

## Technology and Influence on Innovation

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**Abstract:** Innovation can be the key element of a company, yet it is dependent on business resources. The relationship between innovation and performance is addressed by several authors who advocate this theme as a driver to solve problems at the business level and subsequently improve performance. Innovation is essentially under great uncertainty, but little information exists about innovation in developing countries. The present research aims to add knowledge about innovation in developing countries, analyzing whether innovation improves business performance (influenced by technology). Thus, the research question is: What is the relationship between innovation and performance in companies? These hypotheses are related to a specific objective: to identify the factors that improve the company's performance. Using secondary data obtained by the World Bank, and seeking to make known developments in innovation and the relationship with technology and performance in developing countries, the correlation of several variables was worked out in a first approach to the theme through an analysis factorial. It is concluded that there is no positive relationship between performance and innovation in developing countries.

**Key words:** innovation; performance; technology; business; resources

**JEL codes:** O350

### 1. Introduction

Innovation refers to a criterion that is not technology or science but a change in an economic-social landscape, i.e., a change in the behavior of people/consumers and/or producers, such as citizens, students or teachers (Drucker, 1986).

Innovation is the theme that will be addressed in the course of this article, since it has been developed combining all existing barriers into excellent business opportunities. Leite (2002) cited by Cerveira (2009) defines innovation as the basis of entrepreneurship and the key element in the competitiveness of companies.

The impact of innovation on a company's performance can range from increasing sales to increasing productivity and efficiency (Moreira, Gherman & Sousa, 2017). From the point of view of company strategy, it is crucial to identify the innovations (and the type of innovations) that can improve the company's performance (OECD, 2005).

The present research has the objective to analyze if the innovation improves the performance of the companies (influenced by the technology). Thus, the research question to be answered during the article is: What

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is the relationship between innovation and performance in companies? To answer the question, the research hypotheses will be formulated and tested empirically.

These hypotheses are related to a specific objective: to identify the factors of innovation that improve the performance of the company. The article is divided as follows: Review of Literature and Hypotheses, Methods, Results, Discussion and Conclusions.

### **1.1 Review of Literature and Hypotheses**

Innovation is the creation and adoption of new ideas (Gopalakrishnan & Damanpour, 1997) which can be the (direct) result of a choice or determined by external conditions (Moreira, Gherman & Sousa, 2017).

Several studies of trade flows have adopted a technology-based perspective as the starting point (Roper & Love, 2002). Leidner et al. (2010) identified seven information-based innovations (study conducted in a hospital environment) and Omachonu and Einspruch (2010) defined technology as one of the main drivers of innovation (Moreira, Gherman & Sousa, 2017).

H1: Innovation is driven by Technology

Innovation can occur in several ways, according to Pires and Marcondes (2004) may be radical or incremental (Roberts, 1988; Leifer et al., 2000). For Mendes (2014) incremental innovation implies alteration and improvement of some components, maintaining the way in which they are interconnected while, radical innovation results in a new architecture, that is, a complete change to what exists.

Although incremental innovations are more frequent than radical innovations, the latter are positively associated with performance (Moreira, Gherman & Sousa, 2017).

There are two main theoretical lines on the relationship between innovation and trade (Wakelin, 1998): Neo-endowment models — the specialization is based on material supplies, working capital and more recently human capital and knowledge and technology-based models (Roper & Love, 2002). It can be said that innovation is, for many, synonymous of development and progress, and is usually associated with advanced technology (Marques, 2004).

Technological innovation is directly related to information (Porter & Millar, 1985) and can radically modify the competition rules, through changes in the nature of the competition in industry, including the access to bank financing, the ability to generate new business and the fact that it can be considered as a lever for the company to create competitive advantage (Pires & Marcondes, 2004).

Innovation is the result of the skills and capacities that are accumulated over time and whose stock can be used for strategic leverage of changes but limited by the direction and adjustments of organizational efforts (Pennings & Harianto, 1992; Pires e Marcondes, 2004).

H2: Business innovation influences the performance

Although Schumpeter's work on innovation can be discussed more rigorously, Marques (2004) argues that it is only necessary to know that the innovation process generates more than normal returns. In support of this view, Geroski et al. (1993), also cited by Marques (2004), examined the relationship between innovation and company profitability and found in a sample of 539 companies in the United Kingdom that each innovation increases the profit margins of innovative firms by 16.5% relative to the average of the sampling.

