v. 4, n. 18, 2024

Scientific Journal of Applied Social and Clinical Science

INNOVATION, TECHNOLOGY AND ORGANIZATIONAL PERFORMANCE: AN ANALYSIS IN THE INDUSTRY OF MINAS GERAIS

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Abstract: This research aims to analyze and interpret the relationship between innovation, technology creation, quality management, information management and organizational performance in the Minas Gerais industry. In a market of increasing competitiveness and full of uncertainties, it is essential that organizations master these relationships in the search for new consumer markets and profitability for their business operations. The research highlights topics such as innovation, information technology, industry 4.0, internet of things and competitiveness, among others. A quantitative approach was used. The research data were collected through an e-survey questionnaire with a 5-point Likert scale, exclusively in the industry of the State of Minas Gerais. The applied analysis technique refers to the measurement model (Outer Model) and use of the structural equation software PLS (Partial Least Squares - Path Modeling) to successfully identify suitable conditions for the results. The findings of this study provided relevant information on how employees and members of companies must strengthen their collaboration to enhance their competitive advantages. The database consisted of 257 respondents, assessed on 34 variables, including 9 sociodemographic variables and 25 variables related to 5 constructs (Innovation, Technology Creation, Quality Management, Information Management and Organizational Performance). The success of the research is related to the objectives formulated based on the results, which demonstrate the tendency of respondents to agree with all statements related to the positive impact on organizational performance.
Keywords: Innovation, technology, quality management, information management and organizational performance.

INTRODUCTION

The current economic and business situation is a theme that has led researchers, consultants and professionals to promote studies dedicated to the themes of innovation, technology and organizational performance within organizations. Contemporary business models have become increasingly transient and heterogeneous, putting the concept of lasting competitive advantage at risk (GHANI; ZAKARIA, 2013; WESTERMAN; BONNET; McAFEE, 2016).

The innovation process is fundamental to the competitiveness of companies, associated with the renewal and evolution of the business, improving what is offered. Innovation, therefore, is an essential activity, linked to permanence in the market and business growth (BESSANT; TIDD, 2009).

With the advent of new technologies, political structures and mergers of large markets, institutions have been encouraged to renew, improve change management and the value chain in their formation (GHANI; ZAKARIA, 2013). What was once ephemeral has become definitive and crucial for the maintenance, stability and longevity of their businesses. Well-known companies are threatened by startups that exponentially and almost instantly multiply their capital on the world's stock exchanges (DOZ, KOSONEN, 2010; TERRA et al., 2012).

In this context, innovation has become a strategic differentiator, no longer being momentary or questionable (TIGRE; NORONHA, 2013). Technology, combined with well-defined processes and ideas that emerge almost suddenly, is embedded in new products or production processes, enabling companies to generate income, reduce costs, improve the quality of processes and preserve the environment (WESTERMAN; BONNET; McAFEE, 2016). Innovation is therefore a process that begins with an abstraction,

continues with the development of an invention and results in the introduction of a new product, process or service to the marketplace (SCHUMPETER, 1981). Without investment in innovation, it is not possible to generate knowledge, which is a fundamental factor for the reproduction of new ideas that stimulate the production process (WESTERMAN; BONNET; McAFEE, 2016).

Technological adaptability and evolution are essential to determine a company's competitiveness and ability to grow and remain in the market. Innovation is a key factor in the development of technology, which in turn improves performance. Innovation management maturity and measurement models consist of comprehensive and guiding assessment instruments that provide managers with resources to explore the advantages of organizational innovative processes. Consequently, innovation allows companies to protect themselves in uncertain and unstable times, becoming capable of facing new turbulence and seeking opportunities for efficient and assertive exploration in difficult times (TORRES et al., 2015).

The transfer and acquisition of technology is a long and continuous process, complex and dynamic, and its success is influenced by several factors, coming from multiple sources (BIRKINSHAW; HAMEL; MOL, 2008). It is a cycle and introduction of new techniques through investment in technologies, improvement of existing technologies and generation of new knowledge (TERRA et al., 2012).

The interdependence and level of maturity in the use of innovation, technology, quality and their interrelationships will directly reflect on the excellence of the corporation's organizational performance. The organizational environment, managed from appropriate resources and processes, is capable of reproducing competitive advantage, leveraging promising processes and results (BESSANT; TIDD, 2009).

REVIEW OF LITERATURE

INNOVATION

The starting point for the analysis of innovation was attributed to Joseph Schumpeter, when he pointed out the expression "creative destruction", in his classic book: Capitalism, Socialism and Democracy, published in 1942. According to the author:

> [...] the opening of new markets – foreign or domestic – and organizational performance, from the artisanal workshop to the conglomerates, illustrate the same process of industrial mutation that incessantly revolutionizes the global economy, from within, incessantly destroying the old, and creating the new. This process of "creative destruction" is the essential fact about Capitalism (SCHUMPETER, 1981, p. 112-113).

