Influence of transformational leadership on organizational innovation and performance depending on the level of organizational learning in the pharmaceutical sector

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Abstract

Purpose – This empirical study aims to examine the influence of transformational leadership (TL) on organizational innovation (OI) and performance (OP) depending on the level of organizational learning in technological firms.

Design/methodology/approach – The research examined a sample of 164 pharmaceutical firms. A global model is formulated and the hypotheses are tested using structural equations.

Findings – First, the study shows a positive relation between TL and OI, between TL and OP and between OI and OP. Second, the study verifies that these relationships are more strongly reinforced in organizations with high-organizational learning than in organizations with low levels of organizational learning. Third, the study supports the theoretical arguments made but not demonstrated empirically in the prior literature.

Practical implications – Organizational learning takes places in a technological community of interaction in which knowledge is created and expands in a constant dynamic between the tacit and the explicit with cognitive and behavioral change. Organizations with greater organizational learning generate a network of learning that will make it easier for them to learn what they need to know and to innovate, enabling the organization to maintain its competitive position as a technological center. This shows that organizational learning improves relations substantially between TL, OI and OP.

Originality/value – This study serves as a reference for fostering organizational learning in technological firms. Organizational learning improves relations among TL, OI and OP. Previous studies, although contributing to the understanding of the direct and indirect relations among leadership, innovation and performance, have not addressed the different effects depending on the level of organizational learning in these technological firms.

Keywords Transformational leadership, Organizational innovation, Organizational performance, Pharmaceuticals industry, Innovation

Paper type Research paper

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Introduction
The concept of innovation is always current. All technological groups and organizations are interested in knowing what influences the results they achieve, how and why they succeed or fail. Belief that their results are related to organizational innovation (OI) has continued to inspire questions and research on the subject by professionals and academics. Although innovation is widely recognized as essential for the survival and growth of organizations (Hurley and Hult, 1998), different definitions of innovation have been proposed. Here, we use the definition of innovation formulated by the Product Development and Management Association (PDMA, 2004): a new idea, method, or device. The act of creating a new product or process. The act includes invention as well as the work required to bring an idea or concept into final form.

Although firm innovation is widely prescribed as a means of improving organizational performance (OP), many firms do not or cannot develop it properly. Researchers have urged attention to what enables firms to innovate, the search for answers “beyond semiautomatic stimulus-response processes” (Zollo and Winter, 2002, p. 341). Leadership style has been emphasized as one of the most important influences on firm innovation, because leaders can decide directly to introduce new ideas into a technological organization, set specific goals, and encourage innovation initiatives from subordinates (Kanter, 1983; Senge et al., 1994).

Transformational leadership (TL), which has been contrasted with “traditional” or “transactional” leadership, stimulates OI and generates greater advantages for OP. TL can be defined as the style of leadership that heightens consciousness by the organization’s members of a collective interest and helps them to achieve it. In contrast, transactional leadership focuses on promoting the individual interests of the leaders and their followers and attaining the satisfaction of contractual obligations on the part of both by establishing objectives and monitoring and controlling the results (Bass and Avolio, 2000). Leaders should thus commit themselves to TL, undertaking self-evaluation of their way of acting (Bass, 1999). Managers’ perceptions of the organizational style of leadership strongly influence the capability of promoting this kind of leadership.

Theories of TL emphasize emotions, values, and the importance of leadership oriented to encouraging creativity in employees. Employees should be considered the firm’s most valuable resource, a resource for which the firm must take responsibility and whose professional development it must promote. Such leadership creates emotional links with its followers and acts to inspire higher values. It is leadership that transmits the importance of having a shared mission and infusing a sense of purpose, direction and meaning into the followers’ labor (Bass, 1999). TL becomes the motor and transmitter of innovative culture and of the dissemination of technological knowledge oriented to seeking the best possible OP. The example of TL committed to the organization’s goals, which stimulates their internalization in its followers, will encourage commitment to results on the part of the organization’s members (Bass, 1999; Bass and Avolio, 2000; Atwater and Spangler, 2004).

Although evidence shows that this kind of transformational leader exercises a substantial influence on innovation, understanding of the processes through which the leader exerts this influence on innovation is still limited and largely speculative (Bass, 1999; Conger, 1999). Further, few studies have been designed to trace systematically the causal path of the effects of TL on performance by examining the intermediate influence of OI (Bass, 1999; Conger, 1999) or the effects of organizational learning (Argyris and Schön, 1996; Senge et al., 1994).
Transformational leaders have charisma, inspiration and intellectual stimulation (Bass, 1999; Conger, 1999; Bass and Avolio, 2000). Charisma generates the pride, faith and respect that leaders encourage their workers to have in themselves, their leaders and their technological organizations. Inspiration is the ability to motivate followers, largely through communication of high-technological expectations. Intellectual stimulation refers to behavior by the leader that promotes employees’ intelligence, knowledge and learning so that they can be innovative in their problem-solving and solutions.

One factor to be considered in the relation between TL and OI is organizational learning (Argyris and Schön, 1996; Senge et al., 1994). Organizational learning involves the acquisition of explicit and tacit knowledge (development or creation of skills, insights, relationships), knowledge sharing, and knowledge utilization (DiBella et al., 1996). This process takes place within a community of interaction in which knowledge is created and expands in a constant dynamic between the tacit and the explicit (Nonaka and Takeuchi, 1995). It involves cognitive and behavioral change (García-Morales, 2004).

Previous studies, although contributing significantly to the understanding of the relationships – between TL and OI, between TL and OP, and between OI and OP – have not addressed these influences as they depend on the level of organizational learning in technological firms. In the technological context, it is especially important to gain a better understanding of factors influencing the successful development of innovations (van de Ven, 1993).

We should also underline the fundamental role of CEOs. They play a major role in informing and molding these variables by determining the types of behavior that are expected and supported (Baer and Frese, 2003). Further, although numerous actors may be involved in the management process, the CEO is ultimately responsible for plotting the organization’s direction and plans, as well as for guiding the actions carried out to achieve them. Therefore, the CEO’s perception is fundamental to the firm. To make sense of the complex environment surrounding them, managers tend to form simplified internal cognitive representations (mental models). Managers use these mental models, managers to focus on certain variables that they judge to be critical. They make decisions and measure their organizational learning, OI, OP, etc. based on these variables (Porac and Thomas, 1990).

To achieve our goals, we have structured the paper as follows. Based on previous research, second section suggests a series of hypotheses on the influence of TL on OI and OP and the influence of OI on OP. The section analyzes how TL affects OI and OP differently depending on the level of learning in an organization. Third section presents the data and the method used to analyze empirically the hypotheses developed in second section in pharmaceutical organizations. Fourth section presents the results obtained, and fifth section discusses the results and implications for managers. Finally, fourth section outlines the main conclusions and points out some of the limitations of this study.

