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The reverse transfer of innovation of foreign subsidiaries of Brazilian multinationals

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Summary This study aims to understand what factors allow the subsidiaries of emerging multinationals to develop innovations that are used by the parent company, that is, what factors drive reverse innovation. The respondents of the survey were Brazilian multinationals with manufacturing activities or professional services abroad. The study began with a base of 46 Brazilian multinationals operating until 2006. From this base, 30 multinationals agreed to participate in the survey. Overall, they had 93 subsidiaries. From these 93 subsidiaries, 66 foreign subsidiaries answered the questionnaire. The article uses data from these 66 subsidiaries. The hypotheses were tested through the statistical techniques of correlations and multiple linear regressions. The results confirm our five hypotheses with an explanatory power of approximately 76%. Therefore, the results show that the reverse transfer of innovation depends on the strategic orientation of the foreign subsidiary's R&D function, strong integration (communication) between the parent and its subsidiaries, the entrepreneurial orientation of the company, the subsidiary's age, and, marginally, entry via greenfield investments.

Introduction

Until recently, the transfer of innovation in multinationals proceeded from industrialized countries to developing countries and, similarly, from the parent company to subsidiaries. However, the increasing internationalization of companies and the consequent increase in the decentralization of R&D (Frost, 1998) and other functions (Andersson & Forsgren, 2006; Frost, Birkinshaw, & Ensign, 2002; Moore, 2001; Rugman & Verbeke, 2001) has changed this situation. Today, technology transfer occurs in several directions that are contrary to the traditional directions: from developing to developed countries and from subsidiaries to the parent company. Corroborating this idea, the authors argue that the main reason for the existence of the multinational corporation (MNC) is its capability to internalize resources and transfer knowledge and technology within its network more effectively than market mechanisms can (Birkinshaw & Hood, 1998; Dunning, 1980; Foss & Pedersen, 2002).

Therefore, instead of being entirely performed in a single unit, especially in the parent company, the innovation in MNCs takes place at the level of several subsidiaries located in different countries, mainly to exploit the competitive advantages of each country. The tendency to engage different countries, decentralizing the development of R&D and

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Theoretical background

Based on a resource-based view (Barney, 1991; Wernefelt, 1984) and the strategic concept of multinational corporations with differentiated network structures (Nohria & Ghoshal, 1997; Bartlett & Ghoshal, 1998), the innovations of a multinational can be developed both at headquarters and at the subsidiaries. The competitive advantage that many MNCs enjoy does not originate solely from their headquarters; it can result from the articulation and mobilization of innovations developed by subsidiaries (Birkinshaw, Hood, & Jonsson, 1998; Cantwell & Mudambi, 2005; Foss & Pedersen, 2002, 2004). For example, in the last two decades, R&D internationalization was viewed as a key factor in increasing a firm's capability to innovate (Chiesa, 1995; Gassmann & von Zedtwitz, 1999; Reddy, 1997). Multinational companies have been forced to rethink their innovation strategies, seeking to create, transfer and exploit knowledge that is increasingly dispersed across the global operations of companies (Teigland, Fey, & Birkinshaw, 2000). This implies the decentralization of innovation for the subsidiaries of MNCs and thereby creates significant management challenges to MNCs. The main challenge lies in reconciling the needs of local innovation with the demands of global innovation (Andersson & Forsgren, 2006; Teigland et al.,2000). Local innovation is difficult to transfer outside of its locale, and its very applicability based on local context. Global innovations developed by subsidiaries, on the contrary, are easy to transfer from place to place, and they have a global scope, as they can be used by the entire multinational (Andersson & Forsgren, 2006; Moore, 2001; Rugman & Verbeke, 2001).

When we consider a subsidiary as a source of competitive advantage for multinationals, we propose that the subsidiary can develop global innovation. In other words, we ponder the possibility of a subsidiary performing the reverse transfer of innovation.

Notably, the definition of innovation is comprehensive and involves not only development of new technologies for new products and processes but also organizational and marketing innovations (OCDE, 2005). We thus experience innovation closely related to R&D activities and other innovation related to marketing functions regarding new products, production departments, or novel organizational processes. We thereby assume that innovation within a subsidiary involves innovation from R&D and other organizational functions. We refer to this as management innovation. This differentiation is important for evaluating innovation in subsidiaries, especially subsidiaries from emerging multinationals, because such companies innovate but do not have formalized R&D activity.

The fact that subsidiaries of emerging multinationals do not always have R&D departments does not mean that innovation is unimportant to them. On the contrary, innovation abroad is essential to the competitiveness of emerging multinationals (Bonaglia & Goldstein, 2007; Mathews, 2006). However, many innovations originate not only from R&D but also from management innovation from other departments. The internationalization of emerging multinationals is not dependent on their own resources being exploited internationally but rather on the search, capture and exploitation of resources located around the world (Mathews, 2006).

