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Who Pioneers and Who Follows: The Role of Intellectual Capital

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Abstract
Pioneering innovation is crucial for attaining a competitive advantage in high-tech industries. Pioneering innovation, in contrast to following innovation, develops and brings to market innovative products ahead of competitors. Many determinants have been shown for supporting a pioneering innovation. This paper analyzes the intellectual capital that fosters or inhibits organizations pioneering or following strategies. A Logit analysis model to predict pioneering innovation orientation is developed and empirically tested using pooled data from 101 high-tech firms during the period of 2010-2012. Our findings indicate of the two types of intellectual capital, the human capital and structural capital of a firm are the significant drivers that influence the use of pioneering innovation strategy. Interestingly, relational capital is not found to be a significant driver of pioneering innovation. By highlighting the importance of a firm's intellectual capitals links to the model of innovative strategy in these high-tech firms, we hope that this model can contribute a supplementary decision-supporting tool for identifying firms with a high likelihood of using pioneering innovation.

Keywords: Pioneering innovation, Logit, human capital, relational capital, intellectual capital

Introduction

Should you create an innovative product before your rivals or wait and emulate their innovation? This is one of the most of fundamental decisions encountered wherever a high-tech firm tries to achieve or maintain a superior competitive position in a competitive business environment (Zhou 2006). Innovation strategy may be more important than production and marketing decisions since it has significant consequences for the long-term market performance of a high-tech firm. In the last two decades, numerous empirical studies have shown that pioneering innovation can achieve substantial competitive advantage and firms who use it are likely to be market leaders (Langerak & Hultink 2008; Teece 2010).

Today one of the important issues considered to have a significant influence on innovation is intellectual capital (Youndt & Snell 2004). Intellectual capital is increasingly seen as a critical driver for creating innovative capacity and consequently market growth. Intellectual capital refers to the non-physical sources of value related to employees' capabilities,

organizations' resources and means of operation, as well as the relationships with the stakeholders (Moon & Kym 2006). The rise of the knowledge-based economy has been attributed to the increasing importance of intellectual capital as a vital resource for an organization's innovation strategy (Kramer et al. 2011; Tödtling et al. 2009). This scenario has led to increased interest among researchers who wish to gain a better understanding of how to develop pioneering innovations (Koc & Ceylan 2007; Mavondo et al. 2005).Therefore, intellectual capital can be the most powerful asset of an organization for promoting its innovative capability. We here suggest that different types of intellectual capital will be required depending on the strategic orientation for innovation of an organization, whether to pioneer or to follow innovation.

To further this debate, two basic shortcomings can be addressed. Firstly, existing studies have devoted great attention to the innovation by assessing the performance differences between tangible and intangible indicators (Doh & Acs 2010; Kramer et al. 2011; Weber & Weber 2007). However, because both pioneering and following innovative strategies have their own merits; it is not clear whether intellectual capital is a more effective driver for pioneering or following innovation. It has left many open questions particularly as far as intellectual capitals are concerned.

Secondly, prior studies on the relationship between intellectual capital and innovation have been mainly carried out with data from Western countries, which leaves the generalization of their findings to Eastern countries another open question. Hsu and Wang (2012) suggest that due to the unique cultural characteristics of Eastern countries, the pioneering and following innovative original phenomenon in Eastern counties (e.g., the Asian four tigers) may not be systematically explained by theories largely embedded in Western countries (e.g., United States). This paper contributes to the debate on intellectual capital in two ways: Firstly, we examine whether the role of intellectual capital varies across different levels of innovation strategy orientation. Secondly, we analyze the effect of intellectual capital on the question of pioneering and following innovation in Eastern countries.

The remainder of the paper briefly reviews the literature on three sub-constructs (human capital, structural capital, and relational capital) of intellectual capital, and then develops a set of hypotheses that identify relationships between the three types of intellectual capital and two types of innovation orientation. In the following sections, we describe the methodology of our study including the data, the measurement, and the analysis. Finally, we present the evidence and discuss implications for future research. Figure 1 presents the theoretical model proposed to explain the underlying processes through which intellectual capital predicts innovation orientation.

