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EXPLORING BUSINESS COMPETITIVENESS IN HIGH TECHNOLOGY SECTORS: AN EMPIRICAL ANALYSIS OF THE MEXICAN SOFTWARE INDUSTRY

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ABSTRACT

The objective of this study is to explore business competitiveness in a high technology sector through the analysis of the relationship among technological innovation, relational capital and market orientation, and their influence on companies' business performance of the Mexican Software Industry. This study is analyzed under a positivistic and deductive approach, using multivariate statistical analysis on the data gathered via an online survey from 198 software industry companies. The outcomes suggest that technological innovation and relational capital significantly influence business performance, while market orientation indirectly influences performance through its interaction with technological innovation.

Keywords: Market orientation; Technological innovation; Relational capital; Business performance; Software industry.

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1. INTRODUCTION

Companies today are immersed in highly dynamic markets, where the goal to satisfy customers is no longer sufficient for long-term success. The business environment is characterized by a persistent need for loyal and profitable customers, for

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rapid technological progress, continuous innovation, strategies to address increasing competitive rivalry, and membership of enterprise networks, among other concerns.

High technology companies, including those in the software industry, are thus driven to develop mechanisms to obtain strategies, generate and use information about customers, markets and competitors. This information is used to develop innovation strategies that allow firms to respond to their dynamic competitive surroundings. However, until recently, high technology companies, especially small firms, have rarely been study object in the fields of market orientation, technological innovation and relational capital. Consequently, a research opportunity arises to analyze the relationship among market orientation, technological innovation, relational capital, and business performance of small companies in the high technology sector. This paper takes the Mexican software industry as the object of study.

2. JUSTIFICATION AND OBJECTIVES

Empirical evidence shows that companies in high technology sectors exhibit internal characteristics that, together with a highly competitive environment, favor an excessive technological orientation, and sometimes the absence of a clear market orientation (García Manjón, 2008; Cahill & Warshawsy, 1994; Litter & Leverick, 1994). In fact, these companies are frequently born out of a technological discovery perceived to have great commercial potential but which, paradoxically, is allowed to develop independently of commercial analysis. In some instances, customers' opinions are considered to have little importance during the initial product development process, as interest is centered on technical aspects due to a belief that excessive attention on the customer would limit the scope to make important innovative improvements.

Companies in the high technology sector understand that one of the best ways to face the situations described above is through the development of external collaborations with companies that have abilities or resources to promote knowledge generation, innovation and growth (Renko & Tikkannen, 2002), in other words, through the development of relational capital and innovation capabilities. Based on the empirical gaps outlined above, the following research objective was identified:

- To propose a research model that encapsulates the relationship among market orientation, technological innovation, relational capital and business performance in a high technology sector.

In order to validate the research model proposed, the study was applied to the Mexican software industry, with a second research objective:

- To analyze which companies in software industry sector perform better in relation to their levels of technological innovation, market orientation and relational capital.

3. RESEARCH PROBLEM AND RESEARCH QUESTION

A great deal of empirical research exists related to the importance of market orientation (customer needs) to business performance (see (Rodríguez, Carrillat, &

Jaramillo, 2004)) and on the relevance of technological innovation and membership of enterprise networks (relational capital) (Pittaway, Roberson, Munir, Denyer, & Neely, 2004; CIC, 2002) across sectors, including high technology (Santos & Vázquez, 2000; Santos & Vázquez, 1997). However, empirical evidence that relates these concepts to the software industry is still an emergent opportunity area. Thus the need arises for empirical research into the relationship among market orientation, technological innovation, relational capital, and business performance in the software industry sector. This paper addresses the following research questions:

Does a relationship exist among market orientation, technological innovation and relational capital in high technology sector companies (software industry)? And, if this relationship exists, does it influence business performance?

4. LITERATURE REVIEW AND HYPOTHESES

4.1 Technological Innovation and Business Performance

Considering the Oslo Manual (2005) guidelines, technological innovation can be measured in terms of **capability, effort and results**, as follow:

a) Innovation capability

Innovation capability is defined as a set of abilities and knowledge necessary to effectively absorb, dominate and improve the existing technology and to create new innovation ((Peeters & van Potterslberghe de la Potterie, 2005; Romijn & Albaladejo, 2002a). For the OECD(2005) capabilities in technological innovation are useful for the classification of companies and industrial sectors in developing countries. The capabilities of an organization allow for a company to take advantage of market opportunities. The most significant innovation capability in a company is knowledge accumulation, which is embedded mainly in human resources, and in processes. It is important to recognize that innovation capabilities are not easily measured, due to the tacit nature of knowledge. As Peeters*et al*. (2005) states, empirical evidence that demonstrates a positive relationship between innovation capability and business performance is still scarce and demands more conceptual research.

b) Innovation effort

In order to properly measure innovation effort, it is important to know the intensity of innovation activities. This involves the collection of detailed information on innovative activities over a period of time and, where possible, the financial investments in these activities. This financial indicator serves as a discriminant factor concerning the strategy and behaviour of the company. In addition, it can be complemented with general information on the sector in which the company operates, which could be gathered from innovation surveys available from diverse sources (e.g.: national institutes of statistics) (OECD, 2005).

c) Innovation results

The category of innovation results captures the success level of innovation in the market and the impact of project results (project impact performance). Factors that can be considered include to: sales, profits and market share, derived from the introduction

of a specific innovation in the market and into the company (Atuahene-Gima, 1996), in other words, the percentage of the sales derived from the introduction of new products into the market and the company (CGCM, 2005).