Finally, we analyze innovation through entrepreneurs, that is, they have behavioral characteristics that distinguish them from other people because they use innovative ways of thinking (Kao, 1998 cited by Leite) instead of solving the problems in the way they are presented to them, identifying segments of new clients or to explore (Cerveira, 2009). For a better approach, entrepreneurship has been studied by various disciplines and by

researchers seeking to focus on different aspects, generating diverse definitions for important concepts. There are different views on the subject of entrepreneurship, from the perspective of Management to Drucker, the designation of entrepreneur cannot be applied to everyone and any individual who starts a small business because the entrepreneur is one who simultaneously creates new types of demand and products or services (Drucker, 1986). As such, the development of a business by an entrepreneur is linked to their need for personal fulfillment, affiliation needs (being close to other people, getting a good personal relationship) and power (they are people with a tendency to dominate or influence others) according to the psychological perspective of McClelland (Cerveira, 2009). Economically, Schumpeter views entrepreneurship from the perspective of creative destruction (from one type of product or technology to another that represents a clear break with the past) (Cerveira, 2009).

In this context, the conceptual research model aims to determine the main factors of innovation that influence the performance of companies, stimulated by technology. Figure 1 looks at the company performance variable and a set of variables, referring to innovation as well as to technology.

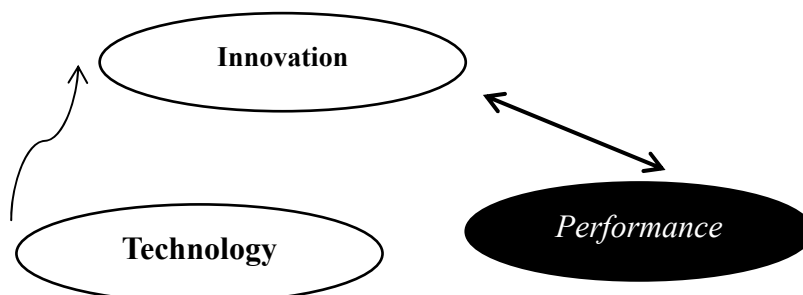


Figure 1 Conceptual Model — Own Elaboration

Finally, some ways of measuring/measuring company innovation are presented and some authors suggest as the main criteria for the measurement of the innovation capacity of companies the type of inputs and outputs of the process of innovation (Lundvall, 1992; Marques, 2004). Inputs can include patents as a generic measure of innovation, while outputs, which may be individual or specific to each organization, include advances or improvements in new products, goods and services, as well as quantity of technological advances involved in the production process (Ferreira & Godinho, 2010; Santos, 2013).

The quantity and quality of services offered to customers can also be considered indicators of innovation (Marques, 2004).

There are several empirical studies that propose alternatives such as the sale of new products (Liu & White, 1997; Santos, 2013), changes in the level of market values of the company (Pakes, 1985; Santos, 2013), the number of new products (Fritsch, 2002; Santos, 2013) and the number of patent citations (Trajtenberg, 1990; Santos, 2013). Obviously some of these measures lead to similar problems (Li, 2009; Santos, 2013) and patents seem to be widely accepted as an indicator of innovation (Li, 2009; Santos, 2013).

According to the theories of industrial organization, profitability is a transitory and non-persistent phenomenon due to high competition, that is, creative imitation can lead to abnormally high profits; however, these are only recorded until other competitors enter the market (Jacobson, 1988; Mueller, 1977, 1986; Rumelt, 1987, 1991; Marques, 2004).

However, very little is known about the impact of enterprise level innovation in developing countries. Most existing studies are limited to either a country or a specific sector (Bogliacino et al., 2012; Cirera & Muzi, 2016).

## 2. Methods

The data used for analysis were collected from a secondary database, taken from the Business Analysis Unit of the World Bank (USA). The database included information on innovation and technology and performance. The years under analysis are 2014 (11 countries); 2015 (9 countries); 2016 (18 countries) and 2017 (6 countries) (Appendix I). The variables selected for evaluation of innovation and technology were selected based on the previous literature review and are: Own site; Email; New product; New product with market innovation; Process of innovation and investment in development. The variables used for the performance of companies are: Acquisition of fixed assets; Sales/year; Productivity; Employment growth and Ability to use (Appendix II).

The Innovation Indicators presented by the Business Analysis Unit of the World Bank are built on a set of issues based on the Organization for Economic Cooperation and Development's Oslo Handbook (OECD, 2005).

