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The Brazilian Multinationals' Approaches to Innovation



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ABSTRACT

Brazilian multinationals, born in a country where the environment is non-conducive to the scientific breakthrough type of innovation so stimulated in other countries, are increasingly expanding in international markets, where innovativeness is an intrinsic component of competitiveness. Aiming to study Brazilian multinationals' approaches to innovation, a new analytical framework was developed assuming that the internationalization process relies on the firm's innovative capability. In turn, innovative capabilities are derived from core competences and competence formation at firm level is influenced by the characteristics of the national environment. A survey involving 61 Brazilian multinationals led to the identification of four approaches to innovation, the competences that enable each one of them and the country-of-origin effects over competence development. That led to the explanation of why firms that do not show the expected strength in R&D, but are able to combine skillfully their organizational competences, manage to develop innovative capabilities which allow them to internationalize successfully. The overall outcome suggests that the dynamic relationships among institutions – competences – innovation – internationalization are setting new grounds for the international expansion of Brazilian firms.

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1. Introduction

The aim of this paper is to develop an approach to solve a puzzle: why are Brazilian multinationals, rarely portrayed as innovators, successfully expanding in an international environment where innovativeness is a key element of competitiveness? Innovation is a sine-qua-non requirement for firms and countries to survive and prosper in the current competitive and turbulent global environment. However, if innovation is seen as the outcome of important scientific and patentable discoveries, then how can emerging countries, which lack the scientific potential of developed countries, generate firms that succeed in the innovation-based competition?

Studies that seek to establish the relationship between innovation and internationalization in companies from emerging countries have identified different causal relationships. For some authors, the innovations that provide competitive advantage in internationalization are country specific. For example, Zeng and Williamson (2007) identified cost innovation as a typical feature of Chinese enterprises, Athreye and Godley (2009) demonstrated that reverse engineering innovation was common among Indian multinationals in the pharmaceutical industry, and Ramamurti (2011) calls attention for the new phenomenon of reverse innovation or the possibility of important innovations occurring in developing countries and then trickling up to developed countries. However, other authors characterize the internationalization of companies from emerging countries as asset-seeking in the sense that companies internationalize mainly to acquire innovative capabilities and thus gain international competitiveness (Child and Rodrigues, 2005; Luo and Tung, 2007; Mathew, 2006). Emphasizing the distinction between output and innovation capabilities, Awate et al. (2012) began to shed light in that debate.

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In principle, the causalities identified by the above mentioned authors are not aligned with theories on innovation and internationalization based on multinationals from developed countries, the pioneering approach of which is attributed to Raymond Vernon (1966) and his “product life cycle” theory. When published, Vernon’s theory consolidated a number of prior developments proposed by American authors who studied productivity differentials and internationalization issues based on technology and entrepreneurship as explanatory factors, both of which have strong cultural and institutional roots in the United States. Vernon’s theory remains valid and is being refined for the case of other developed country multinationals (Abernathy and Utterback, 1975; Contractor et al., 2010; Mudambi, 2008).

In principle, Vernon’s approach is inappropriate to address the way in which Brazilian firms manage innovation because they do not display the capabilities associated to technology and entrepreneurship that American firms possess. On the other hand, Brazilian firms develop different set of capabilities that lead to different types of innovation that provide them international competitiveness. Thus, the research question becomes: “What types of innovative capabilities do Brazilian multinationals develop and what are the reasons for such development?”

To answer that question, this study uses secondary data related to innovation and internationalization as well as primary data obtained through a survey conducted on Brazilian multinational companies. The aim of this methodological approach is to relate the types of innovation adopted by Brazilian multinationals to the types of innovative capabilities they develop and then identify the country-of-origin effects that influence the formation of organizational competences. Data related to investments in R&D and patents, usually employed in studies about innovation, are also employed to fulfill the information required for analysis and interpretation.

In addition to this introduction, this paper is divided into five sections. In Section 2, the literature review addresses the concepts of innovative capabilities, organizational competences and country-of-origin effects out of which the analytical framework for the study of Brazilian multinationals is built. Section 3 elaborates on how Brazilian multinationals build innovative capabilities within the local environment. The research design, research methods and data analysis are described in Section 4, leading to the identification of four clusters of Brazilian multinationals with different approaches to innovation. The results are discussed in Section 5, where the innovative capabilities typical of each cluster are related to country-of-origin effects. Finally, in Section 6, the contributions, limitations and suggestions for future research are highlighted.

2. Building the analytical framework

2.1. The expanding concept of innovation

The basic approach to innovation relates to new outcomes, such as a new product or service. According to Birkinshaw et al. (2008), most of the publications examining innovation over the past fifty years have focused on technological innovation (e.g., Henderson and Clark, 1990; Utterback, 1994). However, “the trend over the last fifteen years has been toward exploring other forms of innovation, such as process innovation (e.g., Pisano, 1997), service innovation (e.g., Gallouj and Weinstein, 1997), and strategic innovation (Hamel, 1998; Markides, 1997), with a focus on understanding how they are managed and how they contribute to long-term firm success”.

To the notion of innovation as an outcome, several authors add the idea of innovation as a process. Bell and Pavitt (1995) define innovation as an organizational learning process in which firms develop new knowledge to manage new products, processes, markets and technologies. Hamel (2000) sees innovation as a strategic process of continuous business reinvention and creation of new business propositions, pushing the perspective of the innovation frontier far beyond products and services. Other authors advance the perspective of innovation through business models, proposing that “the pillars of innovation may come down to the $N = 1$ and $R = G$ foundations as the basis for the creation of value through the co-creation of personalized experiences with the client” (Prahalad and Krishnan, 2008). In this proposition, $N = 1$ means that both products and services must be offered in an ever-increasing customized manner, and $R = G$ means that the best resources and talents must be accessed from anywhere in the world.

2.2. Innovative capability and organizational competences

In this study, innovative capability and organizational competences will be key concepts of the analytical framework. Lawson and Sampson (2001) define innovative capability as a higher order integration capability: it is the ability to mold and manage different key organizational capabilities [competences] and resources that successfully stimulate innovation activities. At this point, the distinction between ‘competences and capabilities’ must be made explicit.

Prahalad and Hamel’s classic paper “The core competence of the organization” (1990) brings on the notion of a firm as an architecture of organizational competences. However, in 1997, Teece et al. (1997: 516) introduce a different perspective when they define dynamic capabilities as “the firm’s ability to integrate, build and reconfigure internal and external competences to address rapidly-changing environments”. In other words, firms must have capabilities or competences to systematically re-invent the corporation to cope with new challenges arising from the environment. Authors like Ghoshal and Bartlett (1988) suggest that corporations must have the competence or capability to create dynamic imbalance to avoid core rigidities (Leonard-Barton, 1992) and allow for reconfiguration.