Schumpeter provides guidance on the importance of creation in the strategy formulation process. For the author, "all elements of business strategy only acquire their true meaning against the backdrop of this process and within the situation created by it" (SCHUMPETER, 1984, p. 113). Innovation is the process of creating something new and destroying what is becoming obsolete. "Innovation is the organization's ability to overcome the competition, establishing a situation of momentary supremacy by creating a new market for its products" (HERRERO, 2005, p. 125).

According to Drucker (1987), innovation must be applied by the corporation's human resources in order to produce wealth and greater productive capacity. Innovation is the ability that a company must have to create, maintain and renew its consumers. Innovation means that all products, processes and markets quickly become obsolete and need to be constantly renewed (DRUCKER, 1987).

Herrero (2005) also makes his contribution explicit when he states:

> [...] companies that are dominant in their current markets and that listen to their customers, promote continuous product improvement and seek increased growth and profitability, while other companies have lost their leadership position and failed because they did not invest in, or were not interested in, adopting the emerging disruptive technologies in their sector". A well-managed company (which is an important factor for success) also runs risks of survival, because management is committed to traditional ways of doing business and does not perceive the potential value of a disruptive technology (HERRERO, 2005, p. 127).

Another relevant contribution to a better understanding of the industrial innovation process was made based on the concept of disruptive technologies, developed by Christensen (2013) in his classic book: "The Innovation Dilemma". According to the author, a disruptive innovation is one that transforms a fraction of the product, previously expensive and difficult to access, into a new product capable of being easily disseminated and widely accepted in the market.

Innovation is the change in technologies to transform labor, capital, materials and information into products and services with high added value. Innovation is the ability to transform the low performance of a new value proposition, based on a disruptive technology, into superior performance, as quickly as possible (HERRERO, 2005, p. 128).

In addition to the definitions elucidated by the authors cited above, it is important to highlight that innovation is not invention. The confusion begins when "invention" and "innovation" are treated as synonyms (BESSANT; TIDD, 2009). Invention is necessary to achieve innovation. Ideas and actions are closely linked to inventions, while results consist of innovations (BESSANT; TIDD, 2009).

CREATION OF TECHNOLOGY

Technology creation is an industry's disposition to emphasize new products and processes, aiming to logically improve its core business. The most prominent dimensions of creation include: radical, incremental, product, process, management and technology creation; as well as organizational performance capacity (FEENBERG, 2002).

Technology originated in Greece and its meaning is "technique, art, craft and study". Greek technology basically involved engineering and practical mechanics, areas of human knowledge related to planning, construction and maintenance of buildings and mechanisms for civil and/or military use. The etymology of the word is described as "a set of knowledge, especially scientific principles, that apply to a given branch of activity" (FEENBERG, 2002).

Currently, the term technology is embedded in all products and/or processes in the industry, whether on a larger or smaller scale. In this regard, Feenberg states:

> Technological development is determined by both technical and social criteria of progress, and can therefore branch off in any of several directions, depending on the prevailing hegemony. While social institutions adapt to technological development, the process of adaptation is reciprocal, and technology changes in response to the conditions in which it finds itself as much as it influences them (FEENBERG, 2002, p. 143).

Technology determines an important focus in industry, imposing the need to study this phenomenon in depth, from a perspective of epistemological consolidation (KLINGE, 2000).

Technology is also understood as a systematic application of technical-scientific knowledge. Since the emergence of industries, a development process has occurred in production methods with the aim of achieving greater efficiency. This

dynamic is necessary to maximize capitalist economic activity, with investments in research to increase productivity and reduce costs during production, so that the profit generated can be as high as possible. After the Industrial Revolutions, which introduced new technologies into production methods, industrial activity could be classified according to three aspects, according to its technological apparatus: traditional industries; modern industries; cutting-edge technology industries.

In the last seven decades, Brazil has undergone major transformations. Two major growth cycles, driven by import substitution, one in the 1950s and the other in the 1970s, were responsible for the basis of our industrialization. Periods of rapid growth were interspersed with moments of stagnation and crisis, generally resulting from the weakness of international integration. Structurally high inflation or external fragility were recurring dilemmas, but Brazil has undoubtedly become one of the world's leading economies and has changed the face of its society (TIGRE; NORONHA, 2013).

QUALITY MANAGEMENT

Structural and revolutionary transformations are guided by the reduction of hierarchies, decentralization of authority and processes that encourage partnership and focus on the quality of products and processes, aiming at customer satisfaction and increased competitiveness (OSBORNE; GAEBLER, 2010).