In this investigation, the sample is all formal (registered) companies with 5 or more employees and the indicators are based on surveys of more than 127.000 companies in 139 countries (World Bank, 2017). In this case, state enterprises are excluded, from a number of areas such as construction, restoration, logistics, communication and information technology.

This study seeks to contribute to the understanding of the influence of innovation and technology on companies' performance. The objective of this study is to determine the factors of innovation that have influence (positive and negative) on the performance of companies. Therefore, the main objective is to analyze whether innovation influences the performance of the company.

## 3. Results

The data obtained by secondary data were submitted to statistical treatment using a factorial analysis, using SPSS (v.24). The values of the index Kaiser-Meyer-Olkin (KMO) indicate that Factorial Analysis is appropriate, varies from author to author. For Hair, Anderson and Tatham (1987) acceptable values are between 0.5 to 1.0.

The factorial analysis, with principal components analysis and varimax rotation using the KMO method (0.544). Thus, the factorial analysis presented in Table 1 was performed, considering that the value is acceptable but not relevant.

**Table 1 Factor Analysis — Own Elaboration**

Areas	Variables	Factors			
		Innovation	Production	E-commerce	Capacity
<b>Innovation and Technology</b>	Own site			0.835	
	E-mail	0.504		0.635	
	New product	0.805			
	New Product with Innovation in the Market				-0.584
	Innovation Process	0.900			
	Investment in Development	0.827			
<b>Performance</b>	Usability				-0.802
	Sales/year		0.971		
	Job growth			-0.760	
	Productivity		0.930		
	Acquisition of fixed assets				0.521

The Innovation Factor groups the variables New Product, Innovation Process, Investment in Development, all these variables with scores greater than 0.8. The e-mail comes together, but in a score closer to 0.5 that is, it is verified that the innovation processes are stimulated by the use of e-mail.

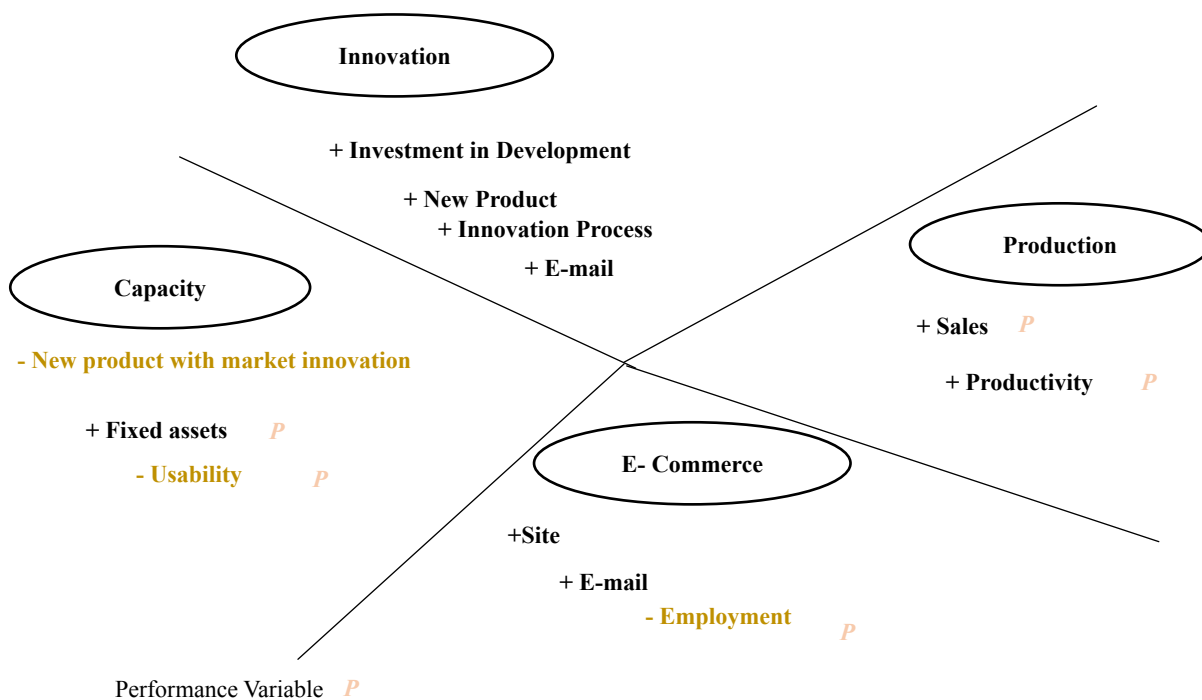
On the other hand, the Production factor presents high sales and productivity scores (> 0.9) that is, there is a direct relationship between productivity and the percentage of sales per year.