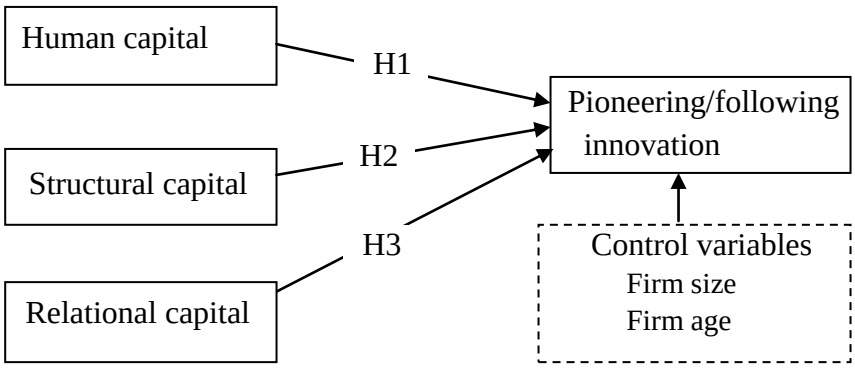

Figure 1. Theoretical model

Analytical framework and hypotheses

Several studies have underscored the importance of intellectual capital as an organization's knowledge resources (Hsu & Sabherwal 2012; Kang & Snell 2009; Morris & Snell 2011). Researchers have recognized intellectual capital to be the sum of all intangible knowledge firm utilized for competitive advantage, beyond the firm's physical capital (e.g., Subramaniam & Youndt 2005). Previous research has identified three main aspects of intellectual capital: human, structural, and relational capital (Reed et al. 2006). Human capital is defined as the capacities of individuals of an organization, their creativity, competence, skill, etc. (Tian et al. 2011). Structural capital, on the other hand, covers a number of properties related to the organization rather than to specific individuals, such as processes, systems, and information in a database (Aramburu & Sáenz 2011). The third aspect, relational capital refers to the relationships that an organization has with its customers, suppliers, partners, and other stakeholders (Carmeli & Azeroual 2009).

Types of innovation can be distinguished on the basis of their degrees of novelty. Zhou (2006) proposes two distinct types of innovation. The first type, pioneering innovation, is seen as the greater the creating knowledge, the greater revolutionary alterations associated with new products into the market before their rivals (Hermann et al. 2009; Sood & Tellis 2005). However, if the second type of innovation, namely following innovation, i.e., if the creating knowledge is that the refine and reinforce existing products and service, then innovation is response the minor improvement or adopt competitor's technology (Fuller & Matzler 2007; Un 2010).

Human capital and pioneering innovations

An influence on an organization's propensity for innovation orientation is attributed to have its access to a variety of new knowledge. The propensity for access to diverse knowledge is most likely to be seen in an organization's human capital. Human capital, which can dominate the growth of an organization, is one of the important assets for its innovative activities (Alpkan et al. 2010; Dakhli & De Clercq 2004; Kaasa 2009). Human capital represents the primary resource that directly influences the activities of pioneering innovation (Jack 2010), and it is the qualities possessed by individuals. The excellent experiences, professional skills, creativities, specialties, etc. of individuals in an organization constitute the major source for new ideas and knowledge (Hill & Rothaermel 2003; Rothaermel & Deeds 2006).

Organizational routines are built up in order to be constantly perfected, and major changes occur only with difficulty (Gilbert 2005), moreover, access to new knowledge domains enlightens organizations about pioneering innovation-creating. While organizations begin to question their capability to develop new knowledge, they thereby increase their likelihood to relinquish existing knowledge and ultimately foster pioneering innovations (Klas et al. 2010). Rather than relying on current knowledge for to solve existing problem, new transformative knowledge favors pioneering innovation, as an organization combine the special capabilities of human capital and makes them available for different solutions to new challenges (Nerkar 2003; Phene et al. 2006; Tether & Tajar 2008).