Quality management involves satisfying customer expectations, meeting global quality requirements (CASE, 2002). Pertinently, quality and management play an important role in determining the next generation of quality management (DEFEO; FANSSEN, 2001). Thus, a multinational or global quality manager must grow in the international arena. Furthermore, with the evolution of advanced technologies, in various industries, quality specialists must adapt to these new conditions to remain competitive in global markets (HUANG et al., 2015).

Today, companies must be confident in their quality management and organizational performance capabilities, and that they bring high quality, safe and competitively priced products to the market; if they want to sustain growth in the global market. Quality management is a widely used concept that has become one of the most important items for most organizations. This new management approach, as it is called by Scholtes (1992), allows companies to keep up with changes and even anticipate them, as it emphasizes the continuous improvement of products and services, through the use of the scientific method and monitoring of data that support decision-making. In addition, it has proven to be useful in any company, whether it produces goods or services, large or small, public or private (ANTUNES; TREVIZAN, 2000).

MANAGEMENT OF INFORMATION

Information management capability is the ability to provide data and information to users with adequate levels of connectivity, confidentiality, security, reliability, timeliness, access and accuracy, as well as the ability to adapt these in response to changes in business needs and directions. Information management, supported by technology, enables higher-order business capabilities, which in turn influence the development of the organization (SAMBAMURTHY; SUBRAMANI, 2005).

Information is a source of knowledge and a competitive advantage. In an edition of The New York Times, Wurman (1989) wrote:

> One day of the week contains more information than an ordinary mortal could receive in a lifetime in seventeenth-century England; in the last thirty years more, new

> information has been produced than in the preceding five thousand years. In this context, it can be said that knowledge is the 'currency' of our time, and the speed of change is the 'rate of inflation'. The higher this rate, the faster this currency loses its value (WURMAN, 1989, p. 32).

Information management capability can play an important role in leveraging knowledge resources in organizations (SAMBAMURTHY; SUBRAMANI, 2005). Organizations often implement information systems that are specifically designed to support various aspects of information and management activities (ALAVI; LEIDNER, 2001).

Effective information management can minimize process variability by providing a common model for all workers to use in performing their tasks, which in turn improves organizational performance (HUANG et al., 2015).

Information management capability is a critical enabler of customer management capability. Companies with greater ability to plan and integrate their information technology resources and provide timely information are more effective in improving customer service and relationships (HUANG et al., 2015).

Better information management capabilities enable companies to gather customer information and disseminate relevant content through the Internet, virtual communities and information channels (NAMBISAN, 2002). A high level of information and management capabilities enables organizations to design metrics and analyses that provide visibility into the real-time performance of various processes; integration between processes and anticipation of degradation in process performance (KALAKOTA; ROBINSON, 2003).

ORGANIZATIONAL PERFORMANCE

Historically, the multidimensionality of the concept of organizational performance is used to maximize or minimize a function previously defined as Performance Index (PI), aiming to find an "optimal solution" to the problem, that is, one that results in the highest possible PI (KAPLAN; NORTON, 2004).

There are numerous metrics and tools for measuring organizational performance and the performance of people, areas and corporations. The most common is the BSC (Balanced Scorecard), which can be translated as "Balanced Performance Indicators". This performance measurement and management methodology was developed by professors at Harvard Business School (KAPLAN; NORTON, 2004).

Organizational performance in the industry must be constantly improved and established as a target to be repeatedly achieved by organizations. Performance will fluctuate frequently and its goals will be improved according to internal and external market indicators, which will permeate the direction of previously defined goals.

According to Barney (2002), the evidence that a company has a sustainable competitive advantage is the presence of performance consistently above the norm. Competitive advantage can originate both from unique resources and competencies, as well as from the exploitation of a specific and protected position in the market structure (COOL; COSTA; DIERICKX, 2002).

DEFINITION OF HYPOTHESES

Based on a literature review and the work of Huang et al. (2015), four groups of concepts emerged as influencing organizational performance: innovation, technology creation, quality management, and information management capability. The following hypotheses capture the influence of these constructs. The dependent variable is organizational performance. In accordance with the research purpose, this study develops four hypotheses to explore the effects of the relationships. The description of these hypotheses is listed below.

The definition of the hypothesis is closely related to the formulation of the problem. Hypotheses can be defined as attempts to solve the research problem; they are necessary in studies that attempt to determine the factors or reasons that influence certain events; that intend to analyze relationships between phenomena; or that seek to determine the existence of certain characteristics (RICHARDSON, 2010). The questions formulated below were extracted from the work of HUANG et al, carried out through a careful survey of senior executives in Taiwanese companies.

According to Richardson (2010), formulating a hypothesis is the next step after defining the problem. Once the problem has been determined, the researcher must define what to research and ask himself what the possible answers to the research problem are; only then must he select those that seem most appropriate to him in order to validate his tests using the information collected. The possible answers are the hypotheses that detail the objectives of the research and guide the search for an explanation of the problem being researched.