Thus, competences and capabilities have been competing for the same position in the academic literature. Prior studies have attempted to bring order to the field. For example, Teece (2009) quoted Winter (2003) when trying to differentiate between dynamic capabilities and competences: “The archetypal enterprise with competence/resources but lacking dynamic capabilities will, in equilibrium, ‘earn a living’ by producing and selling the same product, on the same scale and to the same customer population” (Winter, 2003). Therefore, competences are accordingly associated with the management of the status quo, in which no innovative activity exists, and classified as operational management (Teece, 2009:55).

Conversely, dynamic capabilities are related to the capacity of renewing competences to achieve congruence with the changing business environment (Teece et al., 1997) involving, above all, sensing, seizing and reconfiguring (Teece, 2009). Thus, innovation is essentially related to a firm's dynamic capabilities.

In this study, innovative capability is defined as a dynamic capability, meaning the ability to mold and manage multiple organizational competences and resources aiming at the creation of innovation strategies.

2.3. Innovation capabilities, organizational competences and country of origin effects

Firm-level differences, such as competitive environments, strategies, task complexities and management styles imply that the importance of innovation processes may vary across firms and countries (Meyer et al., 2011; Tidd et al., 1997).

To analyze the country of origin effects (COE) on innovation and internationalization, the dimensions proposed by Sethi and Elango are adopted. The authors admit that "nations engender competitive advantage through a combination of factor endowments, unique cultural traits, and deliberate policy options" (Sethi and Elango, 1999) and suggest that COE comprise three sets of elements: (1) both economic and physical resources and industrial capabilities, (2) cultural values and institutional norms, and (3) national government economic and industrial policies.

The level of institutional development of a country is associated to the configuration of its formal and informal institutions. Institutions bear a set of formal rules and informal standards devised to guide interactions in society. Both these rules and standards can function as elements that constrain or encourage certain behaviors (Mudambi and Navarra, 2002; North, 1990). If societal life is likened to a game, institutions represent the 'rules of the game' and the 'players' are organizations, which are composed of groups of individuals who are guided by common interests. This implies that the formal factors (economic, financial, political, administrative, geographic and demographic) impact in the formation of competences and innovative capabilities at firm level (Mudambi and Navarra, 2002).

Institutions can be influential in the company decision-making processes as they set the level of uncertainty of operating in certain markets. Strong institutional environments reduce uncertainty by creating structures that are favorable to the execution of established contracts, thereby reducing transaction costs. Furthermore, these environments can stimulate competition to promote an attractive macroeconomic environment for the long-term micro investment decisions of enterprises and contribute to the formation of business trajectories based on dynamic innovative capabilities (Nelson, 1993; Nelson and Winter, 1982; Teece, 2009). Similarly, weak institutional environments increase uncertainty because they create structures that are unfavorable to the fulfillment of contracts, increasing transaction costs and inhibiting innovation (North, 1990).

Organizations and institutions are in a constant process of mutual interaction (North, 1990). It is important to recall the concept of co-evolution (Rodrigues and Child, 2008), in which the economic and social development processes of a country influence strategy formulation (Aulakh and Kotabe, 2008; Tempel and Walgenbach, 2007). Studies on international business investigating the impacts of institutions in international strategies were elaborated by Yiu and Makino (2002) and Meyer et al. (2011), among others.

The informal institutions that configure local culture influence innovation by other means. There are countries where entrepreneurship is cultivated thus stimulating innovation (Schumpeter, 1939) and others where a parochial, conservative and risk-averse culture inhibits innovation (Barros and Prates, 1996).

2.4. Analytical framework and research question

The analytical framework for this study is depicted in Fig. 1.

The firm is understood as a bundle of resources and capabilities, which represents sources of sustained competitive advantage when they are rare, imperfectly imitable, valuable and not substitutable (Prahalad and Hamel, 1990). In their international expansion innovative capability is required as an input for strategy formulation and implementation. Innovative capability implies in harnessing the competence base (Koc and Ceylan, 2007; Lawson and Sampson, 2001).

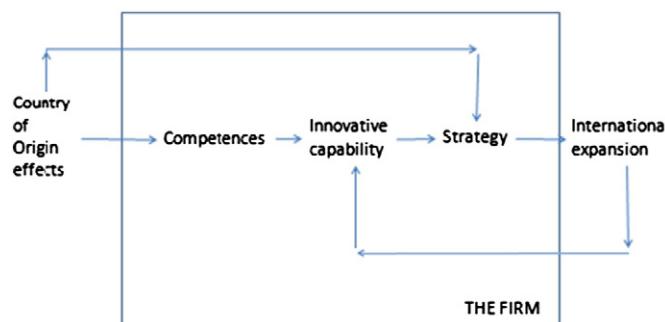


Fig. 1. The analytical framework.

Enterprises are strongly influenced by country of origin effects, in what concerns management practices (Ardichvili and Kuchinke, 2002) and competence development (Hamel and Heene, 1994; Kogut, 1991). "The influence of a nation's history, infrastructure and culture permeates all aspects of life within the country, including the norms, values, and behaviors of managers in their national companies. Nationally influenced behavioral characteristics become an ingrained part of each company's 'way of doing things' and shape its international organization structure and processes" (Bartlett and Ghoshal, 1998). Evidently, country of origin effects will also influence the process of formulating and implementing strategies.

Finally, the analytical framework proposes that internationalization itself drives the upgrading of organizational competences and the innovative capabilities of emerging multinationals through a feedback loop, as noted by Mathews (2006) and Luo and Tung (2007), among others.

3. Building innovation capabilities in the Brazilian environment

3.1. Innovation and internationalization of Brazilian companies

The performance of Brazilian companies is poor when measured by traditional indicators. Fig. 2 shows that aggregate investment in R&D is almost level since the year 2000 and the slight improvement in the recent years is not comparable to what is happening in China and India, where figures reached 9% and 1.8%, according to the Innovalatino report (2011). Symptomatically, the number of PhD-qualified staff in R&D laboratories is stabilized in 1500 over the same period.

If patents are used as an indicator of innovative activity the picture is similar. The patenting gap between OECD and Latin American countries is wide, and even the top Latin American performers – Brazil and Mexico – are well below the OECD average (Innovalatino, 2011). One of the determinants of that situation is that the Brazilian institutions regulating intellectual property have been neglected by the state, leading to a situation where it takes up to seven years for a patent request to be issued. Consequently, the productive sector became skeptical about the whole system. On the other hand, patent requests for USPTO are still modest, as shown in Fig. 3, especially when compared to China's and India's evolution.

However, among local firms, Brazilian multinationals stand out for their innovative capability. Some secondary information may help to illustrate the argument.