It is important to consider whether or not individuals possess the necessary levels and combinations of knowledge and skill to complete the tasks that they are responsible for (Crook et al. 2008; Segal et al. 2010; Sirmon et al. 2011). Working with individuals involve personal judgment and decision making that is not easily imitated by rivals and cannot to be based solely on tools or systems (Brown et al. 2007). A pioneering innovation needs to be more person-oriented than technology-oriented. Accordingly, we can expect that with higher quality of an organization's human capital, the firm will have more propensities to employ pioneering innovation, and vice versa. Hence, we hypothesize:

H1: The greater the human capital; the higher the likelihood of an organization to use pioneering innovation.

Structural capital and pioneering innovation

From a dynamic perspective, modern marketplaces are characterized by rapid technology breakthroughs and shrinking product life cycles. Pioneering innovation activities are aimed at learning and coordination for the development of new products or processes, and these prove to be fundamental in responding to an increasingly volatile environment. Structural capital can enhance firm-specific knowledge absorbing and is the results of its collective learning. Organizations rely on their own idiosyncratic structural capital including practices, systems, procedures, and norms (Choi & Kim 2008; Krause et al. 2007; Moran 2005). Consequently, an organization needs developing structural capital to improve its efficiency and facilitate coordination in a context characterized by pioneering innovation (Li & Vanhaverbeke 2009).

Structural capital is important for understanding the pioneering innovative activity that an organization has and can use to meet the challenges and changes in a competitive environment (Newell et al. 2004; Wu & Wang 2007). Its infrastructural characteristics (e.g., systems of knowledge management) and procedural factors (e.g., operation process) could create a trajectory of new knowledge development. Previous researchers have argued that the managerial systems and operation processes that an organization uses to create pioneering innovation activities are associated with shrinking its innovation development cycles (Danneels 2002; Ellonen et al. 2009).

Structural capital contributes newer, more dynamic and higher quality of innovation knowledge to an organization. This should not be considered as static but rather as capable of being moulded in order to reflect the changes produced by the innovation. Such a collection of systems closely consolidated as enterprise behavior can overcome challenges and create novel opportunities. Thus, successful pioneering innovative activities are achieved through structural capital that is systematic, deliberated and coordinated to process new knowledge (Cabello-Medina et al. 2011; Carmona-Lavado et al. 2010; Leenders & Voermans 2007). Based on the above theory concerning structural capital, the following hypotheses are proposed:

H2: The greater the structural capital; the higher the likelihood of an organization to use pioneering innovation.

Rational capital and pioneering innovation

Relational capital theorists suggest that pioneering innovation can be increasingly generated by rational capital (Capello & Faggian 2005; Kale et al. 2000). The relationship between relational capital and innovation has been explored using resource dependency theory (Salancik & Pfeffer 1978), transaction cost value (Williamson 1989), resource-based theory (Tyler 2001) and social capital theory (Tsai and Ghoshal 1998). A central proposition of these theories is that when organizations invest in relation-specific assets and engage in knowledge exchange through dyadic knowledge sharing, pioneering innovation can be created.

The pioneering innovation in terms of the discontinuity of relationships dimension implicates that there are existing weak-ties relationships for such innovation. As a result, a relationship of strong ties must be fostered to support pioneering innovation (Doh & Acs 2010). A high level of relational capital (i.e., strong ties relationships) is not only vital for effective functioning of organizations, but it also has a positive effect on pioneering innovation. More specifically, an organization with a high level of relational capital is more accessible and willing to be helpful, and it is more willing to support and encourage innovative ideas, since the

individuals involved can have the confidence needed to turn new ideas into pioneering innovations (Brachos et al. 2007; Van Wijk et al. 2008).