Therefore, it is clear that the perspective of a differentiated competitive strategy for emerging multinationals disagrees with the central premise of the economic paradigm (Dunning, 1980; Vernon, 1966) that dictates that the foreign market is an extension of the domestic market. According to this paradigm, the market should be explored, and resources that formerly endowed competitiveness in the original domestic market should be extended to a company's subsidiaries. Emerging multinationals can and should exploit the parent company's innovations and build local innovations. However, competitiveness is only ensured if the company reverses its order of values and develops the capacity to globally take advantage of the innovations developed by its subsidiaries. The market outlook and market position of the last emerging multinational entrant (Bartlett & Ghoshal, 2000) dictate another strategy for the development and transfer of innovation. This strategy involves being more active than multinationals from developed countries. Such a strategy implies that emerging multinationals must seek and develop innovations abroad and develop capabilities to transfer such competences faster and more actively than others multinationals.

Thus, because the reverse transfer of innovation is central to the success of emerging multinationals, the core issue regards which organizational factors influence the development and reverse transfer of innovations in R&D functions or in other management functions in foreign subsidiaries of emerging multinationals.

The strategic orientation of the r&d function in foreign subsidiaries

Regarding R&D activities, the literature recognizes that subsidiaries have begun to move away from their traditional functions of using technologies developed by the parent company and often invest in the creation and development of technological competences that are complementary to the MNC's competences (Pearce & Papanastassiou, 1999). In some cases, such innovations (translated into new products or variants) can be implemented in other units of the network (Bartlett & Ghoshal, 2000) to complete the objectives of the R&D laboratory of the subsidiary or help in the implementation of products that do not show excellence in innovation activities (Papanastassiou & Pearce, 1997). In short, this type of positioning increases the range of knowledge available to the group and facilitates its application in an increasingly effective way, both from the technological and global competitiveness points of view (Papanastassiou & Pearce, 1997). In this way, the innovation process has a polycentric characteristic, where the generation of knowledge is more dispersed and results are quickly transferred in the form of products to global markets (Gammeltoft, 2006).

Corroborating this concept, Pearce and Papanastassiou (1999) argue that a strategic reformulation in search of global innovation has as a central element the increase of R&D activities in foreign subsidiaries. The central argument therein lies in the fact that the exchange of knowledge within the multinational network 'improves the quality of innovation both through the cross-fertilization of individual

technologies and through the merging or recombination of knowledge between related technologies' (Zander, 1999).

Based on this fact, this article argues that subsidiaries that develop R&D abroad are more likely to develop innovations that can be transferred to the headquarter. In other words, the subsidiary would develop intensive activities for applied research for the development of new products, new processes of development and prototyping of new products aimed at creating innovations to the corporation as a whole, not just for the local market (Boehe, 2007, 2008; Oliveira, Boehe, & Borini, 2009).

This inference has been proven in some studies, such as that by Mansfield and Romeo (1984), who showed that in 1979, 47% of the expenditure on R&D laboratories of American multinationals abroad resulted in technologies transferred to the United States. Criscuolo (2003) showed that in the period from 1980 to 1999, 21% of the total patents in the chemical and pharmaceutical sector assigned to European multinationals were registered by their US subsidiaries. Thus, Bayer recognized that the matrix did not have adequate skills and set up an R&D center in the then-emerging biotechnology cluster in the city of Berkeley as a means of acquiring innovations created by these subsidiaries (Schlegelmilch, Ambos, & Chini, 2003).

However, from studies investigating subsidiaries of multinationals from developed countries, the question remains regarding whether the subsidiaries of multinationals in emerging markets, which make use of a structure of R&D with guidance from global strategies, boost the transfer of reverse innovation. Some studies confirm that Brazilian multinationals do so. For example, Borini, Fleury, and Fleury (2010) show the development of R&D competences in the foreign subsidiaries of Brazilian multinationals and show that such subsidiaries have a strong relationship with the reverse transfer of innovation. Furthermore, João (2009) shows that most patents filed by Sabó (Brazilian Multinational) are filed abroad (Germany) and thereafter transferred to Brazilian headquarters.

Therefore, this article argues too that, for multinationals in emerging markets, the existence of a functional structure of R&D with a global orientation with respect to foreign subsidiaries is positively associated with reverse innovation.

H1. *The reverse transfer of innovation relies on an R&D structure of the subsidiary with global orientation.*

The effect of integration between the parent company and its subsidiaries

Hakanson and Nobel (2001) use the term 'integration' to define a strong relationship between a parent company and its subsidiary; the authors show that integration is one of the key factors for the reverse transfer of knowledge.

Integration in the multinational network is related to sharing values between the units, which allows a parent company to understand its subsidiaries, and vice versa. From this perspective, integration is best defined by the relationship of interdependence and strategic alignment between a parent company and its subsidiary. Such a relationship leaves the control of activities dispersed among different units, depending on the specific capacities and competences of each subsidiary. Therefore, integration is related to the alignment between headquarters and subsidiaries. According to Nohria and Ghoshal (1997), the two organizational elements that are essential for integration are communication and socialization among units.

Organizational communication is vital in reducing uncertainty and disseminating knowledge (Johanson & Vahlne, 1977). More specifically, communication reduces the uncertainties of the innovative process (Allen, 2007; De Meyer, 1985; Moenaert & Souder, 1990); this occurs because activities with high uncertainty, such as typical R&D activities, require a greater exchange of information as compared to activities with lower uncertainty (Daft & Lengel, 1986; Loch & Terwiesch, 1998). Previous studies on R&D projects show that efficient and effective communication is a prerequisite for the success of innovation projects (Moenaert, Caeldries, Lievens, & Wauters, 2000). Studies conclude that many problems leading to project failures arise from poor communication between team members (Allen, 2007; Moenaert et al., 2000). Moreover, regarding projects developed by teams dispersed worldwide, a lack of communication and trust may be factors driving the reasons for failure (Pinto & Pinto, 1990).