The Studies and Projects Finance Organization (Financiadora de Estudos e Projetos—FINEP) is the governmental institution that supports innovation in Brazil. It awards the country's most innovative companies every year. Recent winners are Brazilian multinationals: 2008 – Sabo (auto-parts), 2009 – Natura (cosmetics), 2010 – Embraer (aircraft) and 2011 – Braskem (petrochemicals). The magazine

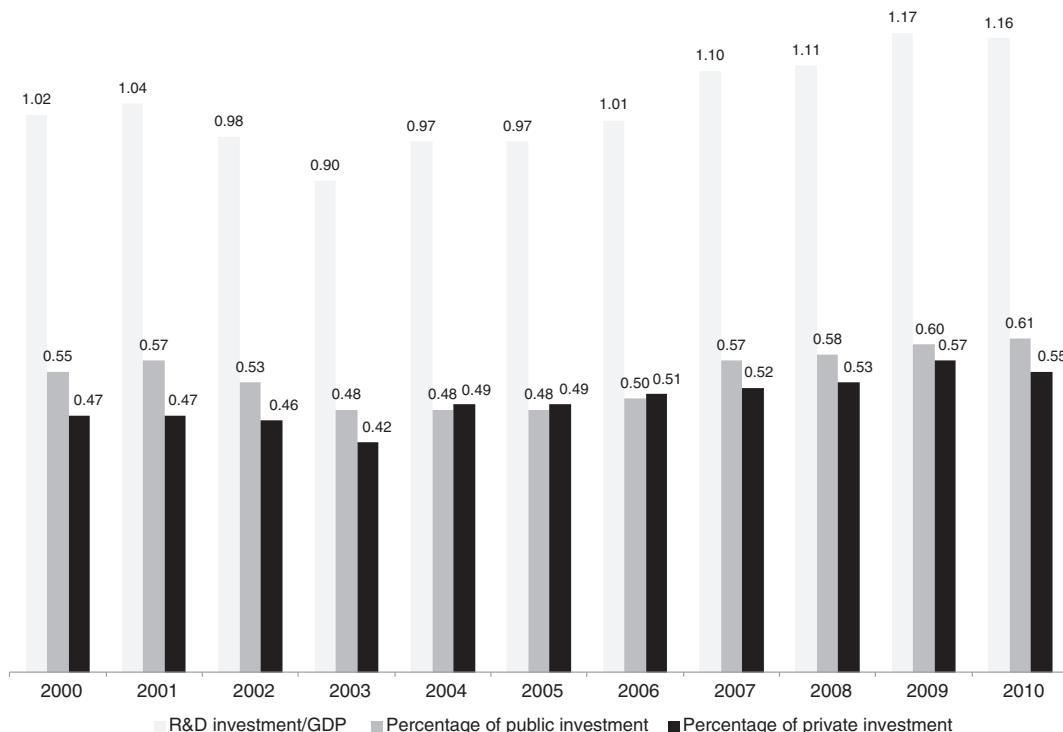


Fig. 2. Evolution of R&D investments in Brazil (2000–2010).

		2007	2008	2009	2010	2011
Brazil	Requested	375	442	464	568	586
	Granted	90	101	103	175	215
China	Requested	3,903	4,455	6,879	8,162	10,545
	Granted	772	1,225	1,665	2,657	3,174
India	Requested	2,387	2,879	3,110	3,789	4,548
	Granted	546	634	679	1,098	1,234

Source: USPTO

Fig. 3. Patenting activities in the USPTO: Brazil, China and India.

Epoca Negocios also established an innovation ranking beginning in 2009, looking at both Brazilian companies and subsidiaries of foreign multinationals operating in Brazil. To date, the winning companies have been subsidiaries of multinationals: Whirlpool has won twice, and BASF has won once. However, the Brazilian firms listed among the top 20 innovators are always multinationals, without exceptions; these firms include Natura, Embraer, Braskem, Embraco (compressors), Weg (electric motors) and Totus (IT provider), among others.

In the international sphere, there is less recognition of Brazilian multinationals as innovators: the only Brazilian representative among *Bloomberg Business Week's* 50 Most Innovative Companies is Petrobras, ranked 41st (in comparison, there are five Chinese companies on the list).

3.2. Country of origin effects on firms' innovation capability in Brazil

The influence of the sociopolitical infrastructure on innovation can be traced back to the 1930s when Brazil adopted an import substitution policy, which is currently seen to have led to weaker international competitive standing compared to countries that adopted export-led industrialization policies. This policy was discarded in the late 1980s but has not yet been replaced because in the 1990s, strictly following IMF guidelines, the government assumed that the best industrial policy is no industrial policy; the markets will decide. This decision had detrimental impact not only on industrial structure but also on the policy formulation apparatus, which was disassembled. In the past ten years, the incumbent public administrators have been attempting to reorganize institutions to allow for the effective formulation and implementation of industrial and technological policies, but outcomes have been modest to date. Besides the difficulties stemming from economic and industrial policies, there are other drawbacks associated to both educational and fiscal policies. Moreover, "one of the central problems of the low innovation capacity of Brazilian companies and the low intensity of knowledge involved in technological innovation in Brazil is that there are no support mechanisms, lines or appropriate funding for innovation in companies" (Arbix, 2007). Consequently, the environment in which Brazilian firms have been operating over the recent decades can be characterized as inconsistent and unsupportive in regards to both innovation and internationalization.

Another important factor influencing the posture of Brazilian firms toward innovation and internationalization occurred in the 1950s when the Brazilian government, aiming to accelerate industrialization, decided to transfer the leading role of this initiative to subsidiaries of foreign multinationals, especially in high-tech industries, while Brazilian private firms settled in traditional sectors (timber, paper, furniture, textiles, food, beverages, publishing and printing among others). As Vernon's product cycle theory would soon after reveal, the subsidiaries of foreign multinationals essentially became manufacturers of products that had already been standardized in developed countries; their role therefore does not include innovation of any type. At the same time, Brazilian firms remained in industrial sectors where innovation is not critical.

There were a small number of short-lived attempts to develop high tech industries in Brazil. For example, in the automobile industry, in the 1950s, there was the Romi-Isetta project for a compact car similar to the Tata Nano and, in the 1970s, the Gurgel-Itaipu project for an electric car; both ventures ended in failure, due to a lack of governmental support (in fact, they were more discouraged than supported). The same occurred in the electronics industry, where Gradiente was the national leader until succumbing to international competition when local markets were opened in the 1990s. Although several initiatives and programs to reverse this trend have been established since the mid-1990s, the number of firms that are able to compete based on product innovation is still low, as it will be shown.

The so-called large national projects, aiming at the creation of technology pull in advanced industries were short lived as well. The Renewable Energy project (in the 1970s, focusing on sustainable sources of energy, including ethanol) and the Informatics (Information Technology) program, in the 1980s, came to a halt, due to discontinuities in the institutional setting. The governmental program that had a more long-term impact on local firms was the Brazilian Program for Quality and Productivity, which was inspired by the Japanese Management Model. Its focus, however, was on shop-floor productivity.