Some studies suggest there is a close and positive relation between firm's R+D+i efforts and business performance (Jimenez-Jimenez et al. (2010). The impact of innovative projects at enterprises level used to be reported in terms of gains in cost efficiency, sales or market share. However, this impact can be dependently of the innovation process. For example, the analysis of public service organizations in UK done by Damanpour et al. (2009) (quoted in Jimenez-Jimenez et al. (2010)) conclude that the adoption of a specific type of innovation every year (service, technological process, and administrative) had no effect on the organizations' performance. Those results show that the relationship between innovation and performance is complex and requires more research; even though, the theory and most of the empirical studies suggest a positive relationship. Therefore, the following hypothesis is proposed:

Hypothesis 1. *Technological innovation is positively related to business performance*

4.2 Market Orientation and Business Performance

Market orientation has been identified in the last decade as a factor that helps to improve business performance. Market orientation has been discussed as an important organizational antecedent of business success (Kohli, Jaworski, & Kumar, 1993; Narver & Slater, 1990). The argument runs that market oriented organizations, that is, those companies that track and respond to customers' needs and preferences, are more able to satisfy these needs, and thus perform better (Rodríguez et al., 2004; Alvarez, Santos, & Vázquez, 2001).

It is important to notice, that market orientation is more than a set of marketing activities. Market orientation can be considered, on one hand, as the business strategy that prioritizes customer interests and needs over other concerns (Deshpandé, Farley, & Webster, 1993; Narver et al., 1990), and on the other, as a set of activities (Kohli & Jaworski, 1990) that considers: a) organizational generation of market intelligence b) dissemination of that intelligence among departments, and c) organization responsiveness to it.

For the purposes of this research, market orientation must be understood under the perspective of creating superior value for the customer needs. In this way, it was studied in terms of the three dimensions proposed by Kohli, Jaworski& Kumar (1993): intelligence generation, intelligence dissemination, and responsiveness.

- ***Intelligence generation.*** Market orientation is a corporate culture and differentiation strategy that privileges the delivery of superior value to customers (Slater & Narver, 1994). A business with superb market information collection and processing capabilities **can predict more precisely and make rapid changes** in the marketplace based on its knowledge of what superior value means to customers (Pelham, 1997). Failure to ascertain current and future customer needs will result in the development of products and services that do not satisfy customers (Kara, Spillan, & DeShields, 2005).

- ***Intelligence dissemination.*** In order for market orientation to operate effectively, information developed in the intelligence generation stage must be shared with other functional units of the business. Superior performance from market orientation can only occur where there is an appropriate interfunctional coordination. Information exchange is crucial to achieving this goal. Successful dissemination or sharing of information provides marketers with the opportunity to ask questions and amplify or modify interpretations to provide new insights. Accomplishing this task requires that businesses provide forums for information exchange and discussion. This may include information technology, task forces, face-to-face meetings, integrator roles, or liaison positions. Openness in communication across business functions assists in responding to customers' needs. Information dissemination is thus critical to the success of the market orientation process (Kara et al., 2005).
- ***Responsiveness.*** Superior performance can only be achieved by **responding continuously to the customer's changing needs**. Thus, once the marketers have gathered the market intelligence and processed it by sharing it with the appropriate interfunctional groups, they must then develop appropriate action plans (Kara et al., 2005). Day (1994a) argues that a market orientation culture creates the need to gather the market intelligence and functionally coordinate actions to gain a competitive advantage. Kohli and Jaworski(1990) and Narver and Slater (1990) emphasize that the scale to which a business implements its market orientation strategy depends on its desired level of organization-wide concern and responsiveness to customer needs and competitive action.

In the last two decades hundreds of empirical studies have been conducted into the relationship between market orientation and business performance. However, empirical results of market orientation research are both complex and mixed (Gonzalez-Benito & González-Benito, 2005; Kara et al., 2005). For instance, in the meta-analysis conducted by Rodríguez et al. (2004) findings suggest that the relationship between market orientation and business performance is positive and consistent worldwide. One of the main contributions of that research is a sample that includes studies conducted in 23 countries spanning five continents; it is important to mention that stronger correlations between market orientation and business performance were found for not-for-profit compared to profit firms and service compared to manufacturing firms.

Supporting the previous mentioned facts, at literature review done by González-Benito (2005), it was found that nearly 88% of the studies analyzed (131 total) show a positive relationship between measures of market orientation and measures of performance, but no generalized consensus has yet emerged. On the one hand, the complexity involved in making both concepts operational presents an obstacle, and on the other, a debate exists regarding whether market orientation should be analyzed as a set of behaviors, or as part of the organizational culture (Clark, 2002), including the company size and the classification of the country as developed or developing (Mahmoud, 2011).