Socialization is defined as information-processing routines that facilitate the transfer of knowledge from the subsidiary to its parent company. Socialization is related to the ability to facilitate relationships of trust, create a shared vision, and minimize differences regarding preferences and interests among members in the network, using mechanisms for information exchange that meet the costs and benefits requirements (Tsai & Ghoshal, 1998). There are several mechanisms of organizational socialization, including the temporary transfer of employees between units, constant travels, the creation of standards and procedures reinforcing company culture, training programs and informal communication (De Meyer, 1991; Ghoshal & Nohria, 1994).

When socialization mechanisms are used often and intensely, the integration between the parent company and its subsidiaries increases. The proximity created helps parent company managers acquire more awareness and confidence in the competences of the subsidiaries. It is notable that the reverse transfer will only occur when new knowledge is combined with confidence of its potential benefits for application in the home country of the MNC (Gupta & Govindarajan, 2000).

Birkinshaw and Nobel (1998), by examining communication between subsidiaries and parent companies with respect to the R&D units of multinationals, showed that the most integrated subsidiaries (Birkinshaw & Morrison, 1995) (those with a higher degree of communication and socialization) developed more knowledge as compared to those subsidiaries that simply implemented innovations. Similarly, Hakanson and Nobel (2001) studied the R&D subsidiaries of Swedish multinationals and concluded that the high integration between headquarters and subsidiaries is related to reverse technology transfer.

Birkinshaw and Morrison (1995) show that the stronger is the relationship between the parent company and subsidiary, the smaller are the chances of a lower investment in the subsidiaries or rejection of the subsidiary projects. The divestment decision increases in difficulty as the number of businesses, contacts and working relationships

between the parent company and the subsidiary increases. A brighter future for the subsidiary and its development exists because the stronger is the working relationship and the degree of normative integration between the parent company and subsidiary, the lower is the chance for the subsidiary to not be in line with the corporate strategies or not have the essential competences to maintain its strategic position within the corporation (Birkinshaw & Morrison, 1995; Nohria & Ghoshal, 1997). Papanastassiou and Pearce (1994) note that subsidiaries that obtain global mandates for R&D should credit this to their different capacities and a strong relationship with the parent company.

More recently, Borini, Fleury, Fleury, and Oliveira (2009) show that initiatives of subsidiaries of Brazilian multinationals are strongly correlated with the integration of headquarters and subsidiaries.

Therefore, it seems that like multinationals from developed countries, strong integration drives the development of capabilities of emerging multinationals because the parent company has more confidence in the subsidiary and realizes the opportunities for development of non-local skills outside the country of origin. Thus, a higher investment is directed towards the development of competences in the subsidiaries because has a reliable corporate strategies.

H2. *The reverse transfer of innovation relies on a strong integration (communication) between the parent company and its subsidiaries.*

Entrepreneurial orientation

The concept of entrepreneurial orientation suggested in this article focuses on the analysis of corporate entrepreneurship, or widespread entrepreneurship in a corporation that allows entrepreneurial actions of employees, arising from the stimulation and support of the visionary character of each employee (Fillion, 2006). This visionary character can be defined as a set of perspectives regarding new businesses, products and processes that are developed over time, until the emerging perspectives correspond with the central perspective of the business, product or process to be undertaken. Entrepreneurship requires space and regular working time from the employee and only occurs with the institution's reciprocity of entrepreneurial actions (Fillion, 2006).

Thus, entrepreneurial orientation refers to the positive bias of the company to new business opportunities. Entrepreneurial orientation is essential for the creation and development of initiatives and competences in subsidiaries (Birkinshaw & Hood, 1998), but it involves more than just the creation of a new business or new production method. It involves credibility and freedom in making risky decisions (Birkinshaw, 1997) and indicates a company's willingness to act proactively in the face of a risky decision-making environment (Birkinshaw, 1997).

The characteristics of the entrepreneurial orientation are the following:

(1) The support and experience of senior management in entrepreneurial activities that are aimed at creating a stimulating organizational environment for new business ideas and practices (Birkinshaw, 1997).

(2) The risk is a positive attribute; if calculated well, the failure of entrepreneurial activities is not a synonym for poor performance but rather indicates that an organizational process can create new opportunities (Birkinshaw, 1997; Birkinshaw et al., 1998).

The relationship between entrepreneurial orientation and the development of capabilities requires constant rebuilding of businesses and processes in a continuous and emerging manner (Mintzberg, 1989). Although a company's founder may have been an entrepreneur, his views are destined to fail if there is no support for entrepreneurship at all of the levels of the company (Fillion, 2006).