**Background and hypotheses**

The effects of TL on OI and OP in technological firms depend on the presence of previous capabilities by which firms synthesize and acquire technological knowledge resources and generate new applications from those resources (Calantone et al., 2002). In this section, we present a model consisting of different hypotheses about how TL
affects OI and OP depending on the level of organizational learning. We analyze these antecedents and integrate them to achieve systemic thinking in a global model. Figure 1 shows the proposed model. The results, discussion and conclusions sections will help us to understand whether the hypothesized relationships are empirically verified and what their implications may be.

The influence of TL on OI depending on the level of organizational learning

The strategic literature highlights leadership style as an especially important influence on innovation (Kanter, 1983; McDonough, 2000). There is currently broad consensus that a collaborative and participative leadership style (transformational) is more likely to encourage innovation in the technological organization (Kanter, 1983) than transactional styles of leadership (Manz et al., 1989). It is important to highlight that managers’ perceptions of their own role in their organizations strongly influences the capability to promote this kind of leadership in a technological organization.

Several features of TL are relevant for firm innovation. Transformational leaders have an interactive vision and pay maximum attention to effective communication and value sharing (Adair, 1990) and to encouraging an appropriate environment for innovative teams (Tushman and Nadler, 1986). They support collective processes of organizational learning (Manz et al., 1989), reciprocal trust between organization members and leaders (Scott and Bruce, 1994), and favorable attitudes toward proactivity, risk (Lefebvre and Lefebvre, 1992) and creativity (Tierney et al., 1999). All of these features together enable a better understanding of the strong relationships between TL and factors positively influencing OI (Kanter, 1983).

As indicated earlier, transformational leaders have charisma, inspiration and intellectual stimulation. These characteristics are more active if there are organizational learning processes that enable organizations to be more innovative (Bass and Avolio, 2000; Bass, 1999; Conger, 1999). The influence of TL on OI is encouraged by the process of organizational knowledge creation (Cohen and Levinthal, 1990; Senge et al., 1994; Nonaka and Takeuchi, 1995).

The extensive and diverse literature on OI has received important contributions from research on organizational learning in the last decade. Many of these contributions have

\[ \xi_1 \]

Transformational Leadership

\[ \eta_1 \]

Organizational Innovation

\[ H1(+) \]

\[ H2(+) \]

\[ H3(+) \]

\[ \eta_2 \]

Organizational Performance

Figure 1. Hypothesized model
observed a greater relationship between TL and OI encouraged by organizational learning (de Weerd-Nederhof et al., 2002). Different types of organizational learning (adaptive/generative) mediate the relationship between TL and OI (incremental/radical). The deeper innovation reaches, the greater the change process rate and the degree of learning required. Thus, the process of organizational knowledge creation by which new knowledge is drawn from existing knowledge (organizational learning) stimulates OI (Cohen and Levinthal, 1990; Nonaka and Takeuchi, 1995).

For innovation to come to the fore by means of TL in technology organizations, a high degree of effective organizational learning is required (Bessant and Buckingham, 1993; Glynn, 1996). An increasing number of firms are thus analyzing innovation as an organizational learning process (Maastricht Economic Research Institute on Innovation and Technology, 1992) or applying organizational learning models to specific aspects of the innovation process (Cohen and Levinthal, 1990).

A technological organization committed to learning increases the effect of TL on innovation capability, because the organization is not likely to miss the opportunities created by emerging market demand. It has the ability and knowledge to anticipate and understand customer needs, possesses better state-of-the art technology, uses that technology in innovations and has a stronger capacity to understand the strengths and weaknesses of rivals. By learning from both its successes and its failures, the organization can generate greater innovation capability than its competitors (Calantone et al., 2002). These arguments lead to the following hypothesis:

**H1.** TL will be more positively associated with OI in technological organizations with high-organizational learning than in technological organizations with low-organizational learning.

The influence of TL on OP depending on the level of organizational learning

Leadership in organizations today should move toward becoming TL, which inspires employees to participate with enthusiasm in team efforts and to analyze beyond their own interests, reorienting the training and construction of teams to improve OP (Bass, 1991). Among the main internal causes of the organization’s failure is the leader’s inability to assume the transformational role needed to stimulate OP, to create synergy between the transformational leader and OP. High performance in the organization is stimulated by creating an organizational climate. This climate is fostered by the existence of TL, which enables the articulation of leadership as a process fully integrated in the organization.

Leaders invest time and resources to construct teams and organizations that have the competencies required to execute strategic and anticipatory changes. This is a function more in accord with a transformational style of leadership (Nadler and Tushman, 1990). Transformational leaders construct systems that provide direction, energy and enthusiasm to the organization, creating good conditions for learning and innovation in the whole organization to improve OP (Tushman and Nadler, 1986).

Previous studies have also asserted relationships between leadership and organizational learning, demonstrating their influence on OP (Tushman and Nadler, 1986; Senge, 1990; McGill et al., 1992; Senge et al., 1994; Bierly et al., 2000). Traditional leadership is highly individualistic and asystematic, making team and organizational learning less necessary. In contrast, TL builds teams and provides them with support
for processes of change that improve OP through organizational learning (Bass, 1999; McDonough, 2000). This style allows the organization to learn through experimentation, exploration, communication and dialogue (Tushman and Nadler, 1986; Slater and Narver, 1995; Senge et al., 1994; Lei et al., 1999).

More specifically, TL is fostered by organizational learning by promoting intellectual stimulation, inspirational motivation, and self-confidence among organization members (Coad and Berry, 1998). Organizational learning encourages shared mental models in technological organizations. These favor TL and facilitate technological learning and the use of new technologies that improve OP (Senge et al., 1994). Based on the foregoing, we propose that:

**H2.** TL will be more positively associated with OP in technological organizations with high-organizational learning than in technological organizations with low-organizational learning.

*The influence of OI on OP depending on the level of organizational learning*

Different theories have revealed that innovation is essential for better performance. Marketing theories show that organizations that concentrate on speed of innovation gain a greater market share, which produces high income and high profitability. Research in strategic theory underscores that organizations that adopt an innovation first are able to create “isolation mechanisms”. Because knowledge of the innovation is not available to competitors, these mechanisms protect profit margins, allowing important benefits to be gained. Likewise, the theory of resources and capabilities maintains that the capabilities, resources and technologies needed to adopt the innovation make external imitation more difficult and allow firms to sustain their competitive advantages and obtain greater OP (Lengnick-Hall, 1992; Lieberman and Montgomery, 1988).