To summarize this section, while there is no reason to believe that the strength of the relationship between business performance and market orientation varies depending on industry characteristics, customer characteristics, or on the type of performance measurement used, the literature generally supports the proposition that market-driven and innovative firms will outperform their competitors (Kara et al., 2005; Slater et al., 1994; Day, 1994b; Jaworski & Kohli, 1993; Narver et al., 1990). Therefore, it is expected that:

Hypothesis 2. *Market orientation is positively related to business performance.*

4.3 Relational Capital and Business Performance

The study of business networks conducted by Almaya and Ebers(1998) emphasizes that, although a great number of studies related to inter-organizational relationships, enterprise Inter-organizations and networks have taken place, this number of studies does not seem to be accumulating knowledge, and it does not lead to a conceptual consolidation; on the contrary, it seems that the increasing in number of studies has contributed more to a situation of "disorder", this probably derived from the heterogeneity of concepts, theories and research results, producing a "jungle of concepts and terminology where each new participant can plant a tree". Considering the previous facts, our analysis of relationships among the concepts of relational capital, technological innovation and business performance draws on those research works that better suit the objectives of this research.

Our theoretical conceptualization of relational capital is based mainly on Intellectus Model, designed to measure and manage the intangible values of knowledge (intellectual capital) (CIC, 2003). In this way, relational capital considers only the relationship between the company and its providers and competitors (we do not include customer relationship as part of relational capital).The research in the case of consulting industry (service industry),the empirical research of Huang &Hsueh(2007) about the cause-effect relationship and path coefficients found that among the 3 paths to business performance –structural capital, human capital and relational capital- only the path of relational capital to business has a direct and significant influence on business performance. By the other side, Smirnova et al. (2011) shows that in industrial markets competitor orientation directly and positively impacts on performance.

The previous facts lead to the following hypothesis:

Hypothesis 3. *Relational capital is positively related to business performance*

4.4 Interactions Among Technological Innovation, Market Orientation, and Relational Capital

- *Market orientation and relational capital*

By 1990s and 2000s, companies that had a strong market orientation, the development of new products could be expected to be one of the most important activities. One of the first researchers to emphasize the importance of the role of the customer or user in an innovation process was Eric von Hippel ((1978 quoted (Pittaway, Robertson, Munir, Denyer, & Neely, 2004)). Hippel suggests that customers should play an active role in the innovation process. According to Leskievicz&Sandivik(2003) product innovations are among the most powerful tools used by marketing managers.

They have the capacity to significantly influence demand for a firm's products, the same research provides empirical evidence of the contribution of market orientation to success of using product innovations. Other studies emphasize that the link between technical activities and marketing in the initial stages of an innovation process allows the development of products/services oriented towards customer needs (Pittaway et al., 2004).

Empirical studies tend to support the idea that the adoption of a market oriented philosophy influences positively the effectiveness and results of a company's innovation activities (Morgan & Bolinao, 2008; Peeters et al., 2005; Walker, 2004; Peeters & van Potterslberghe de la Potterie, 2003b; Helfert, Ritter, & Walter, 2002; Atuahene-Gima, 1996; Deshpandé et al., 1993). It is important to mention that, recently, research performed by Maatoofi&Tajeddini(2011) found that managers' support for innovation is greater in entrepreneurship oriented firms than market oriented ones. Therefore:

Hypothesis 4.*Market orientation is positively related to technological innovation*

- *Market orientation and relational capital*

In the literature, there are two definitions that state a relationship between marketing and relational capital 1) Kotler's ((1972), as quoted in (Hernández & Rodríguez, 2001)): "Marketing studies the way in which the interchange relationships are created, stimulated, facilitated, valued and governed. The essence of marketing is in the relationship of interchange, defined as the link of resources, people and activities oriented towards the creation and interchange of value for the market". 2) Webster's ((1992) quote in (Hernández et al., 2001)) states that, among other factors, marketing addresses the need to: "managing strategic associations and positioning the company among sellers and buyers in the value chain, with the objective of providing a superior value to the buyers". In a recent study, the research of Sirnova et al. (2011) shows that marketing orientation aimed at developing a competitor orientation has direct positive outcomes for a firm. Therefore, considering the previous findings, the following hypothesis is proposed:

Hypothesis 5.*Market orientation is positively related to relational capital*

- *Relational capital and technological innovation*

Nowadays, innovation is understood not just as a technical issue but as a relational process that involves a variety of stakeholders, including: technological suppliers, customers, and technological centres (Arboníes, 2006). One of the aspects that emphasizes the innovating nature of a company is the outsourcing activities (Kulmala & Uusi-Rauva, 2005). Interaction and cooperation with industrial customers, suppliers, associations, public agencies and other agents external to the company can provide access to resources that would otherwise be difficult to access. Of these, interactions with customers and suppliers are the most significant (Muscio, 2006; Shameen & Zahra, 2006; Romijn et al., 2002a).

Empirical studies have found that innovation is influenced by many actors, both inside or outside of the organization. According to Pittaway *et al* (2004) the most important actors for the commercial sector are: customers in the first place (33.5%), suppliers in the second place (21.9%), and cooperation with universities (8.9%). Another empirical evidence (Romijn & Albu, 2002b) suggests that, although this last

percentage is relatively low, the companies that have more relationships with universities and research centers are those that make a greater number of radical innovations, while those that have more relationships with suppliers make a greater number of incremental innovations. Concerning customers, their contribution is focused on product development that better addresses new market needs.