An example that illustrates the above concept is the multinational Brazilian Odebrecht. Norberto Odebrecht property development, one of the leading Brazilian contractors, currently develops projects in 15 countries outside of Brazil: Angola, Argentina, Bolivia, Chile, Colombia, Djibouti, Ecuador, United Arab Emirates, United States, Mexico, Peru, Portugal, Dominican Republic, Uruguay and Venezuela. Over 23,000 employees are employed in projects to build hydroelectric plants, sewage systems, water supply systems, transmission lines, airports, subways, bridges, roads, and other structures. The highlight of this company is the managerial technology known as TEO (Odebrecht Entrepreneurial Technology), a philosophy based on four principles: spirit of service, human factor, concepts and criteria and, lastly, the production of material and moral wealth. The legacy of this culture is the belief that the company should be increasingly based on innovation, creativity and human imagination, which constitute the raw materials of the new economy (Mazzola, Oliveira, & Giao, 2010).

The example of Odebrecht confirms Lee and Williams' (2007) study, wherein they explain that entrepreneurship, within a perspective of communities, does not flourish in situations where centralization or hierarchies exist. Under these circumstances, the motivation to innovate is completely annulled in the organizational environment. For the dispersion of knowledge within a multinational with entrepreneurial orientation, sharing knowledge generated by the parties is appreciated. In this context, an environment where employees working under the same control (in this case, the multinational) and those all over the world are able to generate new ideas and initiatives should be developed. Bartlett and Ghoshal (2003) highlight the role of senior executives in fostering such an environment and joining it with other units of the multinational.

Thus, one expects multinationals fostering an entrepreneurial spirit to be concerned with the development of innovations in their subsidiaries because the entrepreneurial stimulus is an important mechanism for the development of novel competitive advantages (McGrath, MacMillan, & Venkataraman, 1995). The subsidiaries that act more independently are seen as those with the highest degree of entrepreneurship; they thus generate a greater number of initiatives (Verbeke & Yuan, 2007). Obviously, some innovations will only be useful in the local context; however, others fostered by the entrepreneurial spirit can positively influence other parts of the company, to the extent that subsidiaries are no longer the recipients of knowledge but rather a source generating new knowledge for other parts

of the corporation, including in other parts of the world (Keupp, 2008).

Because the reason for the internationalization of Brazilian multinationals is to search for resources, it is expected that those who foster the entrepreneurial orientation are not simply feeding the local innovation but aim to generate global innovations that may facilitate reverse transfer.

Therefore, the following is expected:

H3. *The reverse transfer of innovation relies on a strong entrepreneurial orientation provided by the parent company.*

In addition to the three abovementioned factors extrinsic to the management model, previous studies have emphasized that the organizational factors that influence the reverse transfer of innovation are moderated by the entry mode and a subsidiary's period of existence (Frost & Zhou, 2005; Hakanson & Nobel, 2001; Rabiosi & Santangelo, 2011). These aspects will be explored in the following sections.

The mode of entry

When a multinational company wants to take full control of its operations abroad, it may choose to conduct acquisitions through the purchase of an existing industrial plant abroad or via greenfield investments, characterized by the creation of new operations including the construction of a production plant, purchasing equipment and hiring new employees. These two options involve the greatest resource commitments and thereby the greatest risks, as well. The downside is that the possibility of achieving good results for the corporation is also higher, as compared to other modes of entry, as the market share is more complete. Despite the high cost, acquisitions may be good options that result in rapid access to a local market. The greatest challenge in this case is to address cultural differences at the integration of both the acquired and the buyer company. However, the option of starting a business from scratch involves high investment risks with respect to time and resources, though it allows the multinational greater flexibility and control of activities related to the choice of resources, production technologies, and layout, among other factors (Deresky, 2004; Tanure & Duarte, 2006).

Over time, subsidiaries may exhibit different degrees of local integration and internal integration in the multinational network (Andersson, Forsgren, & Holm, 2002; Hakanson & Nobel, 2001). According to Hakanson and Nobel (2001), the integration of subsidiaries established through acquisition tends to be more time consuming and difficult due to natural resistance to the acquisition process. However, the greenfield units initially show a high degree of integration because they lack experience, need the support of the parent company and may face large-scale expatriation. Over time, subsidiaries in developed markets tend to accumulate knowledge and capabilities and establish reputations and legitimacy in the host country. They become self-sufficient, thereby compromising the level of internal integration.

Thus, the units established through acquisition, despite a higher level of accumulated knowledge and skill, initially have a lower level of integration with the parent company. This integration tends to increase over time as the units begin to share values and a common culture. By contrast, units established through greenfield investments initially show high integration, decreasing over time and with the accumulation of skills and local insertion (Hakanson & Nobel, 2001; Rabiosi & Santangelo, 2011).

In comparison with greenfield units, the subsidiaries created from acquisitions would generally have had time to accumulate and develop knowledge, and it is plausible that this knowledge could be used as a new source of global competitive advantage. However, the strategic combinations do not automatically occur; the performance of synergies would depend on the integration between two units (Rabiosi & Santangelo, 2011). Moreover, according to Harzing's (2000) reasoning of global and multi-domestic strategies related to entry modes, it is possible to propose that new knowledge arising from acquisitions is likely to facilitate a simple local innovation. In fact, Frost and Zhou (2005) concluded that units established through acquisition are far less likely to conduct reverse transfer of innovation when compared to subsidiaries established through greenfield investments because the units established through acquisitions are less integrated into the multinational network of innovation.