Moran (2005) has highlighted the strong ties in relationships for improving innovation performance. Previous studies suggest that the strong ties in relationships can stimulate to innovation between organizations by lessening the need for monitoring mechanisms, increasing the freedom for rigid rules, and enhancing idea generation through interactions among partners (Land et al. 2012). Thus, from the perspective of relational capital, organization which has dense collaborative social networks can learn new technologies, ideas, and opportunities necessary to innovate quickly because of the increased interaction within a trustworthy network. These relationships can help to gain access to knowledge and information about pioneering innovations (Hessels & Van Lente 2008; Pérez-Luño et al. 2011). In accordance with this concept, the present research proposes the following hypothesis:

H3: The greater the relational capital; the higher the likelihood of an organization to use pioneering innovation.

Methodology

Sample

In this study, the sample consists of Taiwanese firms drawn from high-tech industries defined by the four-digit Standard Industrial Classification (SIC) code. The high-tech industries were selected to vary on critical dimension such as human capital and structural capital that might be the determinants of pioneering or following innovations. In reviews of the major classification schemes of Taiwanese high-tech industries Hsu and Wang (2012) and Yang and Kang (2008) identified four industry sub-groups: electronic computers (SIC code 3571), computer peripheral equipment (SIC codes 3577), communication equipment (SIC code 3663), and semiconductor and related devices (SIC code 3674). This study collected sample data from these public companies listed in the Taiwan Economic Journal (TEJ) for the years 2010 to 2012.

A sample of 53 firms was classified as using pioneering innovation firms (market share above 15%) and a sample of 112 firms was classified as using following innovation firms (market share less than or equal to 15%) during the period of 2009-2011. However, 20 out of the 165 firms were deleted due to missing data; since they were not active for the next year period after 2009. Thus the final number of observations used in this study is 145 firms. Approximately 70% (i.e., 101 firms) of the 145 firms were selected at random for estimating the Logit regression. Of these, 30 firms were pioneering innovation firms and 71 firms were following innovation firms. The remaining 30% of the 145 firms (i.e., 44 firms) were used as an out-of-sample group for tests of the model's prediction power. To examine the model's power to predict pioneering innovative firms, the Logit regression model must be tested on a group of out-of-sample firms. Since the Logit regression's coefficient estimates are obtained from the estimation sample, any test based on this sample is likely to be biased and an out-of-sample is necessary.

Model specification

The objective of the empirical analysis is to test the effectiveness of intellectual capital in predicting the type of innovation-orientation in the high-tech industry for the purpose of improving innovation performance. We employed the pooled data including observation per firm and year. In this case the assumptions of the linear regression model relating to homoskedasticity and normally distributed errors are violated, and so count models are more appropriate, in particular the Logistic model. Whether a high-tech firm is likely to be a pioneering innovation firm or not can be represented mathematically by quantitative variables which assume one of only two possible values: yes or no. Binomial Logistic regression analysis was selected as the

most appropriate technique for identifying the innovation orientation that distinguishes between the two categories of high-tech firms. The Logistic regression model can be represented as follows.

$$\ln[p/1-p] = \alpha + \beta_1 HC_{it} + \beta_2 SC_{it} + \beta_3 RC_{it} + \beta_4 FS + \beta_5 FA + \varepsilon_{it}$$

where is the value of the dependent variable between 0 and 1, HC is human capital, SC is structural capital, RC is relational capital, FS is firm size, FA is firm age, and is a standard error term. The subscript =1, 2, …, 101, stands for high-tech firms, while =1, 2,and 3 stands for the years of 2010-2012.

Measure

Dependent variables

The categorization of high-tech firms into pioneering and following innovation has been done in various ways in previous studies, such as a classification based on radical or incremental innovation (Hommels et al. 2007; Tellis et al. 2009; Un 2010), and as exploration or exploitation innovation (Hernández-Espallardo et al. 2011; Wu & Shanley 2009), which is similar to the classification of first mover or late entrants (Rhee 2006; Shamsie et al. 2004). These previous categorizations were based on collected data by questionnaires. However, this study's categorization of high-tech firms into pioneering or following innovation was based on the index of market share, which provides a clear split of samples and can be applied to practical situations. The dependent variable is measured by binary variables that assign the value of 0 to the pioneering high-tech firms with more than 15% market share, and the value of 1 to the follower high-tech firms with less than/equal 15% market share. This categorization criterion is consistent with those used by previous studies (e.g., Wang & Hsu 2010).