Collaborative research networks are especially important in high technology sectors, as these are industries where a single organization is unlikely to have all the resources and capabilities necessary to develop and implement a significant innovation. This reality has encouraged the creation of technological clusters (Schilling, 2005). Collaboration that arises from these networks can occur through joint associations, licenses, investigation societies, networks of added value, scientific interchange, research programs supported by the government and even through informal networks (Schilling, 2005; Pittaway et al., 2004). The research of Erlendsson (2005) (quoted in (Bolinao, 2009)) revealed that innovative companies are most likely to use alliances and partnerships as a means of adapting to market shifts. All these findings lead to the following hypothesis:

Hypothesis 6. *Relational capital is positively related to technological innovation*

4.5 Technological Turbulence (Environmental Moderator)

Kohli and Jaworski(1993)consider three factors that can exert moderating effects between market orientation and business performance: market turbulence, competitive intensity and technological turbulence. In this research only technological turbulence was considered.

Some authors (Jaworski et al., 1993) (for more detailed information see (Deshpandé, 1999)) propose that organizations that work with emergent technologies can gain competitive advantage through technological innovation, diminishing, but not eliminating, the importance of market orientation. In contrast, organizations that work with stable, mature technologies are weakly positioned to leverage technology for competitive advantage, and so have to trust in market orientation to a greater degree (Deshpandé, 1999). According to Song and Parry (2009) the desired level of market orientation is potentially lower for firms that have the opportunity to establish a competitive advantage through technological innovation. As a result, when technological turbulence is high, the relative importance of certain kinds of market intelligence (e.g., consumer perceptions and preferences) will be lower than when technological turbulence is low.

Following Song and Parry (2009), they have analyzed that existing studies of market orientation have hypothesized that the strength of the market orientation & performance relationship depends on environmental variables such as market turbulence, technological turbulence, and competitive intensity, and they found that empirical studies have failed to confirm these hypotheses. However, they argue that environmental uncertainty influences the desired level of market orientation, and the gap between the desired and achieved levels of market orientation influence business unit performance; their data analysis confirms that the desired level of market orientation is a function of market turbulence, competitive intensity, technological turbulence, and innovation strategy. These considerations suggest the following hypothesis:

Hypothesis 5.*Technological turbulence has a moderator effect on the relationship between market orientation and business performance*

The conceptual model examined in the study is presented in Fig. 1.

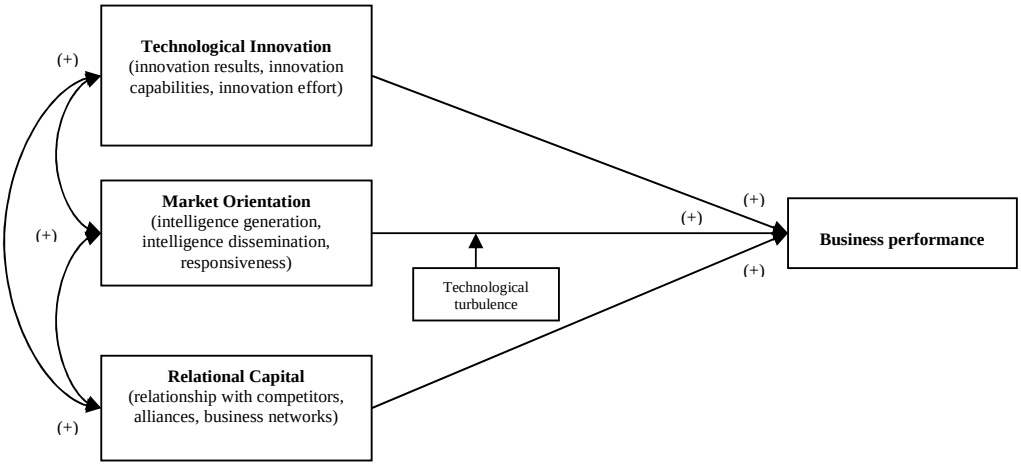

Fig. 1. Research general model

5. RESEARCH METHOD

5.1 Sample, Data Collection Procedure and Questionnaire Design

The object of study for this empirical research was the Mexican software industry. This industry is small, with about USD$500 million yearly accruing from the provision of software-development services to the international community (Miller, 2007). In the case of Mexican software companies the average percentage of profit margins before taxes in 2005 was from 6 to 10% (González-Bañales, 2006). The target group was selected using two criteria: first, firms should be software developers; and second, they should be located in Mexico. Non-probabilistic sampling techniques were applied (convenience and 'snow ball').

The estimated population was 2,199 software companies; the calculated sample size was 97. The final number of usable questionnaires was 198; the response rate was 9.3% over the total population. It is important to mention that, due to the fast rate of change in the software industry, it is hard to define a world-wide or even national total population of software companies (Kulmala et al., 2005). The respondents in this study were mainly owners and managers of small and medium size businesses. Data collection was conducted through an online survey, designed and managed using the open source tool PHPSurveyor (nowadays the name of the application is LimeSurvey). The questionnaire design and measurement were conducted in year 2006-2007 based on the following scales: marketing orientation scale items were adopted from Kohli, Jaworski& Kumar (1993) –MARKOR- technological innovation scale items were based on the recommendations of Oslo Manual (OECD, 2005) and on items suggested by Peeters(Peeters & van Potterslberghe de la Potterie, 2003a; Peeters et al., 2003b); relational capital scale items were based on the Intellectus Model (CIC, 2002).