POPULATION AND SAMPLE

The research is limited to the scope of the Industries of the State of Minas Gerais, Brazil; however, the population of this research is unknown. The identification of the respondents was characterized as optional, in order to promote greater comfort and reliability to the respondents regarding the questions in the form.

The choice of the industry of MG was limited to identify the relationship between the constructs addressed in the scope of the research, being equally effective for the academic and corporate audiences; in addition to being a basis for further in-depth studies and research related to the subject.

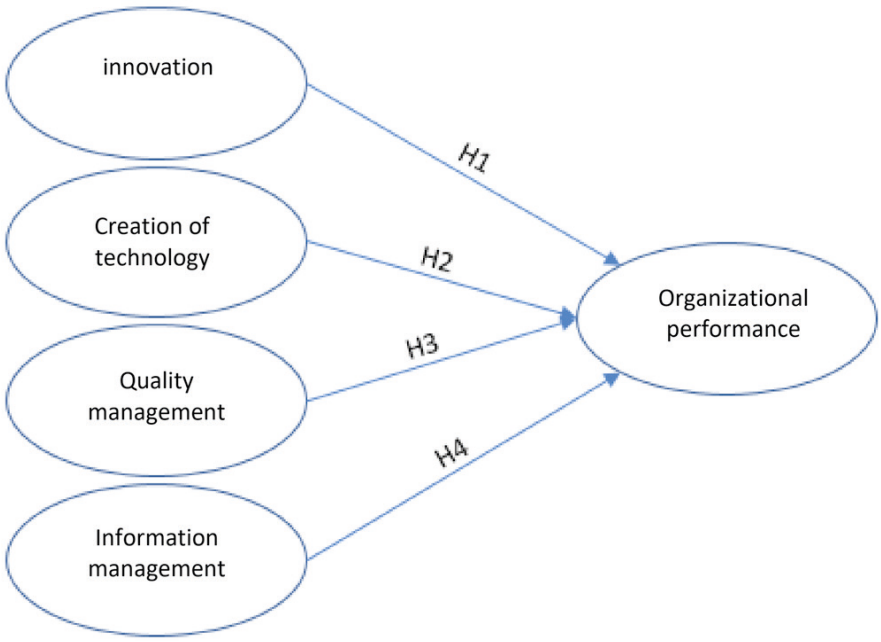
DATA COLLECTION

According to Martins and Theóphilo (2009), the questionnaire is sent to potential respondents and must be answered in writing or via e-survey, and it is recommended that the purpose and objective of the research be presented.

Therefore, the e-survey questionnaire was created using the Google Forms tool (APPENDIX A) highlighting the purpose of the research and made available by sharing a link to potential respondents, who were selected through the FIEMG industry registry http://www.cadastroindustrialmg.com.br, email, WhatsApp, LinkedIn and FUMEC mailing list (exclusively master's and doctorate programs).

Initially, there was an attempt with FIEMG to make the industry registry available via.csv, thus facilitating the sending of invitations to respond to the questionnaire. As this was not successful, a tool was developed in.html to extract the data. The extracted file was used to send the e-survey; however, the participation of respondents was quite low, due to the outdated information in this registry. Out of a total of 14,595 registered companies, only

Hypothesis	Description
H1	There is a positive effect of innovation on Organizational Performance
H2	There is a positive effect of Technology Creation on Organizational Performance
H3	There is a positive effect of Quality Management on Organizational Performance.
H4	There is a positive effect of Information Management on Organizational Performance.



Source: Adapted from HUANG *et al.*, 2015

Construct	Item	Description
Innovation	I1	Our team members provide their innovation manuals and methodologies to other team members.
	I2	Our team members share their experience or know-how of innovation work with other team members.
	I3	Our team members apply learned innovation knowledge and acquired experiences.
	I4	Our team members use innovative knowledge to solve new problems.
	I5	Our team members apply innovative knowledge to solve new problems.
Creation of technology	CT1	Our team members have specialized technology creation knowledge related to the tasks performed.
	CT2	Our team members rely on other members' knowledge of technology creation over the credibility of the project.
	CT3	Our team members trust the information that other team members bring to the discussion.
	CT4	Our team members know each other and have the ability to work together in a well-coordinated manner.
	CT5	Our team members have the technology creation capabilities to respond to task-related issues smoothly and efficiently.
Quality management	GQ1	There were identified improvements in productivity, service levels and efficiency.
	GQ2	It uses technology to support quality management assurance and improvement.
	GQ3	Intense competition in the supply chain requires assessment from the customer's perspective and attention to quality management processes.
	GQ4	Customer satisfaction is affected by perceived quality.