Thus, there is a positive link between innovation and OP (Zaltman et al., 1973) or between different aspects of innovation (e.g. innovation design or speed, flexibility) and performance (Calantone et al., 2002). The innovation literature also includes various empirical studies supporting this relationship, as do various works that use econometric methods to demonstrate it empirically (Lööf and Heshmati, 2002).

The more valuable, imperfectly imitable and rare innovations (e.g. technological) are, the higher performance will be (Irwin et al., 1998). Technological organizations with greater innovation will achieve a better response from the environment, obtaining more easily the capabilities needed to increase OP and consolidate a sustainable competitive advantage (Zaltman et al., 1973; Bommer and Jalajas, 2004). Not promoting innovative projects and activities will have a negative effect on productivity and OP (Lööf and Heshmati, 2002). However, being the first to market by innovation is not always optimal (Tellis and Golder, 1996).

Organizational learning’s influence on the relation between OI and OP should be analyzed empirically, since little knowledge is available concerning its influence and the mechanisms by which it encourages this relation (Snyder and Cummings, 1998). It is wrong to assert that an increase in organizational learning always improves this relation and growth in OP (Inkpen and Crossan, 1995), since learning may not always improve an organization’s results (Huber, 1991). Nonetheless, generally speaking, organizational learning has a positive influence on this relation and on improvements in performance (Argyris and Schön, 1996; Fiol and Lyles, 1985; Senge, 1990).
Firms that show a greater breadth, depth and speed of organizational learning have greater performance levels (Hurley and Hult, 1998; Zahra and George, 2002). This normally occurs in firms from all sectors, for both manufacturing firms (Schroeder et al., 2002) and technological companies (Decarolis and Deeds, 1999). We should not forget that organizations that encourage the organizational learning spirit sacrifice some immediate performance to achieve future performance, since immediate performance is due to the organizational learning drawn from yesterday while future performance will be the product of today’s organizational learning process (Senge, 1990). We thus propose the following hypothesis:

**H3.** OI will be more positively associated with OP in technological organizations with high-organizational learning than in technological organizations with low-organizational learning.

**Methodology**
This section presents the research methodology used in this study. We describe the sample used, discuss how each of the variables included in the study is operationalized and finally present the statistical analysis.

**Sample and procedure**
The first step in an empirical study is selecting the population to be analyzed. The population for this study consists of the most important pharmaceutical organizations in Europe and America. The sample was selected randomly from the Amadeus and Hoovers database. Choosing a sample of firms located in the pharmaceutical sector and in a relatively homogeneous legal and political space minimizes the impact of the variables that cannot be controlled in the empirical research (Adler, 1983).

Drawing on our knowledge about key dimensions of this investigation, previous contacts with interested managers and scholars, and new interviews with managers and academics interested in the topic and familiar with technology and the pharmaceutical sector, we developed a structured questionnaire to investigate how organizations face these issues. We omitted the responses of the interviewees in this first stage from the subsequent analysis of the survey data. We decided to use CEOs as our key informants, since they receive information from a wide range of departments and are therefore a very valuable source for evaluating the different variables of the organization (Baer and Frese, 2003). The same types of informant were chosen to ensure that the level of influence among the organizations is constant, which increases the validity of the variables’ measurements (Glick, 1985).

Surveys were mailed to the selected pharmaceutical organizations (high-technology firms) along with a cover letter. We used this method because it allowed us to reach a greater number of organizations at a lower cost, to exert less pressure for immediate reply, and to provide the interviewees with a greater sense of autonomy. Initially, we explained the goal of the study and offered recipients the possibility of receiving the results once the study was completed. To reduce possible desirability bias, we promised to keep all individual responses completely confidential and confirmed that our analysis would be restricted to an aggregate level that would prevent the identification of any organization. We told interviewees that they would receive the questionnaire soon and reiterated the necessity that the person chosen answer it, even
at the cost of receiving fewer responses. If the survey was not returned, we sent another copy later. This enabled us to obtain 164 valid responses.

To assess non-response bias, the characteristics of responding businesses were compared to those of the nonresponding businesses. This analysis indicated that respondents did not differ significantly from nonrespondents in respect to return on assets, return on equity, return on sales or number of employees. Nor did we find significant difference between early and late respondents (Armstrong and Overton, 1977). Table I provides the details of this analysis. Likewise, a series of $\chi^2$ and $t$-tests revealed no significant differences due to geographical location or size in the variables studied.

**Measures**

Before embarking on the construction of the causal relations model, we evaluated the psychometric properties of the different constructs that we wish to use in the model. To do this, we used the program Lisrel 8.30 and confirmatory factor analysis on each construct. For the indicator to be reliable, we confirmed that the factor loads should be higher than 0.4 and significant ($t > 1.96; p < 0.05$), and individual reliability above 50 percent. Should more than one indicator not fulfil the reliability requirements, these indicators should be eliminated one by one. Once the individual reliability of each of the indicators was assured, we studied the composite reliability of the whole scale for

<table>
<thead>
<tr>
<th>Variables</th>
<th>Non-responding businesses (total)</th>
<th>Responding businesses (total)</th>
<th>$t$-value (sig.)</th>
<th>Responding businesses (first mailing)</th>
<th>Responding businesses (second mailing)</th>
<th>$t$-value (sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on assets</td>
<td>21.69</td>
<td>23.17</td>
<td>0.458</td>
<td>22.67</td>
<td>23.34</td>
<td>− 0.09</td>
</tr>
<tr>
<td>Return on equity</td>
<td>22.02</td>
<td>27.92</td>
<td>1.73 (0.1)</td>
<td>35.27</td>
<td>25.63</td>
<td>(0.924)</td>
</tr>
<tr>
<td>Return on sale</td>
<td>18.68</td>
<td>20.67</td>
<td>0.79 (0.429)</td>
<td>16.95</td>
<td>22.90</td>
<td>0.968</td>
</tr>
<tr>
<td>Number of employees</td>
<td>466.11</td>
<td>453.53</td>
<td>− 0.137</td>
<td>370.48</td>
<td>510.30</td>
<td>− 0.771</td>
</tr>
<tr>
<td><strong>Sector</strong></td>
<td><strong>Pharmaceutical</strong></td>
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<tr>
<td><strong>Geographical location</strong></td>
<td><strong>Europe, America</strong></td>
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<tr>
<td><strong>Methodology</strong></td>
<td><strong>Structured questionnaire</strong></td>
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<tr>
<td><strong>Procedure</strong></td>
<td><strong>Aleatory sampling</strong></td>
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<tr>
<td><strong>Sample (response) size</strong></td>
<td>2,476 (164)</td>
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<tr>
<td><strong>Sample error</strong></td>
<td>7.6 percent</td>
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<tr>
<td><strong>Confidence level</strong></td>
<td>p-q = 0.50, Z = 1.96</td>
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<tr>
<td><strong>Period of data collection</strong></td>
<td>From February 2003 to June 2004</td>
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| Table I. Technical details of the research |
each of the scales (Table II). To do this, we applied the $\alpha$ Cronbach, the composite reliability (> 0.7) and the average variance extracted (> 0.5).