6. ANALYSES AND RESULTS

Hypotheses were tested with path analysis using a series of regressions for the total sample. From 137 questions asked in the original questionnaire, 20 final variables were obtained through factor analysis, principal components method and the Varimax rotation method (see Appendix A). The final variables description is presented in Table 1.

Table 1. Factor analysis summary

Variables				Factor Analysis		Descriptive Statistics			
		Name	Description	of Var.		in.	ax.	ean	td. Dev.
Dependent Variable									
Business performance		1	Economic outcome (profits and sales growth)	3.30	.636	2.210	.427	.000	.000
Independent Variable									
Technological Innovation (IT)	Innovation results	T1	Perceived benefit of innovation impact on the global organization performance (profitability, market share, productivity, quality service...)	0.70	.781	3.366	.417	.000	.000
		T2	Number of new or significantly improved products in the last 2 years				8	.520	.326
	Innovation effort	T3	Measurement of innovation effort (qualitative and/or quantitatively)	1.20	.967	0.817	.931	.000	.000
		T4	Percentage of total sales assigned to innovation activities				00	9.192	2.089
	Innovation capability	T5	Generation of competitive intelligence (innovation projects)	8.26	.771	2.254	.147	.000	.000
		T6	Organizational support for developing innovation culture	7.90	.799	3.584	.202	.000	.000
		T7	Personnel assigned to research and development activities (R&D)					.960	.349

		T8	Postgraduate personnel (masters degree and Ph.D.)				00	5.479	5.187
Market orientation (MO)	Intelligence generation	O1	Intelligence generation	0.79	.663	2.389	.067	.000	.000
	Intelligence dissemination	O2	Intelligence dissemination	5.96	.673	2.517	.550	.000	.000
	Responsi-veness	O3	Responsiveness	2.99	.621	2.446	.438	.000	.000
	MO		Market orientation factorial: grouping MO1, MO2 and MO3	0.72	.793	2.739	.007	.000	.000
Relational Capital (CR)	Relationship with competitors	R1	Benchmarking activities	4.63	.844	0.346	.649	.000	.000
		R2	Relationship with competitors: agreements and collaboration projects	9.41	.636	0.193	1.275	.000	.000
	Alliances	R3	Number of alliances with competitors				0	.939	.362
		R4	Average age of the alliances in years				2	.556	.107
		R5	Alliances: perceived benefit	8.01	.648	0.721	.767	.000	.000
	Enterprise networks	R6	Enterprise networks: perceived benefit	0.21	.918	2.813	.560	.000	.000
		R7	The company is engaged with an industrial cluster				No) Yes)	.202	.403
		R8	The company belongs to an "integrating company" [a]				No) Yes)	.202	.403
Moderator									
Technological Turbulence		T1	Technological Turbulence	7.18	.618	3.077	.809	.000	.000

[a] An "integrating company" is a company of services. It is constituted to give services to its partners called integrated partners. The minimum to conform an integrating company is the alliance of 4 companies. The maximum is limitless. The members will contribute to the capital of the integrating company. Those companies

must be micro, medium or small sized. Mexico takes the concept of "integrating companies" from the Italian model; there are called industrial districts and partnerships-consortiums.

The outcome of path analysis is shown in Table 2. The variables not displayed (CR1, CR2, CR3, CR4, CR7, TT, IT4, IT7) were removed from the table as they were found to be invalid in relation to the regression model.

Table 2.Summary of path analysis (standardized coefficients β)

Independent variables														**Dependent variable**	**Adjusted** *R-squared*
Market orientation	**Relational Capital**					**Technological innovation**							**Tech Turb**		
	Comp. Relship	*Alliances*			*Business networks*	*Innovation results*		*Innovation effort*		*Innovation capability*					
MO	**CR1**	**CR3**	**CR4**	**CR5**	**CR6**	**IT1**	**IT2**	**IT3**	**IT4**	**IT5**	**IT6**	**IT7**	**TT1**		
n.s.	-0.141*	n.s.	n.s.	n.s.	.173*	.199**	.198**	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	**R1**	0.142
	n.s.	n.s.	n.s.	n.s.	.126*	.183**	n.s.	.158**	n.s.	.299***	.427***	n.s.	n.s.	**MO**	0.612
n.s.	n.s.	n.s.	.170*		.283***	n.s.	279***	n.s.	n.s.	n.s.	n.s.	-.172*	n.s.	**CR5**	0.208
.298***	n.s.	.141*	n.s.	.155**		n.s.	n.s.	.149*	-.133*	248***	n.s.	n.s.	n.s.	**CR6**	0.410
.459***	n.s.	n.s.	n.s.	n.s.	n.s.		n.s.	n.s.	n.s.	.149*	n.s.	n.s.	n.s.	**IT1**	0.294
.196**	n.s.	n.s.	n.s.	278***	n.s.	n.s.		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	**IT2**	0.125
.287***	n.s.	n.s.	n.s.	n.s.	.197**	n.s.	n.s.		n.s.	.183*	n.s.	n.s.	n.s.	**IT3**	0.291
.257***	n.s.	n.s.	n.s.	n.s.	.352***	n.s.	n.s.	n.s.	.169**		n.s.	n.s.	.130*	**IT5**	0.368
.551***	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.		n.s.	n.s.	**IT6**	0.300

*p < .05; ** p < .01; ***p<.001; n.s. p> .10

The statistical results derived from Table 2 are consolidated in the simplified path analysis model presented in Fig. 2. This graphical model reveals interesting findings in terms of relationships among variables, because there are strongly, partially and weakly significant relationships.