The Brazilian culture is also unfavorable to entrepreneurial innovation. Authors like Tanure (2009) and Caldas (2006) note that Brazilian cultural traits still reflect the country's colonization by the Portuguese, who established rigid and hierarchical organizations, depleted the colony's natural riches and exploited the land through a slavery-based regime. The social elements that were introduced in the formation of Brazil's rural and agricultural society have subsequently influenced its urban and industrial society, as well as the way Brazilian firms are managed. Therefore, the stereotypical Brazilian entrepreneur is described as conservative, risk-averse and shortsighted. These characteristics do not favor the development of innovation-based enterprises. One indicator frequently mentioned is their reluctance to take on partnerships and joint projects, which are fundamental to enhance the innovative capability and speed-up innovation.

Finally, regarding factors endowment, Brazil is in a privileged condition to produce commodities. The fact that Brazil is rich in natural resources presents disadvantages and advantages. From an optimistic perspective, commodities are growing in the Brazilian trade balance, and there is evidence that global demand for commodities, and thus their prices, may be high over the next two decades. From a pessimistic point of view, what economists refer to as “the natural resources curse” must be considered. The blessing of rich natural environments may hinder diversification and innovation. According to [Mesquita Moreira \(2004\)](#), “The bulk of the empirical growth literature, at the very least, does not support enthusiasm for natural-resources and the few papers that reject the natural-resource curse confirm the benefit of diversification”.

In sum, the country of origin effects exerted by Brazil is not conducive for innovation, especially the breakthrough type of innovation.

3.3. Innovation and internationalization

There are still relatively few studies that highlight the importance of innovation in the internationalization of Brazilian companies ([Arbix, 2007; Borini and Fleury, 2011](#)). On the other hand, there are a considerable number of studies seeking to identify the factors that influence the country's export performance, especially those produced by Foundation for Foreign Trade (Fundação para o Comércio Exterior-FUNCEX) ([Veiga, 2002](#)). Recent analyses by FUNCEX show that among manufactured products, those classified as having high-tech content have presented the biggest declines. This fact can be interpreted both from the perspective of the fragility of the Brazilian industry in this sector as well as the policies and practices of the multinational corporations in developed countries that control most of the transactions.

The few studies that seek to determine the relationships between company innovation and internationalization have used an aggregate approach, working with data collected in industrial censuses or specific surveys on innovation, such as the Survey of Technological Innovation (Pesquisa de Inovação Tecnológica-PINTEC). In this context, prominence must be given to Glauco Arbix's analyses, which focus on the issues of innovation and internationalization, concluding that in the case of Brazilian companies, “technological innovation generates specific assets that enable – and encourage – the internationalization of the firm. This movement of internationalization, in turn, positively contributes to the firm obtaining a premium price for its exports” ([Arbix, 2007:71](#)). Thus, even in these types of studies, the themes of internationalization and export performance overlap.

At firm level, there are several case studies highlighting the issue of capacity for innovation. These studies include:

- Sabo, an auto parts producer that acquired the German company Kaco to increase its R&D competence ([Stal, 2008](#))
- Petrobras, which acquired Perez-Companc Argentina to diversify its energy competences ([Antonio et al., 2010](#))
- Vale, a mining company that acquired INCO, the biggest nickel company in the world, and so obtained important patents in the mining business ([IPEA, 2010](#));
- Natura, a Brazilian cosmetics company that innovates according to the principles of sustainability ([Stal, 2010](#))
- Embraer, an airplane producer that innovates mainly in project and operations management ([Bedaque et al., 2010; Fleury and Fleury, 2011](#)) and
- WEG, an electric motor producer that is innovative with regard to products ([Galina and Moura, 2010](#)).

These studies provide insights into how each multinational became internationalized and what role innovation played in this process. In comparison, the purpose of this study is to provide a panoramic picture of the innovations that support the internationalization of Brazilian companies.

3.4. Research question

In light of the previously mentioned arguments, the research question is “What types of innovative capabilities did Brazilian multinationals develop and what were the reasons for such development?”

4. Research methodology

4.1. Research design

In principle, there are two approaches to addressing the issue of Brazilian multinationals' approaches to innovation. The first approach is traditional, associating innovation with investment in R&D, number of patents and number of highly qualified individuals allocated to innovation activities, among other factors. The second approach is oriented toward characterizing the innovative capabilities of enterprises, seeking to find and understand the competences and resources that determine the type of innovation practiced by the company.

In Brazil, studies that seek to examine how Brazilian companies innovate using the first approach have faced methodological difficulties. For [Arbix \(2007\)](#) these include the problems for distinguishing Brazilian from foreign companies due to local rules declaring the ownership of capital and the incompatibility of criteria for classifying relevant information on this subject adopted by local institutions. Consequently, accessing and integrating data from different databases is extremely difficult.

In the present study, the analytical framework described in [Section 2.4](#) was applied. The basic unit of analysis is the company, and because the studied companies are multinationals, it can be assumed that the first steps of internationalization have already been completed. To have been successful in this process, each company uses competitive innovations that are generated through its innovative

capabilities, which can mobilize four different types of competences: production and operations, marketing, technology (R&D) and administrative (Fleury and Fleury, 2011; Rugman et al., 2010).

In what concerns innovation, these can be classified as product, process and management innovation, following the guidelines of the Oslo Manual (OECD, 2005). Additionally, it was assumed that country-of-origin effects can be classified as socio-political (formal institutions), cultural (informal institutions) and factors endowment.

Aiming to identify the organizational competences and innovative capabilities of the Brazilian multinationals, a survey technique was used. The identification of the basic innovation strategies (product, process, and management) came from secondary sources. Those procedures allowed the analysis of the firms' innovation approach and internationalization goal in accordance with the previously mentioned analytical framework.

The survey was designed following the steps proposed by Forza (2002) while seeking to emulate the approach developed by Knight and Kim (2009) in their study of international business competences. The questionnaire featured seventeen statements to measure different dimensions of organizational competences and innovative capabilities, as shown in Table 1 of the factor analysis. The majority of these were taken from Knight and Kim's questionnaire, although several items were added to align with the specific focus of our research. The questionnaire was presented to three experts from academia and tested on two representatives of the entrepreneurial sector to guarantee the fitness and comprehension of the employed concepts. The firm-level respondents were the managers in charge of international operations at the headquarters level, including CEOs in certain cases. These managers were asked to indicate the degree to which each of the statements applied to their company on a scale ranging from 1 to 5.

4.2. Sample

Fieldwork was conducted using a survey encompassing all Brazilian multinational companies according to the GINEBRA database. In the construction of that database, companies were admitted as multinationals only if there were clear evidences that they actively managed one or more productive operations abroad. This approach differs from other research approaches that depart from secondary information related to foreign direct investments. The database began to be constructed in 2006 and is constantly updated and compared to other lists, such as BCG Global Challengers, UNCTAD and America Economia, for cross-checking. It includes manufacturing companies, as well as technological professional services firms (Engineering and Information Technology) with project offices abroad and service companies with significant presence in other nations.