**Transformational leadership.** The strategic literature includes research that measures and evaluates TL (Podsakoff and Organ, 1986; Coad and Berry, 1998). Owing to its extremely close relationship to our work and to the fact that it reflected the different prior trends well, we used the scale designed by Podsakoff et al. (Podsakoff et al., 1996) for diverse aspects of TL. We established a Likert-type five-point scale (1 – “total disagreement” 5 – “total agreement”) of four items (Appendix) to reflect CEOs’ perceptions of TL in the organization. We tested not their transformational style but the CEOs’ perceptions of TL in the technological organization. Using a confirmatory factor analysis ($\chi^2 = 1.07$, root mean square error of approximation (RMSEA) = 0.001, normed fit index (NFI) = 0.99, non-normed fit index (NNFI) = 0.99, comparative fit index (CFI) = 0.99), we validated our scales and then verified each scale’s unidimensionality and its high validity and reliability ($\alpha = 0.761$).

**Organizational innovation.** We defined innovation for respondents, noting that OI and not industry or market innovation should be their focus. Using a confirmatory factor analysis ($\chi^2 = 0.31$, RMSEA = 0.001, NFI = 0.99, NNFI = 0.99, CFI = 0.99) we validated our scales and then verified each scale’s unidimensionality and its high validity and reliability ($\alpha = 0.772$). The strategic literature has used both subjective perceptions of managers and objective data (Hitt et al., 1997) to measure innovation. We included questions that drew on both types of assessment in our interviews. We calculated the correlation between the objective and subjective data and found it to be high and significant (0.88, $p < 0.01$). We preferred to use objective data for the last year (Appendix).

**Organizational performance.** After reviewing how performance is measured in different studies of strategic research (Homburg et al., 1999), we drew up a scale that included four items to measure OP. We developed a confirmatory factor analysis to validate our scales ($\chi^2 = 33.927$, RMSEA = 0.071, NFI = 0.96, NNFI = 0.96, CFI = 0.96) and showed that the scale of four items was unidimensional and had high reliability ($\alpha = 0.821$). Many researchers have used the subjective perceptions of managers to measure beneficial outcomes for firms, but others have preferred objective data, such as return on assets (Coombs and Gilley, 2005; Wan and Hoskinson, 2005). Scholars have widely established a high correlation and concurrent validity between objective and subjective data on performance, which implies that both are valid when calculating a firm’s performance (Homburg et al., 1999). We included questions that drew on both types of assessment in our interviews, calculated the correlation between the objective and subjective data and found it to be high and significant (0.84, $p < 0.05$). We preferred to use objective data (Appendix).

**Organizational learning.** The capability of organizational learning has received much more theoretical than empirical attention. Further, there are wide differences among the assumptions, procedures, and objectives of previous measures. Owing to the fact that there is a closer link with our research, that they reflected the different prior trends well and that the scale’s validity was verified in detail, we used the first two items from the scale developed by Kale et al. (2000) and added two items based on Edmondson’s (1999) work to compose a multi-item scale of organizational learning. These items have been duly adapted to the present study. We used a Likert-type five-point scale (1—“total disagreement” 5—“total agreement”) with four items and asked to managers to express their level of agreement or disagreement with various questions. We developed
<table>
<thead>
<tr>
<th>Variables</th>
<th>Items</th>
<th>$\lambda^*$</th>
<th>$R^2$</th>
<th>$\alpha$</th>
<th>CR</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational leadership</td>
<td>TRANSLEA1</td>
<td>0.73*(10.89)</td>
<td>0.53</td>
<td>$\alpha = 0.761$</td>
<td>CR = 0.826</td>
<td>SV = 0.547</td>
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<tr>
<td></td>
<td>TRANSLEA2</td>
<td>0.60*(9.07)</td>
<td>0.49</td>
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<td></td>
<td>TRANSLEA3</td>
<td>0.81*(13.56)</td>
<td>0.65</td>
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<td></td>
<td>TRANSLEA4</td>
<td>0.76*(13.00)</td>
<td>0.57</td>
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<td>Organizational innovation</td>
<td>ORGINNO1</td>
<td>0.68*(9.43)</td>
<td>0.56</td>
<td>$\alpha = 0.772$</td>
<td>CR = 0.852</td>
<td>SV = 0.593</td>
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<td></td>
<td>ORGINNO2</td>
<td>0.85*(14.68)</td>
<td>0.72</td>
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<td></td>
<td>ORGINNO3</td>
<td>0.80*(10.69)</td>
<td>0.64</td>
<td></td>
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<tr>
<td></td>
<td>ORGINNO4</td>
<td>0.67*(9.06)</td>
<td>0.52</td>
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<tr>
<td>Organizational performance</td>
<td>PERFOR1</td>
<td>0.85*(22.31)</td>
<td>0.72</td>
<td>$\alpha = 0.821$</td>
<td>CR = 0.926</td>
<td>SV = 0.76</td>
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<tr>
<td></td>
<td>PERFOR2</td>
<td>0.91*(22.48)</td>
<td>0.83</td>
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<td></td>
<td>PERFOR3</td>
<td>0.92*(23.50)</td>
<td>0.84</td>
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<td></td>
<td>PERFOR4</td>
<td>0.81*(18.28)</td>
<td>0.65</td>
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<td>Organizational learning</td>
<td>ORGLEA1</td>
<td>0.82*(15.55)</td>
<td>0.67</td>
<td>$\alpha = 0.779$</td>
<td>CR = 0.893</td>
<td>SV = 0.678</td>
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<td>ORGLEA2</td>
<td>0.91*(19.12)</td>
<td>0.82</td>
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<tr>
<td></td>
<td>ORGLEA3</td>
<td>0.77*(12.76)</td>
<td>0.60</td>
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<tr>
<td></td>
<td>ORGLEA4</td>
<td>0.78*(12.79)</td>
<td>0.63</td>
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</tbody>
</table>

**Notes:** $^*p < 0.001$(two-tailed); $\lambda^*$ = standardized structural coefficient ($t$-students are shown in parentheses); $R^2$ = reliability; AM = adjustment measurement; $\alpha = \alpha$ Cronbach; CR = composite reliability; AVE = average variance extracted.
a confirmatory factor analysis to validate our scales ($X^2 = 5.07$, RMSEA = 0.087, NFI = 0.98, NNFI = 0.96, CFI = 0.99) and showed that the scale of four items was unidimensional and had good reliability ($\alpha = 0.779$). We also requested information on specific aspects of organizational learning (Appendix). A subsequent analysis enabled us to divide the organizations into organizations with a high degree of organizational learning (96 organizations showed a mean value for organizational learning greater than or equal to 4) or medium-low degree of the same (68 organizations showed an average value for organizational learning lower than 4).