Information management	GI1	Our team has information management support for collaborative work regardless of time and location.
	GI2	Our team has information management support to communicate between team members.
	GI3	Our team has information management support to search for and access the information you need.
	GI4	Our team has information management support for systematic storage.
	GI5	Our team members share their official work information reports and documents with other team members.
Organizational development	DO1	The team's products were of excellent quality.
	DO2	The team managed time effectively.
	DO3	The team met important deadlines on time.
	DO4	Performance indicators linked to strategy and management; otherwise it may be dysfunctional.
	DO5	It focuses on managing and evaluating organizational performance.
	DO6	The Scorecard (measurement metrics) can be used to manage, rather than simply monitor, organizational performance.

57 responded to the questionnaire through this communication channel, that is, less than 0.4% of the total. Unfortunately, it proved to be quite inefficient, and we recommend and suggest that FIEMG update this registry with its clients.

In a second step, the PPGSIGC – FUMEC secretariat was asked to send a mailing list for the institution's internal registry of master's and doctoral students, increasing the number of respondents from 57 to 133.

Finally, the master's student's private contact list from Yahoo, WhatsApp and Linkedin was used to disseminate the e-survey, reaching a total of 257 respondents. The research was completed on 11/03/2017 at 3:00 p.m.; the data were subsequently compiled to validate the constructs. The table summarizes the responses by database.

Source	Respondent	Percentage
FIEMG Base	57	22%
PPGSIGC Base	76	30%
Private Base	124	48%
	257	

Source: Prepared by the author.

DATA ANALYSIS AND INTERPRETATION TECHNIQUE

The database consisted of 257 individuals, who were assessed on 34 variables, including 9 sociodemographic variables and 25 variables related to 5 constructs (Innovation, Technology Creation, Quality Management, Information Management and Organizational Performance).

An analysis of outliers was performed, which are observations that present a response pattern different from the others. According to Hair, et.al. (2009), four types of outliers can be classified: (1) errors in data tabulation or coding errors; (2) observations resulting from some extraordinary event; (3) extraordinary observations for which the researcher has no explanation; and (4) observations that are within the usual range of values for each variable, but are unique in their combination of values among the variables. Type 2 and 3 outliers can be classified as univariate, while type 4 outliers can be classified as multivariate.

No values were found outside the range of the scale of their respective variables, thus not evidencing the type of outlier related to an error in the tabulation of the data. In addition, we sought to verify the existence of univariate outliers, which consist of the verification of some divergent response based on each of

the variables of the model, and multivariate outliers, which present a different response pattern considering all variables at the same time.

Univariate outliers were diagnosed by standardizing the results, so that the mean of the variable was 0 and the standard deviation was 1. For this purpose, observations with standardized scores outside the range of |3.29| were considered outliers (HAIR; et al., 2009). Based on this criterion, 29 (0.3%) observations were found that were considered atypical in a univariate manner.

Multivariate outliers were diagnosed based on the Mahalanobis D^2 measure. According to Hair, et al. (2009), this measure verifies the position of each observation, compared with the center of all observations in a set of variables, and, at the end, a chi-square test is performed. Individuals who presented a significance of the measure lower than 0.001 were considered multivariate outliers. According to this criterion, 7 (2.3%) atypical individuals were found in a multivariate way.

Since it is believed that the observations are valid cases of the population and that, if they were eliminated, they could limit the generality of the multivariate analysis, despite possibly improving its results (HAIR; et al., 2009), it was decided not to exclude any of the cases.

PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

The majority of individuals (70.8%) were male. The vast majority of individuals (86.4%) had at least a bachelor's degree. 68.1% of individuals had more than 11 years of experience. A considerable portion of individuals (19.1%) worked in metallurgical industries. Almost half of individuals (44.5%) worked in industries whose revenue was above R$3,600,000.01. Most employees (63.8%) worked in industries whose number of employees was greater than 51. A large portion of individuals (38.9%) were technicians or analysts. Almost all individuals (89.1%) were from Minas Gerais. Most individuals (49.4%) were from Belo Horizonte.

It is worth noting that the items were coded on a Likert scale of agreement from -1 (completely disagree) to 1 (completely agree) and, in order to present and compare the items, the bootstrap interval with 95% confidence was used. Thus, intervals strictly smaller than 0 indicate that individuals tended to disagree with the item; on the other hand, intervals strictly larger than 0 indicate a tendency to agree with the item and intervals that contain 0 indicate neither agreement nor disagreement with the item.

ANALYSIS OF CONSTRUCT VARIABLES

The following tables, graphs and figures illustrate the description of the constructs. It is worth noting that the responses to the items were converted to a scale of 1 to 5, with 1 being "I completely disagree" and 5 being "I completely agree". Thus, it follows that:

Individuals tended to agree, on average, with all items of the Innovation construct. Furthermore, according to the confidence interval, there was no significant difference between the items in terms of the response means, since the intervals overlapped.