Table 1
Factor analysis.

	Component					Comunalities	Cronbach Alpha	Variance
	1	2	3	4	5			
The company has the capability to access different markets to obtain funding.	.816					.710		
The experience accumulated with the operation in Brazil has become a competitive advantage in internationalization.	.736					.659		
The company adopts criteria for good corporate governance.	.688					.625	0.813	37.50%
The company has clearly defined human resources policies to be adopted in our foreign subsidiaries.	.545					.777		
The company adapted the policies and practices of human resource management according to the subsidiary context	.536					.656		
Company functions of value chain (Commercial, Production, Product Development and Services) are highly integrated and aligned to strategic objectives.		.771				.790	0.673	10%
The introduction of new products takes place simultaneously in national and international markets.		.673				.587		
The company has great experience and capability in the use of marketing tools (design, pricing, advertising and others).		.637				.710		
The company organizes and mobilizes resources quickly when we have information from unhappy customers.		.612				.703		
The technology is standardized and available worldwide.			.779			.651		
We have the capability to communicate with people from other countries by means of modern information systems and telecommunication technologies.			.731			.747	0.724	8%
Customers and suppliers have a very positive assessment of the technological competence of the company			.638			.525		
The managers know how each of employees can contribute to creating value for customers and suppliers.			.564			.686		
The main product/service is recognized worldwide				.739		.679		
The image and reputation of the company greatly facilitated the process of internationalization.				.721		.661	0.549	7%
The company's standards of operational performance (cost/price, quality, delivery, etc.) are equal or exceed those of international competitors.					.850	.802	0.777	6%
The company responds to unexpected events, unforeseen, faster than their competitors.					.746	.788		

In bold the variables that show the largest loading factors.

Source: authors.

In 2010, 95 Brazilian firms operating in different sectors of the economy were classified as multinationals. Of these firms, 70 were manufacturing companies, and 25 were service companies. All of them were invited to participate in the survey, and 61 agreed to answer the questionnaire. This represents a response rate of 63%. Among the 61 respondents, 42 were from the industrial sector (69% of respondents) and 19 were from the service sector (31% of respondents).

Of the responding companies, approximately 47% had revenues of over \$500 million (US) dollars (large companies in Brazil), 35% earned between \$100 million and \$500 million in revenues (medium companies in Brazil), and the rest earned less than \$100 million dollars in revenues. In terms of assets, 31% of the companies had over \$500 million dollars in total assets, 18% had between \$100 million and \$500 million and the remaining companies had less than \$100 million in total assets. Regarding the number of employees, 10% had fewer than 100 employees, 25% had between 500 and 2000, 34% had between 2000 and 10,000 employees and the remainder (31%) had more than 10,000 employees in total. Thus large companies by Brazilian standards prevailed in the sample but few of them can be considered as large companies when compared to the global leaders.

4.3. Constructs

The competences construct was developed by the authors based on [Knight and Kim's work \(2009\)](#) and other research works on Brazilian multinationals ([Borini et al., 2009; Fleury and Fleury, 2011](#)). The competence construct involves the four previously mentioned types of organizational competences: production and operations, marketing, technology (R&D) and administrative, the last of which encompasses financial and human resources management competences. The seventeen statements of the questionnaire (detailed in [Table 1](#)) were developed to capture information about these four competences. A point that could not be treated a priori was the differentiation between operational and strategic dimensions in terms of dynamic capabilities. That distinction was made a posteriori after defining the clusters and interpreting the outcomes.

The innovation construct follows the precepts of the Oslo Manual ([OECD, 2005](#)) and the PINTEC's report, developed by the Brazilian Institute of Geography and Statistics ([Instituto Brasileiro de Geografia e Estatística–IBGE](#)), on innovation in Brazilian companies ([IBGE, 2010](#)). Three forms of innovation are assumed: product, process and management innovation. These forms are not mutually exclusive, and companies might innovate in the three areas simultaneously. However, it is assumed that each company prioritizes one particular form of innovation over others, as its core competence. Product innovation was considered core if the company prioritized new product activity and consequently introduced new products into the market, their fundamental characteristics (technical specifications, components and materials, integrated intended uses or functions) differing significantly from the products previously produced by the company. Process innovation was considered core if the company introduced new or significantly improved production technologies, methods for providing services or for the handling and delivery of new or substantially improved products, as well as equipment and new or significantly improved production support activities. This approach to innovation must lead to increased product quality (good or service) or a decrease in the unit cost of production and delivery. Finally, management innovation was considered core if the company implemented new management techniques or significant changes in the company's work organization and external relations to improve its use of knowledge, work flow efficiency or quality of goods or services.

Using the above criteria, the firms included in the GINEBRA database were classified according to the core innovation type, by using secondary data obtained from the research carried out within that project ([Fleury, 2006, 2010](#)), complemented and verified by cases reported in the literature ([Fleury and Fleury, 2011; Oliveira Jr., 2011](#), among others), and the specialized media. Companies were thus classified by their prioritization of product, process or management innovation. Twenty-six companies from the sample were considered as product innovators, twenty-one were process innovators and eleven were predominantly management innovators.

4.4. Results

The exploratory factor analysis aimed to synthesize the relationships among the organizational competence variables to identify common factors. Because the variables were not initially normal, they were transformed into z-scores to adjust to the normality prerequisite ($p > 0.05$) ([Maroco, 2010](#)). The Bartlett's sphericity test showed significance ($p < 0.01$) and a KMO value of 0.780, which is considered good ([Maroco, 2010](#)).

The table of the anti-image matrix's ([Appendix A](#)) shows that the MSA values (main diagonal) are greater than 0.500 and are not inferior to the other off-diagonal values, once again meeting the requirements for the application of the technique (*ibid*). The employed factor extraction method was the main component analysis, resulting in factors (eigenvalue greater than one) that explained 68.5% of the variance. Through Varimax rotation, factors were obtained that corresponded to the competences of Brazilian multinationals.

[Table 1](#) presents the factor loadings considered significant ($p < 0.05$) for the sample size. Moreover, the penultimate column shows the commonalities, which are all above 0.500, and the last column shows the Cronbach's alpha of the construct of organizational competences, which is considered high (*ibid*).

[Table 1](#) shows that five factors were retained. The first factor explains 37.5% of the variance. This factor is composed of the functions related to financial and human resources capabilities. Thus, we consider this factor to be part of 'administrative competence'. This factor reflects the Brazilian multinationals' abilities to create strategic competences based on management skills, especially in the financial and human resources management areas. Based on the companies' experience in the Brazilian context, as well as corporate governance criteria, the companies were able to develop policies and practices adapted to the reality of each country where their subsidiaries operate.

The second factor explains approximately 10% of the variance. This factor captures marketing competences that Brazilian multinationals developed to understand and appropriately respond to client needs both nationally and internationally. Organizational functions are conveniently aligned to provide responsiveness, which is associated with a strong capability in the use of marketing tools.