Model and analysis

Lisrel 8.30 program was used to test the theoretical model. Figure 1 shows the basis of the model proposed and the hypotheses to be contrasted. We used a recursive non-saturated model, taking TL ($\xi_1$) as exogenous latent variable; OI ($\eta_1$) as the first-grade endogenous latent variable; and OP ($\eta_2$) as the second-grade endogenous latent variable. Through its flexible interplay between theory and data, this structural equation model approach bridges theoretical and empirical knowledge for a better understanding of the real world. Such analysis allows for modeling based on both latent and manifest variables, a property well suited to the hypothesized model, where most of the constructs represented are abstractions of unobservable phenomena. Furthermore, structural equation modeling takes into account errors in measurement, variables with multiple indicators and multiple-group comparisons.

Results

This section presents the main results of our research. Table III reports the means and standard deviations for all of the measures, as well as the inter-factor correlations matrix for the study variables. Consistent with the two-step approach advocated by Anderson and Gerbing (1988), we estimated a measurement model before examining structural model relationships, differentiating between organizations with high-organizational learning and organizations with low-organizational learning. We used Lisrel 8.30 to estimate the model.

From Table IV, we can see that all of the indexes show very good fit with the model. The constructs display satisfactory levels of reliability, indicated by composite reliabilities ranging from 0.81 to 0.90 and average variance extracted coefficients from 0.50 to 0.70. Convergent validity – the extent to which maximally different attempts to measure the same concept agree – can be judged by examining both the significance of the factor loadings and the average extracted variance. The amount of variance shared or captured by a construct should be greater than the amount of measurement error (average variance extracted $> 0.50$). All of the multi-item constructs met this criterion, each loading ($t$-values greater than or equal to 1.96) being significantly related to its underlying factor.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Means</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Transformational leadership</td>
<td>3.837</td>
<td>0.717</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Organizational innovation</td>
<td>3.714</td>
<td>0.574</td>
<td>0.492*</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Organizational performance</td>
<td>3.670</td>
<td>0.714</td>
<td>0.365*</td>
<td>0.229*</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Organizational learning</td>
<td>3.932</td>
<td>0.667</td>
<td>0.552*</td>
<td>0.426**</td>
<td>0.268**</td>
<td>1.000</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * $p < 0.01$; ** $p < 0.001$ (two-tailed)
<table>
<thead>
<tr>
<th>Organizations with transformational leadership (TL)</th>
<th>Variables</th>
<th>Items</th>
<th>$\lambda^*$</th>
<th>$R^2$</th>
<th>$\alpha$</th>
<th>CR</th>
<th>AVE</th>
<th>Correlation confidence interval</th>
<th>Goodness of fit statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizations with high-organizational learning</td>
<td>TRANSLEA1</td>
<td>0.80</td>
<td>(0.88)</td>
<td>0.64</td>
<td>0.724</td>
<td>0.911</td>
<td>0.721</td>
<td>TL-OI (0.40-0.57)</td>
<td>$\chi_2^2 = 46.68$ (df = 51), GFI = 0.96, AGFI = 0.94, NFI = 0.96, NNFI = 0.99, IFI = 0.99, RFI = 0.96, CFI = 0.99, RMSEA = 0.001</td>
</tr>
<tr>
<td></td>
<td>TRANSLEA2</td>
<td>0.85</td>
<td>(10.27)</td>
<td>0.73</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TRANSLEA3</td>
<td>0.86</td>
<td>(11.29)</td>
<td>0.74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TRANSLEA4</td>
<td>0.88</td>
<td>(11.46)</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO1</td>
<td>0.84</td>
<td>(11.75)</td>
<td>0.71</td>
<td>0.756</td>
<td>0.880</td>
<td>0.651</td>
<td>TL-OP (0.85-0.93)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO2</td>
<td>0.84</td>
<td>(11.80)</td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO3</td>
<td>0.84</td>
<td>(12.00)</td>
<td>0.71</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO4</td>
<td>0.65</td>
<td>(7.66)</td>
<td>0.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERFOR1</td>
<td>0.87</td>
<td>(13.20)</td>
<td>0.75</td>
<td>0.760</td>
<td>0.898</td>
<td>0.689</td>
<td>OI-OP (0.63-0.78)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERFOR2</td>
<td>0.75</td>
<td>(10.39)</td>
<td>0.56</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>PERFOR3</td>
<td>0.91</td>
<td>(14.01)</td>
<td>0.83</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERFOR4</td>
<td>0.78</td>
<td>(11.12)</td>
<td>0.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizations with low-organizational learning</td>
<td>TRANSLEA1</td>
<td>0.64</td>
<td>(9.20)</td>
<td>0.51</td>
<td>0.714</td>
<td>0.812</td>
<td>0.501</td>
<td>TL-OI (0.34-0.45)</td>
<td>$\chi_2^2 = 181.16$ (df = 51), GFI = 0.95, AGFI = 0.92, NFI = 0.90, NNFI = 0.90, IFI = 0.95, RFI = 0.92, CFI = 0.95, RMSEA = 0.093</td>
</tr>
<tr>
<td></td>
<td>TRANSLEA2</td>
<td>0.68</td>
<td>(10.37)</td>
<td>0.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TRANSLEA3</td>
<td>0.69</td>
<td>(10.42)</td>
<td>0.55</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TRANSLEA4</td>
<td>0.77</td>
<td>(10.98)</td>
<td>0.60</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO1</td>
<td>0.84</td>
<td>(11.58)</td>
<td>0.71</td>
<td>0.707</td>
<td>0.867</td>
<td>0.622</td>
<td>TL-OP (0.73-0.84)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO2</td>
<td>0.79</td>
<td>(16.66)</td>
<td>0.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO3</td>
<td>0.69</td>
<td>(14.27)</td>
<td>0.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ORGINNO4</td>
<td>0.71</td>
<td>(14.54)</td>
<td>0.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERFOR1</td>
<td>0.84</td>
<td>(11.45)</td>
<td>0.70</td>
<td>0.851</td>
<td>0.863</td>
<td>0.615</td>
<td>OI-OP (0.61-0.72)</td>
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</tr>
<tr>
<td></td>
<td>PERFOR2</td>
<td>0.68</td>
<td>(12.74)</td>
<td>0.56</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERFOR3</td>
<td>0.67</td>
<td>(11.51)</td>
<td>0.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERFOR4</td>
<td>0.76</td>
<td>(13.12)</td>
<td>0.74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: *$p < 0.001$(two-tailed). Measurement; $\alpha = \alpha$ Cronbach; CR = composite reliability; AVE = average variance extracted.
than 7.26) in support of convergent validity. A series of $\chi^2$ difference tests on the factor correlations showed that discriminant validity – the degree to which a construct differs from others – was achieved among all constructs (Anderson and Gerbing, 1988). More specifically, discriminant validity was established between each pair of latent variables by constraining the estimated correlation parameter between them to 1.0 and then performing a $\chi^2$ difference test on the values obtained for the constrained and unconstrained models (Anderson and Gerbing, 1988). The resulting significant differences in $\chi^2$ indicate that the constructs are not perfectly correlated and that discriminate validity is achieved. We also confirmed that the confidence interval for the correlation between each pair of critical dimensions does not produce a value of 1, which shows the presence of discriminant validity (Anderson and Gerbing, 1988).