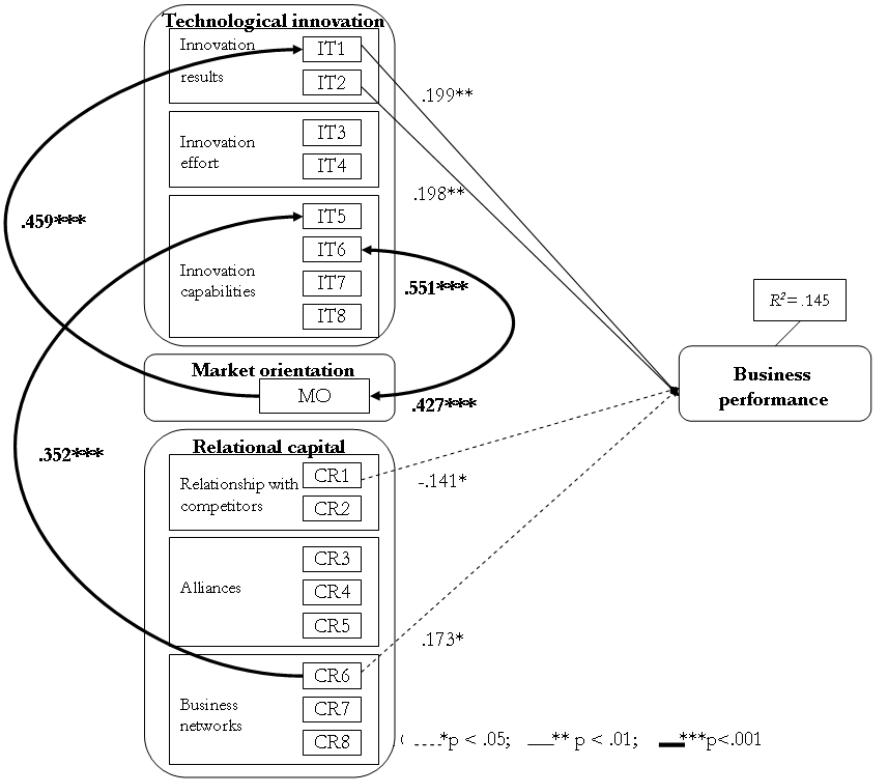

Fig 2. Simplified path analysis model

Note: Simplified model is showing only the relationships that present practical significance in the path analysis

β>.30 small; β>.30 medium; β>.50 high. (Kotrlik & Williams, 2003)

All the coefficient regressions and R^2 between variables can be consulted on Table 2

- *Technological innovation is positively related to business performance* **(H_1 supported). Results suggest that there is a significant positive relationship** ($p <$ .01) **between technological innovation and business performance** (IT1 Perceived benefit of innovation impact on the global organization performance (profitability, market share, productivity, quality service...); and IT2 Number of new or significantly improved products.

- *Market orientation only has indirect relationship with business performance***(H_2 partially supported)**. The indirect relationship is through technological innovation (Innovation Results [IT1 Perceived benefit of innovation impact on the global organization performance (profitability, market share, productivity, quality service...)] and innovation capability [IT6 Organizational support for developing innovation culture]).

- *Relational capital is partially related to business performance***(H_3 partially supported)**, as both positive and negative relationships were found. From one side, there is statistically significant *positive* relationship (p< .05) with low practical significance (β< .20) between business networks (CR6 Enterprise networks: perceived

benefit) and business performance; b) there is statistically significant *negative* relationship ($p< .05$) with low practical significance ($\beta<.20$) between relationship with competitors (CR1 Benchmarking activities) and business performance.

- *Market orientation is positively related to technological innovation* **(H_4 supported).** Results suggest that there is a significant positive relationship between market orientation and technological innovation. A practical significance is observed in a bi-directional relationship between **market orientation and innovation capability** (IT6 Organizational support for developing innovation culture), first: IT6 $\rightarrow$ MO β = .427, $p< .001$); second MO $\rightarrow$ IT6 (β = .551, $p< .001$). Other relationships are between market orientation and **innovation results** (IT1 Perceived benefit of innovation impact on the global organization performance (profitability, market share, productivity, quality service...)) with a high statistical and practical significance [β = .459, $p< .001$]; IT2 number of new or significantly improved products in the last 2 years) [$p<.01$]); **innovation effort** (IT3 Measurement of innovation effort (qualitative and/or quantitatively) [$p<.01$]); **innovation capability** (IT5 Generation of competitive intelligence (innovation projects) [$p<.001$]; Business networks (CR6 Perceived benefit [$p<.05$]).

- *Market orientation is positively related to relational capital* **(H_5 supported).** Results suggest there is a significant positive relationship ($p< .05$) between market orientation and relational capital (business networks [CR6 Enterprise networks: perceived benefit]). A bidirectional relationship is observed.