The third factor explains 8% of the variance and is related to technological competence. Brazilian multinationals are not front-runners but use technology to respond to market demands. The intrinsic components of technology utilization within a firm, e.g. communication with markets and “people-aware”, meaning how managers and employees mobilize and apply technologies to satisfy customers demands, are emphasized in Brazilian multinationals, leading to a positive assessment of their technological competences.

The fourth factor, explaining approximately 7% of the variance, is associated with the global projection of the firm's image. This projection is an interesting outcome because the very fact that Brazilian managers understand that multinationals are becoming internationally recognized with regard to image and reputation is a positive finding. Conversely, this outcome reveals a competence that is related to interaction with markets and institutions that has not yet been considered.

Finally, the fifth factor explains approximately 6% of the variance. This factor was called operations competence and represents the company's capability to work with a competitive operational model in terms of cost/price, quality, delivery and, especially, flexibility; in other words, the ability to respond to market demands faster than global competitors.

Once the five factors were identified, the next step was to describe how these five competences are present in the investigated group of Brazilian multinationals. For this purpose, we performed a cluster analysis of the retained factors. The extraction was initially performed using the method of hierarchical clustering, which indicated the possible existence of four clusters in the sample that could be divided according to the pattern of coefficients of homogeneity (between groups) and Pearson correlation (farthest neighbor). We performed a K-means cluster analysis with this result, concluding that a combination of four clusters was the most suitable outcome. The clusters are presented in [Table 2](#), showing a relatively homogeneous distribution in relation to the number of BrMNEs under investigation.

[Table 3](#), obtained through the analysis of variance test, shows that there are significant differences between the four clusters. [Appendix B](#) shows the supplementary analysis of variance for Tukey's post hoc test, allowing more detail to identify the differences between the entrepreneurial competences on the four clusters.

The multinationals in cluster 1 excel in operations, administrative and technological competences. These firms also show worldwide corporate image recognition. However, they are relatively less developed in terms of marketing competences.

The multinationals in cluster 2 are inferior to all other clusters in relation to administrative competences and also have low technological competences. These companies stand out, however, in terms of marketing and production and operations competences.

The multinationals in cluster 3 excel in technological and marketing competences. In addition, these firms have well-developed administrative competences and image projection. However, they demonstrate weaker competences in operations and production.

Although the multinationals in cluster 4 are not distinguished by marketing, technology or operations competences, they are strong in administrative competences.

[Table 4](#) displays the intersection of the four clusters in terms of the type of innovation prevailing in each company. The chi-square test results show that there is a significant difference ($p < 0.05$) with the nexus of the clusters and type of innovation.

[Table 4](#) shows that cluster 1 predominantly focuses on organization innovation, clusters 2 and 3 are stronger in product innovation and cluster 4 exhibits a preference for process innovation.

5. Discussion

The outcomes of the survey indicate an innovation pattern that in certain cases is comparable to the pattern found in developed countries and in other cases is different and specific, reflecting the diverse influences that markets and institutions exert over firms' competences and strategies.

Administrative or organizational competences are the most important assets for the majority of companies in cluster 1 with regard to internationalization. In fact, cluster 1 encompasses respected BrMNEs such as: Embraer, Gerdau, AmBev and Odebrecht. Their administrative competences led to a management style described by Sull and Escobari, as composed by ‘active waiting’ (preparing for golden opportunities through intelligent management during the comparative calm of business as usual and having the courage to

Table 2
Cluster analysis.

	Cluster			
	1	2	3	4
Administrative	.44170	-.90262	.31670	.32963
Marketing	-.68799	.38654	.42383	-.16808
Technological	.45528	-.11088	.75988	-.1.19867
Image projection	.50554	-.18623	.20326	-.55869
Operations	.38152	.73321	-.62637	-.72447
n	15	17	14	13

Source: authors.

Table 3
ANOVA.

	Sum of squares	df	Mean square	F	Sig.
Administrative	19.593	3	6.531	9.353	.000
Marketing	12.522	3	4.174	5.048	.004
Technological	30.081	3	10.027	19.752	.000
Image projection	9.059	3	3.020	3.394	.024
Operations	23.638	3	7.879	12.612	.000

Source: authors.

announce the main objective and concentrate resources to seize the moment), 'submarine fishing' (the capture of golden opportunities in turbulent markets) and 'competitive timing execution' (making efficient actions more important than grand strategies) in connected organizations with flexible hierarchies (Sull, 2005; Sull and Escobari, 2004).

At the operational level, these firms developed what Birkinshaw et al. (2008) call management innovations, defined as "the invention and implementation of a management practice, process, structure or technique that is new to the state of the art and is intended to further organizational goals". For example, Embraer, an aircraft producer, innovated in complex project management by risk-partnering with globally decentralized manufacturers (Amesse et al., 2001) and AmBev, a beverage producer, introduced an hyper-competitive management model in the consumer goods industry that currently prevails at Ab-InBev, Burger King and may be implemented at Heinz, a recent acquisition.

Therefore, the firms in cluster 1 can be deemed as business model innovators, meaning that Brazilian multinationals are providing the same products but developing new approaches with respect to how that transaction is performed (Santos et al., 2009).

Cluster 2 includes firms such as Marcopolo, Random and a group of IT (Information Technology) services providers. Although their answers emphasize product innovation, they also show strong competence in flexible production and operations, which allows them to provide customized products to their clientele; their operational flexibility and agility permits individual client requirements and criteria to be met. This effect is perfectly in line with the most current operational strategies for both the manufacturing and services industries which focus on niche markets and adopt the concept of servitization (Slack et al., 2007). Marcopolo produces buses in five continents according to client requirements, the most striking example of which is a roofless bus designed and manufactured for the transportation of pilgrims to Mecca. The case of Guerra, a producer of commercial trailers and special vehicles is similar. IT firms are also included in the group that innovates in terms of new products for specific market niches. These types of niches are clearly visible in the Brazilian market, and these multinationals have developed their core competence in operations and supporting competences, such as product/service design and customer relationships, in the context of that niche. Therefore, those firms are innovating in what concerns products and services customization.

Although cluster 3 also encompasses product innovators, the included firms exhibit a particular approach to product innovation. Because these firms supply traditional types of products, such as electric engines, auto parts and chemical products, for global value chains led by developed country multinationals, they are expected to innovate, develop and supply components, parts and subsystems for the competitive performance of the buyer firm and the chain as a whole.

Embraco, WEG and Sabo are important cases in terms of product development in the white-goods, electromechanical and automobile global value chains, respectively. Embraco is a dedicated producer of compressors for the Whirlpool Group. WEG is among the three largest manufacturers of industrial electrical engines in the world and ranks ninth among the 100 Most Competitive Companies in Latin America. Sabo is a supplier of auto-parts, initially in the General Motors international value chain, which acquired a company in Germany then becoming a supplier to other German auto-makers. These three companies have received awards in Brazil for their innovative competences in terms of product development. These innovations have led them to greater competitiveness in global markets, but those innovations were basically triggered by demands coming from the global value chains that supply goods and services globally. This outcome reveals the timid positioning of Brazilian enterprises with regard to product innovation, a point previously mentioned.