Independent variables

According to Williams (2000, p.9), an appropriate intellectual capital measurement method should be relatively simple. In addition, an intellectual capital measure should guide in the right direction. On one hand, the cost of data collection or the implementation and maintenance of the measure should not be too high. On the other hand, it should not too difficult to collect and understand the data. Accordingly, this study does not employ data from questionnaire rather other several non-financial indices to measure intellectual capital.

We propose some operationalization indices that more comprehensively capture the domain of intellectual capital, including the three key dimensions and their sub-factors. We measure human capital using two indices: employee competency and employee sustainability (Kaplan & Norton 1996; Wang et al. 2008). Employee competencies refer primarily the sum of employee knowledge, creativities and skills, etc., which are embedded in individuals not in organizations (Mayo 2000). Employee sustainability refers to long term retention of employee, since high turnover may threaten the accumulated organization knowledge (Bontis & Fitz-Enz 2002).

Structural capital is operationalized as the stock of organization capability, operation processes, and information systems. Within an organization we used two indices to measure structural capital: organization processes and information systems (Hobley & Kerrin 2004; Liu et al. 2009; Lynn & Dallimore 2002). Organization processes are calculated by dividing the renewal expenses by operating expenses. These processes directly affect the organization routine, since once an organization obtains a unique routine process for innovative activities, it ultimately becomes intellectual capital. The information system is calculated by the information

technology expense ratio, and it shows how much of the organization's added value of innovative capability is leveraged by structural capital.

Relational capital is operationalized as two directions of relationships: downstream client (i.e., customer relationships) and upstream suppliers. Customer relationship is calculated by key accounts who are loyal customers exchanging more than 10% of total sales with an organization. A loyal customer base is the major source of innovative ideas (de Pablos 2003; Kotler & Caslione 2009; Rust & Zahorik 1993). Supplier relationship is calculated by the percentage of total expenses paid to the main suppliers. A network of partnerships is likely to play an increasingly important role in maintaining an operation's competitive advantage. As noted, these indices meet the earlier mentioned criteria related to intellectual capital measurement: simplicity, cost effectiveness, and limited number of indictors. These proven indices were predominately adapted in previous studies. We conducted searches in the database of the Taiwan Economic Journal, which includes all Taiwanese published high-tech firms from 2000 to the present.

Control variables

Two control variables, that may influence the innovation orientation beyond intellectual capital, are employed in light of our theoretical framework and in order to test the robustness of our findings. Firm size and firm age has been commonly used in previous studies (e.g.,Barge-Gil & Modrego 2011; Brenner & Broekel 2011). Innovative knowledge generation and diffusion were evolutionary in nature and would thus be affected by a firm size (the natural log form of total financial capital) and firm age (the number of years). We obtained the number of total financial capitals and years of the firm from the Taiwan Economic Journal. All constructs and measures are presented in Table 1.

Table 1. Definitions of Variables

Constructs		Variables	Adapted from
Intellectual Capital (IC)	Human Capital (HC)	Employee competency (EC) = employee productivity	Kaplan and Norton (1996) ; Wang, Law, and Chen (2008); Mayo (2000); Bontis and Fitz-Enz (2002)
		Employee sustainability (ES) = the retention of employee	
	Structural Capital (SC)	Organization processes (OP) = renewal expenses/ operating expenses	Hobley and Kerrin (2004); Liu, Tseng, and Yen (2009); Lynn and Dallimore (2002)
		Information system (IS) = information technology expense ratio	
	Relational Capital (RC)	Customer relationship (CR) = the customers exchange with firm more than 10% of total sale	de Pablos (2003); Kotler and Caslione (2009); Rust and Zahorik (1993)
		Supplier relationship (SR) = percentage of total expense paid to main suppliers	
Pioneering innovation		Market share (MS)	Wang and Hsu (2010)
Control Variables		Firm size (FS) = the nature log of financial capital	Heimerks and Duysters (2007); Barge-Gil and Modrego, 2011
		Firm age (FA) = the numbers of year	Thornhill (2006) Brenner and Broekel (2011)