- *Technological innovation is in some way positively related to relational capital***(H_6 partially supported).** There are both positive and negative relationships. For one side, there are significant positive relationships between: a) Alliances (CR5 perceived benefit) and innovation results (IT2 Number of new or significantly improved products in the last 2 years) ($p<. 001$); b) Business networks (CR6 Enterprise networks: perceived benefit) and innovation effort (Measurement of innovation effort (qualitative and/or quantitatively)) ($p < .05$), c) Business networks (CR6 Enterprise networks: perceived benefit) and innovation capability (IT5 Generation of competitive intelligence (innovation projects)). But, for another side there are significant negative relationships between: a) Alliances (CR5 perceived benefit) and innovation capability (IT8 Postgraduate personnel (masters degree and Ph.D.) ($p< .05$); b) Business networks (CR6 Enterprise networks: perceived benefit) and innovation effort (IT4 Percentage of total sales assigned to innovation activities) ($p < .05$).

- *Technological turbulence does not have a moderator effect between market orientation and business performance (***(H_7 not supported).** Results suggest that technological turbulence does not exert a moderator effect between market orientation and business performance. Through path analysis a statistically significant positive relationship ($p< .05$) was found between innovation capability and technological turbulence (IT5 Generation of competitive intelligence (innovation projects)). The practical significance is low (β = .130).

7. CONCLUSIONS

After exploring business competitiveness in a high technology sector through our proposed research model, total as well as partial support for our research hypotheses were found. The relationship between technological innovation and business

performance (H_2), market orientation and technological innovation (H_4), market orientation and relational capital (H_5) is totally supported. Three hypotheses were partially supported as both positive and negative relationships were found: relationship between market orientation and business performance (H_2), relational capital and business performance (H_3), technological innovation and relational capital (H_5). Finally, the analysis indicates that there is not a moderating effect of technological turbulence between market orientation and business performance (H_7).

One of the most remarkable findings regarding the unsupported hypotheses is the absence of a statistically direct relationship between market orientation and business performance. As stated above, many empirical studies have demonstrated the existence of a positive relationship between market orientation and business performance, across a great variety of sectors and countries (see (Gonzalez-Benito et al., 2005; Rodríguez et al., 2004). In contrast, this study has found that market orientation does not have a statistically significant, direct relationship with business performance, when it interacts in the same analysis with technological innovation and relational capital constructs. However, indirectly, it has an influence through technological innovation.

Although market orientation, innovation and collaboration with stakeholders (customers, suppliers, competitors, government…) are fundamental factors in achieving success in high technology sectors, one characteristic of these sectors is that technological orientation usually exceeds market orientation. Some empirical research has even found that innovation seems to be isolated from market orientation, and sometimes collaboration with business networks can be more of an obstacle than a catalytic factor, specially for small-sized companies (Mohr, Sanjit, & Slater, 2005; Viardot, 2004; Im & Workman, 2004; Renko et al., 2002; Romijn et al., 2002b; Crick & Jones, 2000; Deshpandé, Farley, & Webster, 2000). The findings obtained in this research challenge this conclusion, since, in the case of technological innovation and market orientation, a statistical and practical relationship with high significance was found. Also, it is important to note that findings suggest the existence of a positive and significant relationship between technological innovation and market orientation.

In summary, the analysis suggests that the constructs that present statistically significant influence on business performance on a high technology sector are (specifically to Mexican software industry): technological innovation and relational capital, and indirectly, market orientation through its interaction with technological innovation. In other words, these results suggest that organizations that work with new technologies and experience fast environment changes improve business performance through technological innovation and relational capital, and by assigning indirect importance to market orientation through technological innovation.

8. LIMITATIONS AND FURTHER DIRECTIONS

One of the primary objectives of this research was to understand which high technology companies perform better based on market orientation, technological innovation and relational capital, in the context of the Mexican software industry. Although an extensive number of publications address these subjects, empirical research

that focuses on these three concepts within the context of high technology sector is still scarce. This is one reason why this study is considered partly exploratory.

The exploratory nature of the study for the Mexican case demanded the adaptation of scales used in previous studies, whilst we are aware that not all studies were developed with companies in developing countries in mind. Another particularity of this study is the measurement used for the research variables. For instance, innovation capability measurement had stronger orientation towards new services, due to the focus on the Mexican software industry.

Since the findings suggest that market orientation does not have the expected significant direct influence on business performance, an important extension of the data analysis for this research would be to find indirect relationships among the different components of the model. An option for finding those indirect relationships is structural equation modelling (Partial Least Square –PLS- or Covariance-Base Models –CBSEM-), this technique allows the simultaneous addressing of the issues of construct measurement, and the structural relationships between constructs (Loehlin, 2004; Im & Varun, 2003; Chin, 1998).

Finally, the context of the study (Mexico) constrains the scope to which the results can be generalized to other firms and other national contexts. However, the focus on a Latin American country does increase the understanding of the role of technological innovation, market orientation and relational capital in business performance in the context of developing countries and helps demonstrate the universality and global importance of these concepts. Future research that replicates this study in other national contexts would be a welcome addition towards the understanding of the relationship of technological innovation, market orientation, relational capital and business performance.