The organizational structure and processes of the acquired company are very different from those of the rest of the corporation. The adaptation of processes and systems for innovation transfer requires great effort. Therefore, innovations arising from acquisitions would be less likely to become global innovations as compared with innovations that come from greenfield investments. The exception to this assumption occurs if there is a cultural similarity between the acquired and acquirer company, which is difficult to observe (Bhagat, Kedia, Harveston, & Triandis, 2002).

Emerging multinationals prefer acquisitions as an entry mode strategy (Bonaglia & Goldstein, 2007; Guillén & García-Canal, 2009; Mathews, 2006). Therefore, the cited studies are not empirical and do not demonstrate the relationship between the impact of the entry mode and the reverse transfer of innovation. It was difficult to find an article that measured the entry mode and the transfer of innovation or knowledge. It was, however, possible to find an article on Brazilian multinationals and the transfer of competences, though it did not identify a relationship between the reverse transfer of competence and acquisitions (Borini, Fleury, Fleury, 2009).

However, though not related to emerging multinationals, it was possible to observe a relationship between reverse transfer and greenfield investments. The study conducted by Brouthers and Brouthers (2009), which used samples of Japanese multinationals based in Europe, suggests that organizations with strong intangible capacities are able to leverage their knowledge more effectively within the network if they do so through greenfield investments. Frost (2001) analyzes citation patterns in patents granted to 400 large non-US industrial firms and their US subsidiaries and shows that the incidence of reverse technology transfer is higher for greenfield subsidiaries.

H4. *The reverse transfer of innovation comes mainly from foreign subsidiaries that entered the market through greenfield investments.*

The subsidiary's period of existence

The process of internationalization adopted by the behavioral model (Andersson et al., 2002; Johanson & Mattsson, 1988; Johanson & Vahlne, 1977) proposes that companies accrue knowledge as a result of conducting international operations. It focuses on the acquisition, integration and gradual use of knowledge that is connected with operations in international markets; this leads to rising exposure to such operations (Eriksson, Johanson, Majgård, & Sharma, 1997; Johanson & Vahlne, 1977). The accrued knowledge then drives internationalization (Eriksson, Johanson, Majkgård, & Sharma, 2000; Simpson & Kujawa, 1974).

As experience in international markets increases international knowledge, strong skills in international operations are developed (Yip, Biscarri, & Monti, 2000). Therefore, greater possibilities of strategic exposure to new markets are also created (Root, 1987).

Accordingly, the network theory has been consolidated and is seen as an evolution of the Uppsala Model (Andersson & Johanson, 1997; Andersson et al., 2002; Bjorkman & Forsgren, 2000). This theory strongly emphasizes internal and environmental relationships in foreign countries. A company would choose to advance into a foreign market according to the performance of the networks to which it belongs. Subsidiaries and their relationships in the foreign country would be a source of knowledge, and they would also determine the choice of the market and its performance (Andersson & Johanson, 1997). In this way, decision processes are not centralized at headquarters, and subsidiaries' innovations can be important for internationalization. However, a subsidiary's innovation depends on the subsidiary's embeddedness in host country's network (Andersson et al., 2002; Hakanson & Nobel, 2001). This process, however, requires time and strong effort. Therefore, if older subsidiaries are more embedded (Hakanson & Nobel, 2001), they also tend to be more innovative (Foss & Pedersen, 2002). The subsidiary's age is therefore an important factor in the development of and reverse transfer of innovation (Frost & Zhou, 2005).

If we consider the internationalization of Brazilian multinationals to be recent (Silva, Rocha, & Carneiro, 2009), such as that of other emerging multinationals (Guillén & García-Canal, 2009), we can posit that Brazilian multinational subsidiaries are young. We expect that older subsidiaries are more likely to develop and transfer innovation than new subsidiaries are.

H5. *The reverse transfer of innovation comes mainly from foreign subsidiaries that have experienced a longer period of existence abroad.*

Figure 1 presents the analytical structure of the variables considered in this study. The next section explains the methodological approach used.

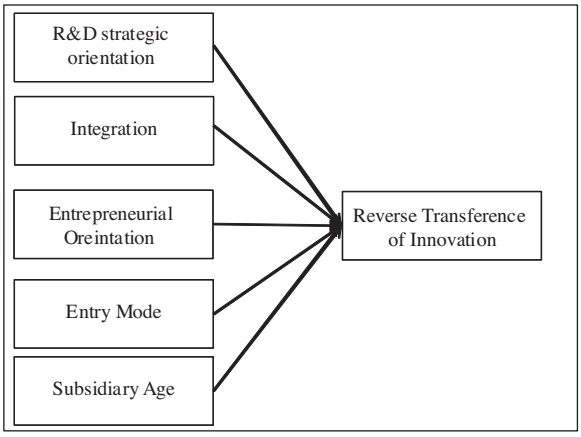

Figure 1 Reverse transfer of innovation in foreign subsidiaries. Source: the study's authors.

Methodology

In this survey, the research population consisted of Brazilian MNCs engaging in manufacturing or supplying technological services with operations abroad. In December 2006, 42 Brazilian enterprises with overseas operations were identified (and classified as multinationals). This figure comprised a diverse range of firms, consisting of those based on natural resources to others based on services such as engineering and IT. We identified multinationals with data from Analise Editorial (2006).