Firms in cluster 4 present a particular profile: they have distinctive administrative competences, especially in financial management, combined with the remaining competences. The list of firms in this cluster includes eleven, out of thirteen, commodity producers (two

Table 4
Cluster × innovation.

		Cluster number of case				Total
		1	2	3	4	
Innovation	Product	3	11	9	3	26
	Process	3	4	5	10	22
	Organization	9	2	0	0	11
Total		15	17	14	13	59

Source: authors.

cement producers, two bulk chemicals producers, two steel producers, one textile producer, two inexpensive shoe producers, one plastic bag producer and one large-scale provider of internet services). Their approach to innovation can be dubbed as “commodity innovation aiming at cost optimization” or, inversely, “cost optimization through commodity innovation”.

Commodity innovations are different from process innovations. Process innovations are usually associated with investments in new plants and equipment in order for firms to improve in terms of productivity, material utilization, quality and reliability, as well as to enhance their capacities to manufacture new products. It is also said that there is danger associated with process innovation because any competitor could easily follow suit, removing the initial advantage gained from the investment. However, commodity innovation, which involves radical new ways of obtaining products that are standardized or slightly commoditized, is not easily imitable and provides the innovator with a strong competitive advantage. Brazilian multinationals operating in resource-based industries and producing “commodities” invest heavily in R&D activities, maintain strong ties with local and foreign universities and research centers and own a significant number of patents.

Petrobras (PB) represents the most relevant example of commodity innovation. All of the recent oil discoveries by PB are in ultra-deep waters more than five thousand meters below the sea level and under a 2000-meter layer of salt. This so-called “pre-salt” layer contains light oil, the recoverable volume of which is estimated at five to eight billion barrels. The exploitation of this layer poses technological challenges that are unprecedented in the oil industry. A technology research pole is being built around CENPES (the PB technology research center), including some of the most advanced technology firms, such as Schlumberger, GE, Siemens and Halliburton, among others.

Companies such as Vale and Petrobras have not only developed new techniques for the extraction of resources. These firms' technical knowledge has also allowed them to pursue opportunities to explore new mineral or oil and gas fields abroad. For example, to exploit the Moatize mine in Mozambique, Vale applied the experience gained at its Carajás operation in northern Brazil, which is the largest open-pit mine in the world. Brazilian agribusiness firms working in tandem with national research institutes have recorded similar achievements.

Another example in cluster 4 is Votorantim Cimentos. This firm was the undisputed leader of the cement industry in Brazil. Its internationalization strategy includes a joint-venture with the Suwannee American Cement Company, aiming at the development of new engineering processes in an experimental plant located in the US state of Florida.

The case of Embrapa, the Brazilian Agricultural Research Corporation, which *The Economist* (26 August 2010) referred to as being responsible for “the Brazilian agricultural miracle”, is another important example.

Fig. 4 synthesizes the types of innovation that Brazilian multinationals implement to compete in international markets.

6. Conclusions

Understanding the way in which innovation contributes to emerging country multinationals' competitiveness has been a challenge for both researchers and practitioners. This article identified the types of innovation which provide competitiveness to Brazilian

Cluster	Core competences	Innovative capability in	Types of innovation	Stereotype
1	Administrative (organizational), operations and technology	Business models development	New ways to produce and commercialize products or services	Leading BrMNEs not related to natural resources
2	Product design, customer relationships and operations	Customization of products and services for market niches	New products for market niches	BrMNEs exploring market niches abroad
3	Technology and marketing (customer relationships)	Development of products demanded by global value chains	New products appropriate for the buyer firms in global value chains	BrMNEs linked to global value chains
4	Administrative (especially finance) and technology (process engineering)	Radical innovations in process engineering to compete in commodity markets	Commodity production at cheaper prices in a sustainable way	Leading BrMNEs in natural resources-based industries

Source: Authors

Fig. 4. Competences, capabilities and innovation in Brazilian multinationals.

multinationals, the capacities they develop to engage in internationalization strategies and the country-of-origin effects over the formation of competences and capabilities.

Through a new analytical approach, four types of innovation: i) business models, ii) customization of products and services for niche markets, iii) product innovation in global value chains, and d) commodity innovation, were associated to different types of innovative capabilities. Each of these innovation capabilities was linked to a profile of organizational competences and to the country-of-origin effects that influenced the formation of competences at firm level.

In Brazil, technological competences were not encouraged, if not inhibited, by the local institutions, both formal and informal. Even so, BrMNEs found a way to make them strategically relevant. The development of distinctive production and operations competences, critical for their internationalization, has always been a basic condition for local firms to strive in the local markets. Brazilian firms also took advantage of their experience with local markets to build distinctive competences in marketing. Their survival and growth in a country where political and economical instability were paramount led them to develop administrative competences that facilitate their successful operations in similar types of environment.

What is striking in Fig. 3 is the evidence that firms can create innovative capability from the combination of their organizational competences and perform well in the international markets. However, that finding must be qualified because most Brazilian multinationals are expanding in traditional sectors of the global economy, and not necessarily in those regarded as knowledge-intensive and technologically dynamic. Moreover, when examining their innovation portfolio, it seems plausible to infer that there are no technological catching-up or leapfrogging strategies similar to those employed by Japanese and Korean multinationals which rose in the previous internationalization wave. In other words, Brazilian multinationals seem to be establishing new conditions for expansion while avoiding more competitive terrains, the so-called red oceans (Kim and Mauborgne, 2005).

It is important to note that there are a growing number of authors advocating the idea that late-moving countries that are rich in natural resources should exploit such comparative advantages, instead of trying to mimic the trajectories of the leading countries (Andersen, 2009; Casanova, 2011; Castro, 2011; Mathews, 2009; Peres, 2010). This perspective assumes that Brazil, wealthy in natural resources, has yet to contribute to the recently globalized society in which the sustainable provision of basic production inputs represents a global challenge. In this case, the technological trajectory shown by Brazilian multinationals may not be mistaken because, according to Figueiredo (2010) the pathways followed by resource-processing firms in their accumulation of innovative capabilities involves a qualitative departure from established technological trajectories, at an early stage in the development of their capabilities. In other words, the logic for accumulating innovative capabilities in resource-processing firms follows a different trajectory when compared to that of knowledge-intensive sectors.

The expansion of Brazilian multinationals in industries that are considered to be outdated or non-priority by developed countries – the so-called sunset industries – and the fact that there is no strategic intent to compete in sunrise industries leads to the conclusion that the actual process of innovation takes on distinct characteristics. In this sense, the Brazilian multinationals' approaches to innovation create an opportunity to review and advance theoretical discussions on international business.