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Appendix A. Factor list

Factor list	**Factor loadings**
Factor R1 (Business performance)	
The average percentage of PROFITS before taxes	0.8561
The average percentage TOTAL SALES GROWTH	0.8561
Cronbach's alpha = 0.636; Total variance explained = 73.30	
Factor IT1 (Innovation results: Perceived benefit of the impact of innovation on global organization performance)	
Which has been the impact of the introduction of innovations in your company (products/services) in the following aspects?	
Productivity	0.8191
Profitability	0.7982
Quality service	0.7495
Market participation	0.7471
Cronbach's alpha = 0.781; Total variance explained = 60.70	
Factor IT3 (Innovation effort: Measurement of innovation effort)	
In what degree does your company use the following concepts to measure the innovation impact?	
Using qualitative measures	0.9707
The obtained profits (derived from the innovation)	0.9545
Using quantitative measures	0.9481
The cost of the innovation	0.9466
Cronbach's alpha = 0.967; Total variance explained = 91.20	
Factor IT5 (Innovation capability: generation of competitive intelligence)	
It indicates the option that you consider better represents the innovation capability of your company, having in consideration the frequency with which the activity happens.	
The company has an IT-based Intranet system to use the knowledge generated by the organization	0.7844
In the company, formal procedures are applied to evaluate the innovation projects risk degree (E.g.: metrics, statistical control, specific methodologies…)	0.7014
The company regularly relies on market surveys and benchmarking practices	0.6797
The company has a specialized training program for the employees	0.6093
The process of personnel recruitment assures to recruit personnel who will bring with them new abilities and ideas for the company	0.6056
The company is organized around projects and multidisciplinary teams	0.5314
Cronbach's alpha = 0.771; Total variance explained = 28.26	
Factor IT6 (Innovation capability: development of innovation culture)	
It indicates the option that you consider better represents the innovation capability of your company, having in consideration the frequency with which the activity happens.	
The strategic goals for innovation are communicated to every employee	0.7877
The company favours brain storming sessions and/or face-to-face contacts to promote innovation projects and creative thinking	0.7617
The company promotes team-works to generate new ideas	0.7541
The personnel is explicitly rewarded for improving knowledge or innovation	0.6926
Cronbach's alpha = 0.799; Total variance explained = 27.90	
Factor MO1 (Market Orientation: Intelligence generation)	
In this company, market research is done to evaluate the perceptions of our customers with regard to products/services that we offer to them	0.7924
In this company, we meet with customers at least once a year to find out what products or services they will need in the future	0.7549
We periodically review the likely effect of changes in our business environment (e.g. regulation) on customers	0.7052
We are slow to detect changes in our customers' product preferences (Reversed score)	0.5802
Cronbach's alpha = 0.663; Total variance explained = 50.794	
Factor MO2 (Market Orientation: Intelligence dissemination)	
We have interdepartmental meetings (or with the key personal of the company) at least once	0.7672

every three months to discuss market trends and developments	
When something important happens to a major customer or market, the whole business unit knows about it in a short period of time	0.7669
Data on customer satisfaction are disseminated at all levels in the company on a regular basis	0.7454
Marketing personnel in our company spend time discussing customers' future needs with other company departments	0.6923
When a member of the company or department finds out something important about competitors, the time in alerting other members or departments is slow (Reversed score)	0.2940
Cronbach's alpha = 0.673 ;Total variance explained = 45.96	
Factor MO3 (Market Orientation: Responsiveness)	
We are fast to decide how to respond to our competitors' price changes	0.8540
At least monthly, we analyze the changes in our customer's product or service needs	0.8540
Cronbach's alpha = 0.621; Total variance explained = 72.99	
Factor MO (Market Orientation: MO1, MO2 & MO3)	
OM2 Intelligence dissemination	0.8605
OM1 Intelligence generation	0.8517
OM3 Responsiveness	0.8098
Cronbach's alpha = 0.793; Total variance explained = 70.72	
Factor CR1 (Relational capital: benchmarking activities -competitors relationship-)	
In one year, how many man-hours does your company devote to make benchmarking activities?	0.9729
In one year, how many man-hours does your company spend doing general analysis of its competitors?	0.9727
Cronbach's alpha = 0.844; Total variance explained = 94.63	
Factor CR2 (Relational capital: agreements and collaboration projects -competitors relationship-)	
Number of collaboration agreements with competitors:	0.9456
Number of joint projects with competitors	0.9455
Cronbach's alpha = 0.636; Total variance explained = 89.41	
Factor CR5 (Relational capital: Alliances perceived benefit -Alliances-)	
Opening of new markets	0.8052
Quality improvement (products and services)	0.7501
Increase in the amount of new products/services (innovation)	0.7431
Sales increasing	0.7043
Reduction of launching costs (new products)	0.6702
Reduction of launching time (new products)	0.5850
Acquisition of new technologies	0.5568
Cronbach's alpha = 0.648; Total variance explained = 48.01	
Factor CR6 (Enterprise networks: perceived benefit)	
Value the collaboration degree that your company maintains with:	0.7820
Suppliers	0.7232
Customers	0.7052
Competitors	0.6137
Universities	
Cronbach's alpha = 0.918; Total variance explained = 50.21	
Factor TT1 (Technological Turbulence)	
Our new customers usually have different needs from those from our existing ones	0.7523
In my sector, the preferences/needs of the customers change substantially at least every two years	0.7516
The information technology products/services and information systems that require our main segment of market is changing rapidly	0.6238
The activity of research and development in my company has been increasing substantially in the last two years	0.6058
Cronbach's alpha = 0.618; Total variance explained = 47.175	