The questionnaire pre-testing was achieved with three multinationals: one questionnaire was administered in person and two were conducted through e-mail and telephone. The results of the pre-testing led to minor changes in the questionnaire. The pre-testing mainly resulted a scale transformation because it did not have 'non-applicable' as an alternative.

The questionnaire was sent to 42 CEOs of multinationals by e-mail and was used to reinforce replies to telephone calls. Thirty of the 42 firms responded to the questionnaire, and 12 of the 30 firms were one among the 14 Brazilian New Global Challengers (Boston Consulting Group., 2011). From the 12 non-respondent firms, two important firms were unable to respond because they were on the brink of important acquisitions and unable to disclose information to the public. Four other firms refused to answer because their internationalization attempts were small and experimental, and they were unsure whether they would continue their internationalization process. The remaining six simply did not respond.

The second stage consisted of having the firms' corporate headquarters send a custom-designed questionnaire to all of their subsidiaries. The 30 Brazilian MNCs sent this questionnaire to 93 overseas subsidiaries. All questionnaires were the same in terms of content. Each of the corporate headquarters involved an average of three subsidiaries, though some involved as many as eight, whereas others involved only one. The questionnaire was designed to be answered by the subsidiary's CEO or the person in charge of international operations. The questionnaire was pre-tested in two Brazilian MNCs. Sixty-six of the 93 subsidiaries responded by letter or through the electronic questionnaire found on the project's website. The data collection lasted eight months, from December 2006 to July 2007. The rate of response was 70%.

Brazilian manufacturing multinationals constitute 79% and service businesses constitute 21% of the sample. Abroad, 42% of the Brazilian MNCs perform manufacturing

activities, 33% develop service activities and the remainder (25%) perform both activities.

The subsidiaries of Brazilian MNCs are mainly located in Latin America (35%), followed by Europe (17%) and North America (15%). Individually, the country with the largest number of subsidiaries is the US (15%), followed by Argentina (14%) and Mexico (8%). China (7%) already stands as a major destination of Brazilian subsidiaries.

Regarding the markets served, 40% of the subsidiaries are exclusively focused on serving the host country. The market that represents the largest destination of sales is Latin America (33%), followed by Europe (23%) and North America (23%). Africa is the market for 15% of the subsidiaries, and Asia, Eastern Europe and the Middle East each account for 10% of the market share of the subsidiaries.

The entry mode of Brazilian MNCs abroad is divided into acquisitions (58%) and direct investment (42%). Approximately 60% of subsidiaries opened after the year 2000, and approximately 75% of them have operated for less than ten years.

Construction of variables

The dependent construct in the equation representing the reverse transfer of innovation consists of four variables (based on Frost et al., 2002). The first two variables verify the development of innovation in (1) R&D functions abroad and (2) other management functions in foreign subsidiaries. The other two variables verify to what extent the innovation developed in (3) R&D and (4) other management functions are recognized and used by the parent company ($\alpha = 0.835$). The first two variables verify the existence of innovation in the subsidiaries. The last two variables verify that this innovation is recognized and used by the multinational. Both Frost et al. (2002) and Birkinshaw et al. (1998) affirm that for reverse transfer to occur, both innovation in the subsidiaries and recognition from headquarters is necessary.

The three independent constructs are the R&D of the base, integration and entrepreneurial orientation. The construct of the strategic orientation of R&D is based on three variables (based on Boehe, 2007, 2008; Oliveira et al., 2009) that investigate the orientation of the MNC with respect to the delegation of the following activities in the subsidiary: (1) applied research in the development of new products, (2) the development of new processes, and (3) the prototyping of new products ($\alpha = 0.948$). The purpose of these variables is to verify how headquarters decentralize innovation activities and what the performance of these activities in the subsidiaries is. Oliveira et al. (2009), Boehe (2007, 2008) state that the decentralization of innovation alone does not measure strategic orientation. Therefore, the variable does not simply verify that the subsidiary possesses product innovation, process innovation or market share; it also measures the intensity of the subsidiary's innovation.

The integration construct was developed through the following variables (Birkinshaw & Morrison, 1995): strong working relationship; trust delegated to the subsidiary; exchange of information; and understanding (by the parent company) the subsidiary's responsibilities. The value of Cronbach's α for this construct is 0.852. The following variables ensure alignment of activities between the headquarters and subsidiary: working together, the constant exchange of information and knowledge of the activities of the subsidiary by the headquarter. In turn, trust is required to support the activities.

The independent variable of entrepreneurial orientation was constructed using the following variables (Birkinshaw et al., 1998): support for entrepreneurial activities; incentive for risk-based decision-making; encouragement of 'taking on risks'; and the top management's experience with innovation activities. The value of Cronbach's α for this construct is 0892. The purpose of these variables is to verify how the entrepreneurial spirit is dispersed throughout a subsidiary's activities. This can be determined from freedom and support to take risks and translated into the experience of executives with entrepreneurial activities.

The entry mode is formed by dummy variables called acquisition (0) and greenfield investments (1).