Analyses and results

Table 2 shows descriptive statistics and correlations for the variables of this study. As pioneering innovation is represented as a categorical variable in the logistic regression analysis, it is not included in the correlation matrix. Results of the logistic estimation model are summarized in Table 3. The model's Hosmer and Lemeshow test (chi-square=14.716; p=0.048) indicates a high level of significance (at the .005 probability level). This implies that the selected Logistic model overall provides a statistically significant explanation of a high-tech firm's innovation orientation. The Nagelkerke R-square value (R^2=0.378) is quite impressive, which is similar to the R-square measure in multiple regression analysis.

Table 2. Means, standard deviations, and correlations.

Variables	Mean	S.D.	1	2	3	4	5	6	7
1. EC	1.149	2.519	1						
2. ES	10.436	10.244	0.239***	1					
3. IS	0.316	0.114	0.389***	0.356***	1				
4. OP	0.418	0.072	0.012	0.592***	-0.072	1			
5.CR	0.376	0.214	-0.086	0.043	-0.012	0.004	1		
6.SR	0.184	0.418	0.312***	-0.123	0.239***	0.438***	-0.052	1	
7. FS	2.327	6.616	0.356***	-0.101	0.153**	-0.395***	0.004	0.112	1
8. FA	12.969	1.146	-0.120	-0.525***	-0.127	-0.336***	0.140**	0.036	0.226**

Notes: ** p<0.05, *** p<0.01.

Table 3. The output of the logistic regression for model

Dependent Variable: pioneering innovation Method: ML - Binary Logit Included observations: 167			
Variable	Coefficient	Wald-Statistic	P value
Intercept	4.246	3.922	0.048**
Human capital (H1)	2.045	1.588	0.011**
Structural capital (H2)	3.673	3.815	0.051**
Relational capital(H3)	1.394	0.634	0.426
Control Variable			
Firm size	2.639	11.854	0.001***
Firm age	3.681346	4.20599	0.002***
Omnibus tests		45.876	
-2 LOG likelihood		122.909	
Cox and Snell R^2		0. 240	
Nagelkerke R^2		0.378	
Hosmer and Lemeshow test (df=8)		6. 439	
% of correctly predicted		82.6%	
Obs. with Dep = 0	30	Total obs. 101	
Obs. with Dep = 1	71		

Note: ** p<0.05, ***p<0.01.

The predictive power of the model was used to estimate the pioneering innovative probability in out of sample. The out-of-sample group of 44 high-tech firms is divided into two subsets, with 14 high-tech firms being pioneering innovation firms and 30 high-tech firms being following innovation firms. After analysis, 89% of these high-tech firms are predicted correctly by the Logistic model in this study. Note that the rate is considerably better than the overall accuracy rates reported by Dietrich and Soresen (1984) and by Palepu (1986).

As we expected, human capital was found to be significant in predicting which high-tech firms are likely to be pioneering innovative firms. These results provide support for H1 (β_1=2.045; p=0.011). This indicates that investing in human capital is beneficial for pioneering innovation since with greater human capital there is higher value of innovation the high-tech firm is. This finding is congruent with previous studies (e.g., Fernandez et al. 2000), but not with Subramaniam and Youndt (2005). We also found that structural capital significantly predicts which high-tech firms are likely to use pioneering innovation. Thus H2 is also supported (β_2=3.673; p=0.05). This indicates that organizational knowledge is accumulated in and utilized through an organization's structure, system, and processes, which seems to help it reinforce its innovative capabilities and consequently enhance its pioneering innovative capability. Interestingly, however, relational capital was found to be insignificant in predicting whether a high-tech firm is likely to use a pioneering innovation. Thus, H3 is not supported (β_3=1.394; p=0.426). Because this findings is contrary to studies based on data from Western countries (Hsieh and Tsai 2007; Moran 2005), it requires special attention in future research on different cultures.

