE) (GAO, 2003)

Participating style

NPD project leader will praise members when members' work results have progress.
NPD project leader will give the sufficient right to members to complete the task.
NPD project leader will consider the welfare of members.
NPD project leader will consider member's feeling when he conducting something or making decision.
NPD project leader will care for members, and let them feel delight to be a members of the team.
NPD project leader give a great support for members.

Selling style

NPD project leader is friendly and easy to get close.
NPD project leader often stressed the importance of the work and asked members to work.
NPD project leader will designate specific people to do specific work.

Telling style

NPD project leader used strict management to members.
NPD project leader will reprimand members when the project performance is poor.

Delegating style

NPD project leader will encourage members to work overtime.

NPD PERFORMANCE (7-POINT SCALE)

Product development and launch proficiency (Souder et al., 1997; Souder and Song, 1997; Cooper and Kleinschmidt, 1988; Dwyer and Mellor, 1991; Souder and Song, 1997)

The degree of proficient concept development is high.
The degree of proficient prototype development is high.
The degree of proficient prototype testing is high.
The degree of proficient market development is high.
The degree of proficient manufacturing start-up is high.
The degree of proficient marketing star-up is high.
The degree of proficient technical service is high.

Product development cycle time (Gupta and Souder, 1998)

We typically have many design changes or redesigns during the development of our new products.

Design change frequency (Yap and Souder, 1994)

Our design changes or redesigns frequently as the new

product development moves closer to the production stage.
Our forecast of the market demand for this product is accurate.

MARKET FORECAST ACCURACY (COOPER, 1983)

Our predictions about customers' requirements are accurate.
Our engineering skill is at the desired level for this project.

Technological core competency

Our manufacturing skill is at the desired level for this project.
Our manufacturing skill is at the desired level for this project.
There is a close fit between out engineering skills and the needs of this project.
There is a close fit between our production skills and the needs of this project.

Innovation level (Song and Montoya-Weiss, 1998; Kleinschmidt and Cooper, 1991)

The technique used in this NPD project is brand new in the market and has never been used before.
The technique used in this NPD project is brand new in the company.
The product produced by NPD project is highly innovated and has never been used before in the market.
The product produced by NPD project is brand new in the company.
The manufacturing process in the new product by NPD project is brand new.
The product produced by NPD project influences the industry.

Team member diversity (Teachman, 1980)

Gender, nationality of project diversity, team member education level, education background, department, and seniority.