The subsidiary's period of existence is measured by difference between the year of establishment of the subsidiary abroad and the year 2010. The resulting variable is the age of the subsidiary abroad. Subsidiaries are on average six and a half (6.83) years old. For the variable existence period, normality is obtained by extracting the log of the variable.

Two control variables were used: industry and enterprise size. The variable industry is a dummy variable representing manufacturing enterprises and service enterprises. Size is also a dummy variable representing small and medium enterprises with less than five hundred employees in the subsidiary and large enterprises with more than five hundred employees in the subsidiary. We use this division because it is applied in Brazil (Dou — Diário Oficial da União, 2006).

Results

Table 1 shows the correlation between the independent variables. It also presents the distribution of descriptive means and standard deviations. It is possible to observe the behavior of the variable and whether there is a strong correlation between the variables indicating multicollinearity. The entry mode variable is not exhibited below because it is a dummy variable.

It can be observed that independent variables are not significantly correlated, except for the variables entrepreneurial orientation and integration and R&D strategic orientation and the period of existence. However, all construct independents are positively correlated with reverse innovation; in particular, it is possible to observe a strong correlation with reverse innovation and R&D strategic orientation.

The intensity of investment and incentives for the strategic orientation of R&D in foreign subsidiaries is very low (mean 2.50). This means that investments in the innovation of products and processes in the subsidiaries are still small, and there is a completely autonomous development within the subsidiaries.

The linear regression model (Table 2) tests the hypotheses. The coefficients displayed are unstandardized coefficients. The model's collinearity was measured using tests of tolerance and a VIF smaller than one, ensuring the absence of multicollinearity among the variables (Hair, Anderson,

Table 1 Descriptive measures and correlation.

	Mean	Standard deviation	1	2	3	4	5
1. Reverse transfer of innovation	2.78	0.96	1				
2. R&D strategic orientation	2.50	1.40	0.560**	1			
3. Integration	3.90	0.91	0.293*	0.154	1		
4. Entrepreneurial orientation	4.10	0.89	0.332*	0.118	0.271*	1	
5. Period of existence (ln)	1.94	1	0.421*	0.239*	−0.04	0.255	1

Source: authors.
* $p<0.05$.
** $p<0.01$.

Tatham, & Black, 2005). The final model including all of the variables is provided below.

Overall, the models indicate a positive adjustment (F) and explanatory power (R^2); the general model (5) presents an explanatory power of approximately 76%.

The signs of the coefficients of all of models show that there is a positive relationship between R&D orientation, integration and entrepreneurial orientation with regard to the reverse transfer of innovation. Model 1 shows the control variables, and the results show that these variables do not exert a direct influence on reverse transfer. Model 2 shows that the three managerial variables have a positive relationship with the reverse transfer of innovation. Notably, strategic R&D orientation and integration exert an influence with a significance level of $p < 0.01$, while that for entrepreneurial orientation is $p < 0.05$. Model 3 shows that the entry mode exerts only a marginal influence ($p < 0.10$) on reverse transfer. Model 4 shows the positive influence ($p < 0.05$) of the subsidiary's period of existence with reverse innovation. Finally, Model 5 shows the dependence all factors in relation to the reverse transfer, thus supporting the hypotheses proposed.

Reverse transfer primarily depends on the development of activities regarding the strategic orientation of R&D in the subsidiaries, that is, R&D activities that do not simply focus on the adaption of products and processes of the parent company abroad, but are directed towards the creation of new products and processes in the foreign country. This result confirms H1.

According to H2, reverse transfer depends on integration, or the strategic alignment of the subsidiary's activities with the parent company's interests, along with the constant exchange of information, knowledge and experience between the subsidiary and its parent.

An entrepreneurial orientation stimulates a culture that supports innovation risk as one of the main corporate guidelines advocated and propagated by the parent company; this confirms H3.

Those who entered the market through greenfield investments marginally collaborate on the reverse transfer of innovation, supporting H4. Finally, H5 is confirmed because the older subsidiaries are more likely to accomplish reverse transfer.

Therefore, the results show that the reverse transfer of innovation relies on the strategic orientation of the foreign subsidiary's R&D function; strong integration (communication) between the parent company and its subsidiaries; the entrepreneurial orientation of the corporation; the subsidiary's period of existence; and entry through *greenfield* investments.

Table 2 Regression.

	1	2	3	4	5	VIF
Reverse transfer of innovation						
Constant	2638	−2112	−2082	−2571	−2519	
R&D strategic orientation		0.485**	0.517**	0.395**	0.443**	1.198
Integration		0.297**	0.318*	0.431**	0.385**	1.305
Entrepreneurial orientation		0.538*	0.452*	0.457*	0.428*	1.077
Entry mode			0.530!		0.269!	1.045
Period of existence (ln)				0.285*	0.470**	1.391
Industry	0.54	0.548	0.238	0.528	0.254	
Size	0.267	0.26	0.26	0.105	0.153	
F	1082	9072**	8674*	10909*	10569**	
R^2 adjusted	0.007	0.658	0.687	0.737	0.761	

Source: authors.
! $p<0.10$.
* $p<0.05$.
** $p<0.01$.