Table V presents the results for the structural model shown in Figures 2 and 3, differentiating between organizations with high-organizational learning and organizations with low-organizational learning. Structural equation modelling (Bollen, 1989) was performed to estimate direct and indirect effects using Lisrel with the correlation matrix and asymptotic covariance matrix as input. The overall fit of the structural model was good, and the completely standardized path estimates indicate significant relationships among the constructs. If we examine the standardized parameter estimates (Table V), the findings show that TL is highly related to and affects OI. Further, this relation is greater in technological organizations with high-organizational learning ($\gamma_{11} = 0.71, p < 0.001$) than in technological organizations with low-organizational learning ($\gamma_{11} = 0.38, p < 0.001$), as was predicted in $H_1$. This is the case because TL encourages OI fostered by the construction of competencies focused on learning (Senge et al., 1994; Lei et al., 1999). The current leader is faced with a combination of new challenges in innovating, based on intellectual capital, mind power and know-how (Bennis, 1999). Such challenges are better overcome by learning organizations that have a climate that promotes experimentation, capacity for systems thinking and shared vision (Coad and Berry, 1998; McGill et al., 1992; Senge et al., 1994), and qualities that foster interpersonal and collective shared spaces where knowledge for innovation is created and shared (Nonaka and Takeuchi, 1995; Slater and Narver, 1995).

As predicted in $H_2$, OP appears to be influenced more strongly by TL in technological organizations with high-organizational learning ($\gamma_{21} = 0.54, p < 0.001$) than in technological organizations with low-organizational learning ($\gamma_{21} = 0.32, p < 0.001$). The results also show an indirect effect (0.37, $p < 0.001$ and 0.23, $p < 0.001$ in technological organizations with high-organizational learning and low-organizational learning, respectively) of TL on OP due to OI (see, for instance, Bollen, 1989, for calculation rules). The global influence of TL on OP is thus 0.91 ($p < 0.001$ in technological organizations with high-organizational learning) and 0.55 ($p < 0.001$ in technological organizations with low-organizational learning). This influence may occurs because the leader designs the proposals, vision and central values that guide the organization to improve its performance by means of policies, strategies and structures stimulated by organizational learning (Argyris and Schön, 1996; Senge, 1990; Wick and Leon, 1995). The leader inspires OI and OP, helping the members of the organization to discover their mental models, restructure their visions of reality to see beyond surface conditions and develop their systemic understanding (Senge et al., 1994).
### Table V. Structural model results (direct, indirect and total effects)

<table>
<thead>
<tr>
<th>Effect from</th>
<th>To</th>
<th>Direct effects&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Direct effects&lt;sup&gt;a&lt;/sup&gt; t</th>
<th>Indirect effects&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Indirect effects&lt;sup&gt;a&lt;/sup&gt; t</th>
<th>Total effects&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Total effects&lt;sup&gt;a&lt;/sup&gt; t</th>
<th>Goodness of fit statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organizations with high-organizational learning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL</td>
<td>OI</td>
<td>0.71†</td>
<td>7.29</td>
<td>0.71†</td>
<td>7.29</td>
<td>0.71†</td>
<td>7.29</td>
<td>(\chi^2 = 46.68 \text{ (df = 51); GFI = 0.96; AGFI = 0.94; NFI = 0.96; NNFI = 0.99; IFI = 0.99; RFI = 0.96; CFI = 0.99; RMSEA = 0.001} )</td>
</tr>
<tr>
<td>TL</td>
<td>OP</td>
<td>0.54†</td>
<td>4.36</td>
<td>0.37***</td>
<td>3.78</td>
<td>0.91†</td>
<td>10.22</td>
<td>(\chi^2 = 181.16 \text{ (df = 51); GFI = 0.95; AGFI = 0.92; NFI = 0.90; NNFI = 0.99; IFI = 0.99; RFI = 0.92; CFI = 0.95; RMSEA = 0.093} )</td>
</tr>
<tr>
<td>OI</td>
<td>OP</td>
<td>0.46†</td>
<td>3.81</td>
<td></td>
<td></td>
<td>0.46†</td>
<td>3.81</td>
<td>(\chi^2 = 46.68 \text{ (df = 51); GFI = 0.96; AGFI = 0.94; NFI = 0.96; NNFI = 0.99; IFI = 0.99; RFI = 0.96; CFI = 0.99; RMSEA = 0.001} )</td>
</tr>
<tr>
<td><strong>Organizations with low-organizational learning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL</td>
<td>OI</td>
<td>0.38†</td>
<td>4.69</td>
<td>0.38†</td>
<td>4.69</td>
<td></td>
<td></td>
<td>(\chi^2 = 181.16 \text{ (df = 51); GFI = 0.95; AGFI = 0.92; NFI = 0.90; NNFI = 0.99; IFI = 0.99; RFI = 0.92; CFI = 0.95; RMSEA = 0.093} )</td>
</tr>
<tr>
<td>TL</td>
<td>OP</td>
<td>0.32†</td>
<td>4.10</td>
<td>0.23***</td>
<td>3.44</td>
<td>0.55†</td>
<td>6.28</td>
<td>(\chi^2 = 46.68 \text{ (df = 51); GFI = 0.96; AGFI = 0.94; NFI = 0.96; NNFI = 0.99; IFI = 0.99; RFI = 0.96; CFI = 0.99; RMSEA = 0.001} )</td>
</tr>
<tr>
<td>OI</td>
<td>OP</td>
<td>0.30†</td>
<td>3.75</td>
<td></td>
<td></td>
<td>0.30†</td>
<td>3.75</td>
<td>(\chi^2 = 46.68 \text{ (df = 51); GFI = 0.96; AGFI = 0.94; NFI = 0.96; NNFI = 0.99; IFI = 0.99; RFI = 0.96; CFI = 0.99; RMSEA = 0.001} )</td>
</tr>
</tbody>
</table>