	Variables	N	%
Gender	Female	75	29,2%
	Male	182	70,8%
Education	High School	35	13,6%
	University level (Graduation)	111	43,2%
	Specialization	86	33,5%
	Master	21	8,2%
	Doctorate	3	1,2%
	Post-doctorate	1	0,4%
Length of professional experience	Over 20 years	74	28,8%
	From 11 to 20 years	101	39,3%
	From 6 to 10 years	64	24,9%
	Less than 5 years	18	7,0%
Type of industry	Electrical and communications equipment	15	5,9%
	Mechanical	17	6,6%
	Metalúrgica	49	19,1%
	Transformation of non-metallic minerals	15	5,9%
	Others	160	62,5%
Income	Up to R$360.000,00	49	19,8%
	Between R$360.000.01 and R$3.600.000,00	88	35,6%
	Between R$3.600.000,01 to 300.000.000,00	67	27,1%
	Over R$ 300.000.000,00	43	17,4%
Number of employees	Up to 10	28	10,9%
	From 11 to 50	65	25,3%
	From 51 to 200	64	24,9%
	Over 200	100	38,9%
Position	Director/Superintendent	23	8,9%
	Manager	51	19,8%
	Supervisor/Coordinator	66	25,7%
	Technician /Analyst	100	38,9%
	Others	17	6,6%
State	Ceará	1	0,4%
	Espírito Santo	2	0,8%
	Goiás	2	0,8%
	Maranhão	1	0,4%
	Minas Gerais	229	89,1%
	Paraíba	1	0,4%
	Rio de Janeiro	4	1,6%
	Santa Catarina	2	0,8%
	São Paulo	14	5,4%
	Sergipe	1	0,4%
City	Belo Horizonte	127	49,4%
	Other cities	130	50,6%

Source: Research data (2017)

Construct	Item	Average	D.P.	I.C - 95%[1]
Innovation	I1	3,71	0,94	[3,59; 3,83]
	I2	3,75	0,84	[3,64; 3,86]
	I3	3,88	0,83	[3,79; 3,98]
	I4	3,74	0,90	[3,63; 3,84]
	I5	3,79	0,90	[3,68; 3,89]
Creation of technology	CT1	3,74	0,80	[3,64; 3,84]
	CT2	3,79	0,75	[3,70; 3,89]
	CT3	3,84	0,76	[3,75; 3,93]
	CT4	3,88	0,78	[3,78; 3,97]
	CT5	3,74	0,80	[3,64; 3,84]
Quality management	GQ1	3,88	0,71	[3,79; 3,96]
	GQ2	3,95	0,72	[3,86; 4,04]
	GQ3	3,93	0,76	[3,85; 4,02]
	GQ4	4,18	0,71	[4,09; 4,27]
Information management	GI1	3,70	0,84	[3,60; 3,81]
	GI2	3,88	0,78	[3,78; 3,97]
	GI3	3,79	0,88	[3,68; 3,89]
	GI4	3,76	0,90	[3,65; 3,88]
	GI5	3,73	0,90	[3,62; 3,83]
Organizational development	DO1	3,86	0,68	[3,77; 3,93]
	DO2	3,52	0,82	[3,42; 3,61]
	DO3	3,61	0,83	[3,51; 3,70]
	DO4	3,60	0,84	[3,49; 3,69]
	DO5	3,68	0,81	[3,58; 3,77]
	DO6	3,91	0,71	[3,83; 4,00]

[1]Bootstrap break.

ANALYSIS OF THE MEASUREMENT MODEL

In the analysis of the measurement model, the convergent validity, discriminant validity and reliability of the constructs are verified. Convergent validity ensures that the indicators of a construct are sufficiently correlated to measure the latent concept. Discriminant validity verifies whether the constructs effectively measure different aspects of the phenomenon of interest. Reliability reveals the consistency of the measures to measure the concept they intend to measure.

The table below presents the weights, factor loadings and commonalities of the measurement model. Thus, it follows that:

- All weights were significant, indicating that all items are important in forming the indicators of the constructs.
- All items presented factor loadings above 0.50.

The table below presents the analyses of convergent validity, discriminant validity, dimensionality and reliability of the constructs of the measurement model. Thus, it follows that:

- In all constructs, the A.C. or C.C. reliability index was greater than 0.60, thus demonstrating their reliability.
- According to the Kaiser criterion, all constructs were unidimensional.
- The AVEs of all constructs were greater than 0.40, thus demonstrating their convergent validation.
- According to the Fornell and Larcker (1981) criterion, there was discriminant validation of all constructs, since the maximum shared variances were lower than the respective AVEs.