Structuring the subsidiary's R&D function is vital for reverse transfer, but it is also important in building the capability to develop product and process innovations and not just simple adaptations. Although not on a large scale, the Brazilian MNCs that seek resources from operations abroad adopt the subsidiaries' innovations, especially those created by units that entered via greenfield investments and have been operating abroad for a longer time. Entry via greenfield investments allows for greater alignment of the parent company's activities with the subsidiary, which when aligned to the period of operation, enables a greater integration of the company to the business network abroad in the creation of innovative resources (Borini et al., 2010).

Integration is essential for the exchange of knowledge and the parent company's support of a subsidiary's innovations (Hakanson & Nobel, 2001). Subsidiaries without such integration may see their initiatives abandoned and not sponsored within the corporate network (Borini, Fleury, Fleury, 2009).

However, support for innovation, in addition to strategic R&D function and integration between the parent company and its subsidiaries, involves an entrepreneurial culture from the parent company that is reapplied to its subsidiaries. Such entrepreneurial orientation allows foreign subsidiaries to take necessary risks (Birkinshaw, 1997) for innovation activities. Aided by integration, it can then be used by the parent and other subsidiaries.

Discussion

The implications of this result will be analyzed in terms of two aspects: the impact on the literature regarding the management of multinational corporations and innovation internationalization beyond its consequences for the internationalization strategy of emerging multinationals such as Brazilian MNCs.

The results reinforce the research regarding reverse innovation; however, they involve innovative elements that need to be understood as factors enabling reverse innovation. First, regarding R&D strategic orientation, Brazilian MNCs concerned with reverse innovation invest in R&D abroad despite its structural difficulties and a relatively new process of internationalization. Unlike traditional multinationals, Brazilian MNCs' internationalization process requires much faster commitment abroad through R&D; otherwise, reverse innovation would not be possible.

Regarding integration, one tradition in R&D studies focuses on the innovation associated with the centralization and decentralization of subsidiaries (Chiesa, 2000; Reddy, 1997; Ronstadt, 1978). However, this article does not address autonomy and integration in terms of structure. On the contrary, it adds to the literature by showing that integration associated with communication and socialization is a strategic way to align the parent with its subsidiaries. This result complements Hakanson and Nobel's (2001) findings because it expands the importance of integration to emerging multinationals. Although the results confirm what happens to traditional multinationals, integration for emerging multinationals such as Brazilian MNCs is a larger challenge to explore because, with the establishment of operations and the granting of autonomy to explore the market, these multinationals must combine aspects of communication and socialization instead of the traditional controlling tools. In principle, communication and socialization in traditional multinationals were damaged by managerial control through budgets, reports, manuals and inspections. Only after gaining trust in the subsidiaries would control decrease in favor of integration. Brazilian MNCs that are seeking innovation abroad do not have time to gain the trust of the subsidiary; they need to develop through the rapid learning of control through socialization and communication.

Despite being previously studied in subsidiaries of multinationals of developed countries (Birkinshaw, 1997; Birkinshaw & Hood, 1998), the importance of entrepreneurial orientation is confirmed as an important factor for emerging multinationals. The development of initiatives is as important as (Borini, Fleury, Fleury & Oliveira, 2009) the reverse transfer of innovation. This finding indicates another challenge for Brazilian MNCs: simulating risk before getting to know the market, even before modeling a management system for the subsidiaries. Those seeking reverse innovation have the double challenge of exploring innovation without losing control of sustainable operations.

Finally, the results that show that the period of existence is an ally to reverse innovation would definitely accurately represent the challenge faced by the Brazilian MNCs willing to take on the strategy of seeking resources. Because the period of existence of the subsidiary is much smaller when compared to traditional multinationals, Brazilian MNCs performing reverse innovation (despite being supported by factors similar to other multinationals, such as R&D and entrepreneurial orientation and integration) must remodel their management strategy, as managerial characteristics must be implemented and executed much more rapidly. Therefore, for further research, the article proposes an investigation of how the implementation of the management model occurs.

Conclusion

The central issue of this article is how to make a subsidiary take charge of global responsibilities in the development of innovation that is recognized by the MNC. The results show that the reverse transfer of innovation relies on the strategic orientation of the foreign subsidiary's R&D function; strong integration (communication) between the parent company and its subsidiaries; the entrepreneurial orientation of the corporation; the subsidiary's period of existence; and, though marginally, its entry mode through *greenfield* investments. As previously demonstrated, the implications of the article are focused on the literature on innovation management in foreign subsidiaries of multinationals and on emerging multinationals such as Brazilian MNCs.

The limitations of this study result from the research method used. The survey to the foreign subsidiaries of Brazilian MNCs is imperative for outlining an overview of the behavior of foreign subsidiaries. However, this type of survey has limitations with regard to the method, which are reflected in its results.

The stratification of subsidiaries presents a static picture that allows us to make some inferences regarding the reverse transfer of innovation. However, case studies, though

less comprehensive than a survey, have the advantage of longitudinally examining the process of competence building in Brazilian MNCs, as well as better identifying the development of the management model within Brazilian MNCs.

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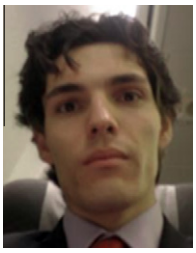

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