**Notes:** *p < 0.10; **p < 0.05; ***p < 0.01; †p < 0.001; <sup>a</sup>standardized structural coefficients
We also verify the positive relationship between OI and OP. This relation is greater in technological organizations with high-organizational learning ($\beta_{21} = 0.46, p < 0.001$) than in technological organizations with low-organizational learning ($\beta_{21} = 0.30, p < 0.001$), supporting $H3$. Because organizations' capability to innovate enables the improvement of performance and because this capability is fostered by organizational learning and OP, management should develop these dynamic capabilities (Calantone et al., 2002; Lööf and Heshmati, 2002). Integrated learning systems permit sharing and transfer of technological knowledge between the different areas and people in the organization, improving OP (Senge et al., 1994). In contrast, poor learning between individuals and between organizations will become an obstacle to transforming OI in performance (Senge et al., 1994). Organizational learning and OI are dynamic capabilities united in the achievement of sustainable competitive advantages (Nonaka and Takeuchi, 1995; Calantone et al., 2002).

Finally, we performed a $t$-test for equality of means between organizations with high-organizational learning and organizations with low-organizational learning to analyze whether there are significant differences with regard to TL, OI and OP. The results of these tests can be seen in Table VI. For each construct, the table provides the mean score, the Levene’s test for equality of variances and the $t$-value. Significant differences can be observed between all constructs.

---

**Figure 2.**
Results of structural equation model

*Note:* Organizations with high-organizational learning
Discussion

Leaders in technology firms are aware that their businesses are sustained by a strong scientific and technical base that is continually renewed due to the fact that new technology tends rapidly to make current technology obsolete. As new technologies emerge, their implications create or revolutionize markets and demand (Shanklin and Ryans, 1997). Successful confrontation of the high complexity of the products available, the high number of competitors, consumer needs and rapid change requires technological transformational leaders. Such leaders design the main technological purpose, vision and values that will guide the organization, creating policies, strategies and structures that enable it to face technological challenges and improve OP (Senge, 1990; Senge et al., 1994).

Technological transformation leaders drive the scientific and technological innovation processes in high-technology industries to improve OP (Medcof, 1999). To achieve this end, they commit themselves seriously to innovation, making one of their goals the dissemination of innovation on all levels of the organization (Lei et al., 1999). These leaders create a shared culture that favors innovative value, generating an organizational mental model that protects the organization against new challenges (McGill et al., 1992). Since innovation derives from the efforts of people who interact organizationally, all of the organization’s members must be involved in the innovation process for it to succeed (Hartman et al., 1994).

Note: Organizations with low-organizational learning
Sustained innovation and performance also require that transformational leaders incorporate innovation as a significant component in the organization’s strategy (Dougherty and Hardy, 1996). TL stimulates innovation strategies that improve OP fostered by the presence of organizational learning. Learning practices stimulate the organization’s abilities and those of its employees, the learning of new capacities and continuous experimentation (Argyris and Schön, 1996). This learning generates competencies, skills and abilities that encourage the growth and personal and professional improvement of all members of the organization. It also creates a sense of community in the organization, which encourages collective commitment, acting as a stimulating motor that drives and unites all the organization’s members to work to achieve what is in the common interest.

Leaders work with cognitive maps to stimulate mental models and reasoning systems. To observe the totality of and interrelations between the parts of the organization, the leader encourages system thinking and generates reflection, not only on the individual but also on the team and organizational levels. All of these factors require the existence of integrated organizational learning that stimulates an environment of dialogue (Isaacs, 1993; Senge et al., 1994).

In this way, TL achieves greater influence on innovation and OP through the correct management of organizational learning. These innovations are valuable, imperfectly imitable and rare, leading to better OP (Irwin et al., 1998). Technological organizations with better innovations will achieve better OP and consolidate a sustainable competitive advantage.

**Conclusions and future research**

This study serves as a reference for fostering innovation in technological firms through a style of leadership that improves OP. In the knowledge economy, effective organizational learning generates the environment that technological organizations must have if TL is to enable innovation and maintain the competitive positions of the firms as technological centers (Senge et al., 1994). Management of these variables gives rise to values within the organization that are difficult to copy and that generate profits and competitive advantages.

**Table VI.** Independent samples t-test

<table>
<thead>
<tr>
<th>Variables</th>
<th>Means Organizations with high-organizational learning</th>
<th>Means Organizations with low-organizational learning</th>
<th>Levene’s test for equality of variances</th>
<th>t-Test for equality of means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational leadership</td>
<td>4.0667</td>
<td>3.5205</td>
<td>2.284</td>
<td>4.870†</td>
</tr>
<tr>
<td>Organizational innovation</td>
<td>4.6774</td>
<td>4.2879</td>
<td>0.196</td>
<td>4.442†</td>
</tr>
<tr>
<td>Organizational performance</td>
<td>4.6316</td>
<td>4.2132</td>
<td>2.883</td>
<td>3.724†</td>
</tr>
</tbody>
</table>

Notes: *p < 0.1; **p < 0.05; ***p < 0.01; †p < 0.001 (two-tailed)
TL encourages a combination of beliefs, expectations and basic principles. These beliefs and expectations encourage rules of behavior with the power to shape the conduct of the individuals and groups in the organization and thereby to differentiate it from other organizations (Schein, 1993). Because these beliefs also correspond to the perceptions of appropriate and inappropriate behavior in a social unit (Rousseau, 2000), it is important to analyze how organizational learning affects the relation between TL and OI, between TL and OP and between OI and OP in technological organizations. Because organizational learning is an essential element for converting individual mental models into shared ones (Senge et al., 1994), it will enable the entity to transform itself into an intelligent organization that innovates and that enables greater performance (Senge, 1990; Argyris and Schön, 1996).

Our research has shown that TL has different effects on innovation and performance depending on the level of organizational learning in a technological organization. Organizational learning is committed to TL and OI and propels these capabilities (Senge, 1990; Swieringa and Wierdsma, 1992), overcoming obstacles that can impede them (Wick and Leon, 1995). Technological organizations that encourage technologies of learning establish a path for professional development that enables them to acquire aptitudes or competencies that provide sustainable advantage through innovation (Senge et al., 1994).