There are two issues that set limits to the findings in this article. The first relates to whether the development of innovative capabilities takes place before or after the internationalization process (see especially the analysis presented in Kumaraswamy et al., 2012). The previous analysis suggests that the typical Brazilian multinational became part of the international production networks or competed fiercely for the local markets prior to internationalizing, what led them to learn how to operate under high quality standards, develop innovative capacities and then internationalize. The fact that the importance of the feedback loop between innovation and internationalization depicted in the analytical framework varied substantially among the analyzed firms adds to the previous comment reinforcing the point that BrMNEs learnt to innovate previously to their internationalization. However, further research is recommended to clarify that point. An untested hypothesis would be that firms with proactive strategies developed innovation capabilities before undertaking their internationalization processes, whereas reactive firms sought innovation after internationalizing to guarantee their survival and growth in both local and international markets. In this study's sample, there are several typical cases showing both strategic positions. If this is supported, the hypothesis that innovative Brazilian firms are more competitive and more prone to internationalization may be confirmed.

The second point relates to whether the identified innovative capabilities are also found to some extent in companies with no internationalization process. The main argument for raising that question emerges from a straightforward view of the causalities assumed in the analytical framework: if country-of-origin effects influenced the Brazilian firms that became multinationals, why wouldn't those effects also influence a larger group of local firms, including those that did not decide for internationalization? Although the data gathered for this study are not sufficient for a detailed answer, it is important to recall that the country-of-origin effects are, for the majority of firms, inhibitors of the behaviors which lead to innovation and internationalization. Thus, the firms that became multinationals had to overcome the handicaps imposed by the local environment through the utilization other sources of competitiveness that may include specific forms of entrepreneurship (Madhok and Keyhani, 2012) aimed to overcome the 'liability of emergingness'.

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Appendix A. Anti-image matrix.

Company functions of value chain (commercial, production, product development and services) are highly integrated and aligned to strategic objectives.		.871a								
The company responds to unexpected events, unforeseen, faster than their competitors.	-0.089		.802a							
The company's standards of operational performance (cost/price, quality, delivery, etc.) are equal or exceed those of international competitors.	0.002	-0.484		.813a						
The technology is standardized and available worldwide.	-0.039	0.049	0.03		.620a					
Customers and suppliers have a very positive assessment of the technological competence of the company.	-0.048	0.065	0.017	-0.051		.818a				
The main product/service is recognized worldwide	-0.047	0.05	-0.021	-0.056	-0.082		.877a			
The company has great experience and capability in the use of marketing tools (design, pricing, advertising and others).	-0.335	-0.033	0.063	0.039	-0.07	0.258		.813a		
The company has the capability to access different markets to obtain funding.	0.085	-0.302	0.029	-0.218	-0.171	-0.232	-0.166		.690a	
The company adopts criteria for good corporate governance.	-0.043	-0.138	0.194	0.148	0.066	-0.005	0.106	-0.338		.846a
We have the capability to communicate with people from other countries by means of modern information systems and telecommunication technologies.	-0.021	-0.273	-0.113	-0.354	-0.322	-0.054	-0.113	0.334	-0.092	.630a

The managers know how each of employees can contribute to creating value for customers and suppliers.	-0.107	0.124	0.083	-0.033	0.139	-0.026	0	-0.158	-0.213	-0.576	.807a						
The company organizes and mobilizes resources quickly when we have information from unhappy customers.	-0.421	-0.15	-0.118	-0.181	-0.198	-0.125	0.029	0.395	-0.152	0.357	-0.26	.742a					
The company has defined the policies and practices of human resource management to be the adopted in the subsidiaries.	-0.066	0.139	-0.024	0.211	0.101	-0.129	-0.069	-0.194	-0.212	-0.27	0.286	-0.401	.800a				
The company adapted the policies and practices of human resource management accordingly the subsidiary context.	-0.181	-0.017	-0.035	-0.262	-0.096	-0.007	0.02	-0.032	0.117	0.414	-0.299	0.268	-0.473	.719a			
The experience accumulated with the operation in Brazil has become a competitive advantage in internationalization.	0.152	-0.097	-0.142	-0.088	0.099	0.143	-0.18	-0.047	-0.223	0.096	-0.1	0.049	-0.228	-0.054	.859a		
The image and reputation of the company greatly facilitated the process of internationalization.	0.139	0.157	-0.104	0.371	-0.042	-0.175	0.089	-0.116	0.082	-0.275	-0.01	-0.296	0.124	-0.373	-0.152	.751a	
The introduction of new products takes place simultaneously in national and international markets.	-0.229	-0.037	-0.04	0.076	0.073	0.036	-0.013	-0.086	0.192	0.044	-0.221	0.097	-0.2	0.092	0.096	-0.101	.827a

Appendix B. Post hoc test.

	(I) Cluster	(J) Cluster	Mean			Interval	
	Number of case	Number of case	Difference (IJ)	Std. error	Sig.	Lower bound	Upper bound
Administrative	1	2	1.344*	0.296	.000	0.560	2.129
		3	0.125	0.311	.978	-0.698	0.948
		4	0.112	0.317	.985	-0.727	0.951
	2	3	-1.219*	0.302	.001	-2.018	-0.420
		4	-1.232*	0.308	.001	-2.048	-0.417
		3	-0.013	0.322	1.000	-0.866	0.840
	Marketing	1	-1.074*	0.322	.008	-1.928	-0.221
		3	-1.112*	0.338	.009	-2.007	-0.217
		4	-0.520	0.345	.439	-1.433	0.393
Technology	2	3	-0.037	0.328	.999	-0.907	0.832
		4	0.555	0.335	.357	-0.333	1.442
		3	0.592	0.350	.339	-0.336	1.520
	3	2	0.566	0.252	.124	-0.103	1.235
		3	-0.305	0.265	.660	-1.006	0.397
		4	1.653*	0.270	.000	0.939	2.369
	1	3	-0.870*	0.257	.007	-1.552	-0.190
		4	1.087*	0.263	.001	0.392	1.783
		3	1.958*	0.274	.000	1.232	2.686
Image projection	1	2	0.692	0.334	.176	-0.194	1.577
		3	0.302	0.351	.824	-0.626	1.231
		4	1.067*	0.357	.022	0.117	2.011
	2	3	-0.389	0.340	.664	-1.291	0.512
		4	0.372	0.348	.708	-0.548	1.293
		3	0.762	0.363	.167	-0.201	1.725
	3	2	-0.352	0.280	.594	-1.094	0.390
		3	1.007*	0.294	.006	0.230	1.786
		4	1.105*	0.300	.003	0.312	1.900
Operations	2	3	1.359*	0.285	.000	0.604	2.115
		4	1.457*	0.291	.000	0.686	2.229
		3	0.098	0.304	.988	-0.708	0.905

Source: authors.

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