Discussion

Based on intellectual capital, this study predicts whether a high-tech firm is oriented to pioneering or following innovation. This paper contributes to the literature on high-tech firms' innovation orientation by increasing the empirical evidence available, filling a gap in terms of intellectual capital perspective and incorporating Logistic model analysis. For these reasons, this paper helps to achieve a better understanding of the driving forces behind pioneering innovation orientation.

Our findings provide support for the claim that human capital can positively affect the pioneering innovation orientation. Through this result is in contrast with previous studies (e.g., Bayo-Moriones & Lera-López 2007), which assume that the introduction of pioneering innovations can be resisted by older employees, particularly pioneering innovations that require them to change their current practices or acquire new skills. As a consequence, it has been claimed that existing inertia in work practices can provoke disagreement by the older employee with respect to pioneering innovation. However, recent studies have criticized this traditional assumption. For example, Maliranta and Rouvinen (2004) affirm that older and firmly established employees are not reluctant to accept pioneering innovation, presumably because they have more experience to face new challenges than do more recent employees, especially in a technology-intensive industry. This finding has an important practical implication: that employee duration is not an obstacle to pioneering innovation in high-tech firms. This should encourage high-tech firms with older employees to overcome their possible reluctance to pioneering innovations due to their length of employment.

Our findings also support the idea that pioneering innovation is more likely to occur among highly educated employees. This result is consistent with the literature regarding human capital (e.g., Morgan et al. 2006). High educational attainment should provide employees with necessary background knowledge about novel technology. In addition, higher education should

provide employees with the training to analyze and solve complex problems, which contribute to the employee's ability to develop pioneering innovation ideas. Thus, this finding has also important managerial implication that qualified human capital can increase a high-tech firm's readiness for pioneering innovation, because an employee with advanced education can facilitate the generation of innovation idea.

Our results also show that structural capital is a clear determinant for the prediction of pioneering innovation orientation. This finding advances support of a positive relationship between structural capital and pioneering innovation. On the one hand, organizational processes have a significant impact on high-tech firms' pioneering innovation. We conjecture that Taiwanese high-tech firms are mostly involved with original equipment manufacturing (OEM) or original design manufacturing (ODM), such as Taiwan Semiconductor Manufacturing Company (TSMC) and United Microelectronics Corporation (UMC). Their production innovation relies on improvements of the production process. Therefore, an organization would want to embed organization process in its routines, and this then can be transformed into pioneering innovation. Furthermore, the operation processes of the organizational capabilities propel high-tech firm's value creation activities that have a positive effect on their pioneering innovation (De Brentani & Kleinschmidt 2004; Marsh & Stock 2003).

On the other hand, the result is positive when we analyze the effects of structural capital considering the sub-constructs of information systems. This result shows the important role of information systems as high-tech firms seek to manage innovation strategic orientation, since these systems are integral to leverage intellectual capital into increasing the innovative value of a high-tech firm (Hobley & Kerrin 2004). This outcomes of this study offer high-tech firms managers some suggestions when an information system is codified in organization knowledge related to pioneering innovation and its meaning is generally agreed upon and understood. Then an information system can be easily interpreted and transferred to pioneering innovation.