ANALYSIS OF THE STRUCTURAL MODEL (INNER MODEL)

According to Hair et al. (2009), SEM (Structural Equations Modeling) is a continuation of some multivariate analysis techniques, mainly multiple regression analysis and factor analysis. What sets it apart from other multivariate techniques is that SEM allows the examination of several dependency relationships at the same time, while other techniques are capable of verifying and examining a single relationship between variables at a time.

The measurement model and regression model were performed using the PLS (Partial Least Square) method. Structural Equation Models (SEM) are very popular in many disciplines, and the PLS approach is

Construct	Item	Weight	I.C - 95%[1]	C.F[2]	Com.[3]
Innovation	I1	0,27	[0,24; 0,30]	0,83	0,69
	I2	0,22	[0,19; 0,26]	0,79	0,63
	I3	0,21	[0,18; 0,24]	0,76	0,58
	I4	0,26	[0,23; 0,29]	0,86	0,73
	I5	0,26	[0,23; 0,29]	0,86	0,74
Creation of technology	CT1	0,26	[0,22; 0,31]	0,72	0,52
	CT2	0,26	[0,23; 0,31]	0,78	0,61
	CT3	0,25	[0,21; 0,28]	0,73	0,54
	CT4	0,26	[0,22; 0,29]	0,75	0,57
	CT5	0,29	[0,25; 0,32]	0,83	0,69
Quality management	GQ1	0,42	[0,34; 0,55]	0,82	0,67
	GQ2	0,32	[0,26; 0,39]	0,79	0,63
	GQ3	0,27	[0,19; 0,33]	0,75	0,56
	GQ4	0,27	[0,19; 0,32]	0,75	0,56
Information management	GI1	0,28	[0,24; 0,33]	0,81	0,65
	GI2	0,22	[0,18; 0,25]	0,80	0,64
	GI3	0,22	[0,19; 0,25]	0,82	0,67
	GI4	0,24	[0,21; 0,28]	0,83	0,68
	GI5	0,28	[0,24; 0,33]	0,80	0,64
Organizational performance	DO1	0,24	[0,21; 0,27]	0,75	0,56
	DO2	0,26	[0,23; 0,30]	0,83	0,69
	DO3	0,25	[0,22; 0,28]	0,78	0,60
	DO4	0,18	[0,14; 0,21]	0,67	0,45
	DO5	0,23	[0,21; 0,27]	0,81	0,65
	DO6	0,19	[0,14; 0,23]	0,55	0,30

[1]Bootstrap break; [2]Factor loading; [3]Commonality.

Constructs	Items	A.C.[1]	C.C[2]	Dim.[3]	AVE[4]	V.M.C.[5]
Innovation	5	0,88	0,91	1	0,67	0,54
Creation of technology	5	0,82	0,88	1	0,59	0,54
Quality management	4	0,79	0,86	1	0,61	0,35
Information management	5	0,87	0,91	1	0,66	0,43
Organizational performance	6	0,83	0,88	1	0,54	0,45

[1] Cronbach's alpha, [2] Composite Reliability, [3] Dimensionality, [4] Variance Extracted; [5] Maximum Shared Variance.

Endogenous	Exogenous	β	E.P. (β)[1]	I.C. - 95%[2]	Value-p	R^2
Desempenho organizacional	Innovation	0,27	0,07	[0,13;0,40]	0,000	57,70%
	Creation of technology	0,21	0,07	[0,05;0,35]	0,002	
	Quality management	0,14	0,05	[0,03;0,25]	0,007	
	Information management	0,28	0,06	[0,17;0,40]	0,000	

[1] Standard error; [2] B*ootstrap break*; GoF = 59,34%.

an alternative to the traditional covariance-based approach. The PLS approach has been referred to as a smooth modeling technique, with minimal demands, when considering measurement scales, sample size and residual distributions (MONECKE; LEISCH, 2012).

There was a significant (p-value=0.000) and positive (β=0.27 [0.13;0.40]) influence of Innovation on organizational performance, therefore, the greater the Innovation, the greater the organizational performance. The result of this research is in line with the work of Liebowitz (1999), Bessant and Tidd (2009), and Terra et al. (2012). The authors state that innovation is one of the factors that influence and improve organizational performance. These combined factors are fundamental pieces for organizational leverage and competitive market differentiation.

There was a significant (p-value=0.002) and positive (β=0.21 [0.05;0.35]) influence of Technology creation on organizational performance, therefore, the greater the technology creation, the greater the organizational performance. The result confirms the statements of Tigre and Noronha (2013), Zackiewicz, Bonacelli, and Salles Filho (2005) and Mcafee (2010), who emphasize that technology is a key factor for the self-sustainable development of industries. Technology is capable of improving processes and products, in addition to responding more quickly to market needs.