The third factor presented, E-Commerce, is associated with the use of own site (0.835) and e-mail (0.635) as sales promoter and communication facilitator between the company and the client. At the same time, employment growth (-0.760) appears in the opposite direction, that is, while the forms of communication increase and improve, there is a decrease in job creation.

Finally, arises the Capacity Factor, which groups variables of innovation but also of performance. This factor adds value to the knowledge held in this area, since the acquisition of fixed assets (0.521) leads to a divestiture in innovative products in the market (-0.584) and in parallel to a decrease in capacity utilization (-0.802).

#### 4. Discussion

The Innovation Factor (Factor 1), groups variables New Product, Process of Innovation, Investment in Development, all with high scores. In parallel, it covers the e-mail variable, although it may not be significant, but this variable plays a role in stimulating innovation. Thus, the H1: Innovation is driven by technology is not rejected.



**Figure 2 Contributions of the Factorial Analysis (Own Elaboration)**

In the illustration above, we present a scheme that briefly describes the results of the factorial analysis performed previously as well as the main conclusions to be drawn from the study.

In the capacity factor, it is verified that by increasing the acquisition of fixed assets, the company reduces the capacity of use and in parallel reduces the capacity of bet on innovative products in the market.

That is, it can be said that performance only improves through fixed assets when there is a decrease in the intensity of work in new innovative products in the market, i.e., H2: The innovation of companies influences performance, but does not influence positively as it was to wait.

### 5. Conclusion

The main objective of the research was to analyze whether innovation improves performance influenced by technology in companies. Based on the literature review, it has been found that there may be theoretical foundations for technology to influence innovation and in turn, innovation influence performance. However, the literature review is based on developing country realities and the current work, the study is based on data from developing countries.

The main results obtained with the factorial analysis, considering the aforementioned objectives, can affirm that innovation is driven by technology (H1), however, there is no direct positive relation of innovation to performance, i.e., innovation influences performance in a negative way: with the use of own sites and e-mails the performance (jobs) decreases. Thus, it can be affirmed that there is a relationship between performance and innovation, but that this relationship differs from the studies presented in the literature review.

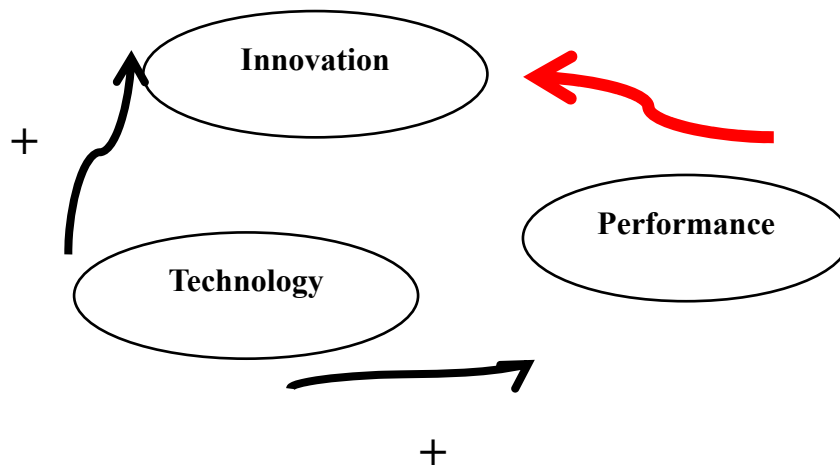


Figure 3 Conclusion (Own Elaboration)

Thus, we conclude that technology has an effect on innovation and in parallel in the performance, but there is no positive effect of innovation on the performance of the company, as one would expect. This conclusion arises as work done with developing countries, thus concluding that the lack of business maturity in these developing countries is not favorable to the innovation-performance relationship, as can be seen in illustration 3.

In the article development, one of the main limitations is the data about the technological environment that did not allow to develop another type of analysis, because in the available data there are few variables associated to the technology. In future work, an analysis should be conducted in-depth using more data on technology, as well as conducting research including public (state) enterprises.

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