Contrary to our expectations, relational capital is not a significant driver in pioneering innovation. This result is in contrast with the majority of the literature, which assumes that relational capital underscores the significance of interrelationships, partnerships, and collaborative networks to an organization's innovation (O Reilly & Tushman 2004; Subramaniam & Youndt, 2005). Three possible explanations are as follows. First, from the viewpoint of formal social networks, relational capital refers to the network of social interaction ties (Nahapiet & Ghoshet 1998). For example, (Kogut, 2000) refers to "the network as knowledge." In this sense, relational networks can also be said to be part of innovation. Because of the specific circumstances confronting pioneering innovation, it requires vast resources (Salomo et al. 2008). Nevertheless, not every contact of one party is valuable to the other party, with the value depending on the strength of the relationship, common goal, and mutual interest. Thus, if the relationship between partners has weak ties, incompatible goals, or conflicts of interest, it can easily leads to a failure of pioneering innovation.

Secondly, from the viewpoints of informal social networks, relational capital refers to guanxi, which is particularly important in Eastern countries, and which has attracted a great deal of research attention (Lin & Si 2010; Wei et al. 2010; Yen et al. 2011). Guanxi is a dyadic, sentimental tie with frequent interaction, high intimacy, and repeated resource exchange. Nevertheless, the pioneering innovation enterprise should perceive that his partner has become stale or too similar in its thinking, since long-term guanxi with partners may incur loss of objectivity. This similarity in thinking can result in more similar behavior of organization and thus a lower level of innovation.

Furthermore, rational choice theory (RCT) (McGovern 2003) supports the rationale for our findings. RCT is based on the belief that all behavior results from individuals pursuing their own interests. Thus opportunism may be the outcome of rational choices. From this perspective, social networks are seen as exchange relations wherein individuals seek to optimize their own interests, in other words, they will be able to serve their own interests much better than others'. This result in knowledge cannot be shared with partners; therefore, pioneering innovation may not be effectively developed.

Limitations

There are some important limitations in this work and the findings presented. First, the acquired dataset is small in statistical terms. Though we believe that the quality of the data acquired is suitable for this research, the small sample size is a weakness and this should be remembered when interpreting the results. Second, we employed the sample for a single nation, which may limit the potential generalization of the results. Although there are theoretical reasons to believe that high-tech firms in other countries may experience similar innovation activities, we consider that the findings are especially useful for Eastern countries such as the Asian four tigers, which have much different intellectual capital from that of western industrialized countries. Third, the nature of the cross-sectional data used in this study may hinder the unambiguous detection of causality relationships. As a result, the findings are confined to the confirmation or repudiation of associations between innovation orientation and other high-tech firm intellectual capital. Thus, a longitudinal research approach will be needed in future studies, which could lead to a more accurate assessment of the nature of relationships between innovation orientation and other intellectual capital variables of high-tech firms.

These limitations should be remembered in interpreting the results. It is recommended that future research in this field predicts relationships between intellectual capital and innovation orientation, and that the effect of different cultures be considered. Therefore, the findings of this research are presented as preliminary rather than conclusive. Determining a conclusive prediction for whether a high-tech firm is oriented to pioneering or following innovation remains a subject for future research.

Finally, "Predicting the innovation orientation of high-tech firms' does not imply that pioneering innovation high-tech firms should be valued more highly than following innovation high-tech firms. Instead, it is important to note that both pioneering and following innovation can play important roles in the high-tech industry. For example, the pioneering innovation firm arises when there are important scale economics in exploiting resources. The greater the gap between the time when a pioneering firm acquire the competitive advantage until other following innovation firms try to imitate it, the longer the pioneering innovation firms can consolidate his advantage in intellectual capital to enhance his innovative capability. But this should be seen against the following innovation firm's ability to free ride on novelty knowledge and market building efforts. The recent high-tech crash and the dominance of Microsoft, which is a follower in its most profitable businesses, provide at least anecdotal evidence that our results may extend to the future development of high-tech settings.

The relative importance of these different types of intellectual capital is likely to co-exist with the different levels of the innovation of high-tech firms. Thus, both pioneering and following innovation orientation could be important strategies contributing to the development of high-tech industries. It is relatively easy to conclude that a too strong and one-sided focus on pioneering/following innovation can be a disadvantage for the organization development. We believe that future work on this interdependence is an important avenue for future research.

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