There was a significant (p-value=0.007) and positive (β=0.14 [0.03;0.25]) influence of Quality Management on Organizational Performance, therefore, the greater the quality management, the greater the organizational performance will tend to be. The result agrees with Scholtes (1992) and Case (2002). The authors state that quality plays a fundamental role in an increasingly competitive market.

Quality aligned with organizational performance allows companies to monitor or even anticipate possible adversities or market needs, thus maintaining their profitability and distancing themselves from the competition.

There was a significant (p-value=0.000) and positive (β=0.28 [0.17;0.40]) influence of Information Management on Organizational Performance, therefore, the greater the Information Management, the greater the Organizational Performance. The result confirms the position of authors Wurman (1989) and Nambisan (2002), when they determine that companies with a greater capacity to plan and integrate their information technology resources and provide timely information are more effective in improving customer service and relationships. Information is knowledge and knowledge is a competitive advantage, capable of providing more assertive results in a shorter period of time.

The constructs Innovation, Technology Creation, Quality Management and Information Management were able to explain 57.70% of the variability in Organizational Performance. In addition, it is worth noting that the model presented a Gof of 59.34%.

	Hypothesis	Result
H1	There is a positive effect of Innovation on organizational performance.	Confirmed
H2	There is a positive effect of Technology Creation on Organizational Performance.	Confirmed
H3	There is a positive effect of Quality Management on Organizational Performance.	Confirmed
H4	There is a positive effect of Information Management on Organizational Performance.	Confirmed

Source: Prepared by the author.

COMPARISON OF INDICATORS WITH VARIABLES

The following is a description of each indicator, and Graph 7 illustrates this description. It is worth noting that they are on a scale of 1 to 5, with 1 being "completely disagree" and 5 being "completely agree". Thus, there was a tendency to agree with all indicators. Furthermore, according to the confidence interval, the mean of the Quality Management indicator was significantly higher than the mean of the other indicators.

Indicators	Average	D.P.	I.C - 95%[1]
Innovation	3,77	0,73	[3,68; 3,86]
Creation of technology	3,80	0,60	[3,72; 3,86]
Quality management	3,97	0,57	[3,90; 4,04]
Information management	3,77	0,70	[3,68; 3,85]
Organizational performance	3,69	0,58	[3,62; 3,75]

Source: Prepared by the author.

FINAL CONSIDERATIONS

This study aimed to analyze the relationship between innovation, technology creation, quality management, information management and organizational performance in the context of industries in Minas Gerais.

To achieve the proposed objective, the following specific objectives were established:

To verify the level of influence of innovation, technology, quality management and information management on organizational performance; to correlate the constructs innovation, technology, quality management and information management with organizational performance; to validate the relationship between the construct's innovation, technology, quality management and information management with organizational performance;

The research was characterized as quantitative, using an e-survey for data collection, with 257 respondents, all from the industry in Minas Gerais. Exploratory factor analysis and structural equation modeling techniques were used to process the data.

It is important to note that both the general and specific objectives were achieved by this research work. The general objective was achieved based on the results of the research, which demonstrate the tendency of respondents to agree with all statements related to the positive impact on organizational performance. The data were tabulated and processed using structural equation modeling with partial least squares estimation (PLS-SEM), which allowed confirmation and acceptance of all hypotheses.

Regarding the specific objectives, they were revisited and compared with the results achieved, evidencing their fulfillment through the theoretical framework, application of structural equation modeling techniques and empirical findings supported by the research, in which it was possible to verify the effects arising from the relationships between the variables of the analysis model proposed in this research.

Therefore, through the statements of the research instrument, it was possible to validate the positive relationship between the established constructs, according to the perception of the respondents, as per the analysis of the results presented in the previous chapter.

The practices elucidated in this study reinforce the relationships between the construct's innovation, technology creation, quality management, information management and organizational performance, in a single proposal, seeking to understand the impacts and relationships between them. The research shows, in the industry of Minas Gerais, a strong interaction between the constructs in the evolution of organizational performance.

The result of the research demonstrates how innovation and other constructs can be transformative, by impacting the organizational performance of organizations, promoting new ways of doing business. This way, it was proven, quantitatively, through a conceptual model, real data collected by the sample and the use of structural equation modeling, that there are opportunities to promote innovation and, consequently, the creation of value in organizations.

It is believed that this research will bring contributions to the academic public and to the Industry of Minas Gerais, by addressing innovative and highly relevant topics for organizations and Colleges/Universities.

The limitation of this study refers to the restriction of the sample, composed only of the industry of Minas Gerais, although this was intentional. As future research, it is suggested to expand the research to other sectors or economic segments, thus comparing the data presented in this research.

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