Further, we verify that TL encourages OI and OP at a higher level if there are competencies focused on organizational learning that minimize the cost of internal change (Slater and Narver, 1995; Lei et al., 1999; Zahay and Handfield, 2004). The innovative organization is an organization that requires learning and that knows how to make and keep itself technologically competent. Learning will enable the organization to change its behavior and thus to renew and reinvent itself technologically, preventing it from falling into technological stagnation and allowing it to generate innovation. While organizations will find themselves in different states of evolution in learning, the sooner they foster measures to prevent this stagnation and to disseminate learning, the less complicated the leap to innovation will be (Bessant and Buckingham, 1993; Glynn, 1996).

Our results also support the importance of encouraging TL in generating innovation. This result is especially appealing because it supports the characterization of TL as more concerned with collective decisions, collective goals, and the generation of capabilities than is traditional leadership, which focuses more on top-down decisions, standardized procedures, and the production of products and services (McDonough, 2000).

Finally, technological organizations need innovation to improve their performance in changing real-life business environments. We verify empirically that more innovation generates better OP in technological firms and that this relationship is more intense as the level of organizational learning increases. The empirical results show that sources of innovating and achieving sustainable competitive advantages and sustainable development in technological firms are sustained by the presence of a complex of essential competencies or resources and technological capabilities that organizations possess (e.g. organizational learning). Each organization should analyze and enable all of the resources and capabilities that permit it to obtain a better competitive position on the market. It should also regenerate its essential competencies, so it can use innovation to face the technological changes in its environment.
In this way, the organization acquires a dynamic and innovative vision that enables it to improve OP, generating resources and technological capabilities that are unique, valuable, hard to replace and difficult to imitate (Irwin et al., 1998).

This investigation has several limitations that may suggest further possibilities for empirical research. First, survey data based on self-reports may be subject to social desirability bias (Podsakoff and Organ, 1986). However, an assurance of anonymity can reduce such bias even when responses are related to sensitive topics (Konrad and Linnehan, 1995). The low risk of social desirability bias in this study was indicated by several managers who commented that it made no sense at all for their companies to go beyond regulatory compliance. Still, the responses are subject to interpretation by individual managers.

Second, the absence of an objective measure of organizational learning is a limitation. However, the external validation of this variable from the archival data of a subset of respondents and the use of objective measures for other variables (e.g. OP, OI) increased confidence in the self-reports and reduced the risk of common method variance (Sharma, 2000). Further, the possibility of common method bias was tested using Harman’s one-factor test and other methods. We also used objective data and randomized the order of presentation of the survey items across the subjects. Common method bias does not appear to be present (Podsakoff and Organ, 1986; Konrad and Linnehan, 1995).

Third, the cross-sectional nature of the research into a series of dynamic concepts (OI, organizational learning) allows us to analyze only a specific situation in time of the organizations studied, not their overall conduct through time. Our approach has reduced the magnitude of this problem, since dynamic characteristics and causal affirmations can be made if the relationships are based on theoretical rationales (Hair et al., 1999). For this reason, we began with a theoretical analysis to enable us to identify and confirm the formal existence of the different cause-effect relationships. Nonetheless, future research should focus on longitudinal study. Innovation is very necessary and complex in technological firms, as it is influenced by organizational, personal, and environmental issues. Longitudinal research can approach innovation with greater precision and study its determinants, processes, and results systematically, for this approach allows us to analyze the evolution of its variables over time and to draw more reliable conclusions about this activity.

Fourth, the use of a single respondent may have influenced the accuracy of some measurements. However, difficulties in obtaining sponsorship for research based on multiple views for each firm, the value of CEOs’ knowledge of their firms, and common practice in organizational research all supported the use of CEOs as respondents. Fifth, we have concentrated on the pharmaceutical sector. In firms from other sectors the results may be different. Above all, it would be interesting to analyze these relationships in non-technological sectors where the organizational characteristics could differ more.

Finally, our model only analyzes the different effects of TL on OI and OP depending on the level of organizational learning. Other factors could be analyzed, e.g. technology shared vision and technology teamwork (Senge, 1990; Senge et al., 1994). Research should also examine other consequences of introducing an innovation process in technological organizations (e.g. quality improvement, staff satisfaction, improvements in relational capacity). More attention to the influence of specific
technological strategic factors on innovation is necessary in the future. Empirical papers supporting (or rejecting) our results in different contexts would be welcomed (especially longitudinal studies). Future studies should be based on a larger sample and might well explicitly integrate the influences of external factors. It would also be interesting to study similar characteristics with information provided by lower levels of management and employees in the organization.

CEOs and managers, clients, suppliers, public administration, investors, strategic allies, the financial system, accountants and the academic world would welcome a more in-depth investigation of the internal conditions that technological firms must have in order to innovate and the consequences of these conditions for OP. Some companies with vast resources may not obtain competitive advantage without these strategic factors. Development of a collaborative scheme between academics and practitioners would allow an organizational strategy to be generated and would permit further study of the processes, means and mechanisms by which to transform OI into sustainable competitive advantage.

References


Swieringa, J. and Wierdema, A. (1992), Becoming a Learning Organization, Addison-Wesley, Reading, MA.


Appendix

**Transformational leadership**

In a technological context:

- The organization’s management has a clear common view of its final aims and is able to transmit them and achieve the commitment of the rest of the organization’s members.
- The organization has leaders who are capable of motivating and guiding their colleagues on the job (masters).
- The firm’s management is always on the lookout for new opportunities for the unit/department/organization.
- The firm’s management always acts as the organization’s leading force.

**Organizational innovation**

- Number of new products, processes, methods or ideas developed and marketed by the organization.
- Number of new markets that the firm has entered.
- Total amount that the company had spent on R&D.
- Total number of employees dedicated to task of R&D.

**Organizational performance**

- The firm’s performance measured by return on assets.
- The firm’s performance measured by return on equity.
- The firm’s performance measured by return on sales.
- The firm’s market share in its main products and markets.

**Organizational learning**

1. The organization has acquired and used much new and relevant knowledge that has provided competitive advantage.
2. The organization’s members have acquired critical capacities and skills that have provided competitive advantage.
3. Organizational improvements have been influenced fundamentally by new knowledge entering the organization.
(4) The organization is a learning organization:

- What are the main and most relevant kinds of knowledge acquired and used by the organization? What competitive advantage have they provided?
- What are the main critical capacities and skills acquired by the organization’s members? What competitive advantage have they provided?
- What organizational improvements have been influenced fundamentally by new knowledge entering the organization?
- What shows that the organization is becoming a learning organization?

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