The influence of R&D internationalisation on the dynamic capability development in Brazilian multinationals

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Abstract: The internationalisation of R&D activities allows multinational companies to have access to technology and innovation, which could not be obtained by simply acting in their countries of origin. Although the literature on R&D internationalisation is extensive, its contribution to the development of dynamic capabilities has been less focused. The main objective of this article is to analyse how R&D internationalisation contributes to the development of dynamic capability characteristics, always bearing in mind that these can be more easily achieved when R&D subsidiaries are spread throughout the world. As for the theoretical background, studies on internationalisation frameworks for R&D activities were gathered at the premises of the development of dynamic capabilities. The methodological procedures adopted were a qualitative exploratory approach to analyse cases of Brazilian multinationals which have R&D subsidiaries in other countries. With this research, one concludes that R&D internationalisation motivated for increase of knowledge, and whose coordination structure is decentralised and highly integrated, influences the development of dynamic capabilities. The main contribution of this paper is to extend understanding on the influence of international R&D management in dynamics capabilities development.

Keywords: R&D internationalisation; dynamic capability; developing country; innovation; strategy; development; emerging country; Brazilian multinationals.

Reference to this paper should be made as follows: Salvini, J.T.S. and Galina, S.V.R. (2015) 'The influence of R&D internationalisation on the dynamic capability development in Brazilian multinationals', *Int. J. Technological Learning, Innovation and Development*, Vol. 7, No. 4, pp.318–335.

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1 Introduction

Due to the acceleration of changes in the environment and the shortened life cycle of new products, organisations must be aware of changes in their industries, market demands, consumers and actions by competitors. In this scenario, knowledge has become an important source for competitive edge, innovation, and organisational growth, leading companies to internationalise their activities related not only to sales and production, but also to those related to exploration, knowledge increase, and R&D activities (Gammeltoft, 2006).

This phenomenon of R&D internationalisation originated from developed countries, which still makes research to be directed to them (Von Zedtwitz, 2005). However, peripheral emerging countries gained certain attention when they started hosting R&D laboratories, and more recently, originating multinational companies with R&D activities abroad (Von Zedtwitz, 2005). Although studies are concentrated in developed countries, Narula and Santangelo (2008) state that the geographical location of companies and their institutional context are neither key points to decide for R&D internationalisation, nor key points for establishment of R&D alliances. In reality, what becomes more relevant in the R&D internationalisation is the ability of the companies to develop their dynamic capabilities (Narula and Santangelo, 2008).

The dynamic capability (DC) is mainly formed by routines and practices adopted by the company in order to quickly respond to environment changes (Augier and Teece, 2007). To Teece (2009), it is not only about adapting the organisation to the environment, but also about the influence of the company on the environment where it is inserted through innovation and cooperation with other companies, entities, and institutions. Among the several studies addressing the composition of DC, Teece (2009) presents a three-element segmentation: the capability of sensing and seizing opportunities and threats, the capability of the company to reconfigure itself to adapt to the environment, and adaptation of the environment to its capabilities.

Nonetheless, most companies only explore local R&D sources, disregarding the worldwide dissemination of knowledge and innovation, which are relevant sources for development of DC (Teece, 2007). Having the ability to seek, incorporate, and operationalise knowledge, wherever it may be, is even more relevant for companies from developing countries to gain competitiveness, since their environments are generally poor in terms of innovation and technology (Doz et al., 2001). However, Bell and Figueiredo (2012) state that organisations from developing countries have increased their networks to promote access to sources of technology, demonstrating that technological

disadvantage is more related to constraints of capability than to the weakness in knowledge and technology in their country of origin.

Thus, the relevance of discussing influences the R&D internationalisation may bring for development and sustainability of DC has become even clearer as this is a theme that comprises innovation and exploration of new environments.

With regard to the intersection of these issues, Teece (2014) used a theoretical analysis to report the importance of global R&D for development of DC. According to the author, organisations ensure different sources of knowledge and technology by internationalising their R&D, which will serve to structure different capabilities to enable them to constantly re-adapt to market changes, thus keeping an organisational sustainability. Ester et al. (2010) sought to identify how the various modes of internationalising R&D activities (e.g., joint ventures, greenfield ventures, networks, among others) influence the development of DC. This research was conducted through the analysis of multiple studies, considering the information and communication technology (ICT) sector and using the Ettlie and Pavlou's (2006) theory of DC. However, the literature has not deeply focused on the relationship between DC and R&D offshoring. This is probably due to the difficulty in conducting empirical studies that integrate the perspectives of DC and other complementary investigation areas (Ambrozini and Bowman, 2009), such as R&D internationalisation.

It is important to point out that there are some studies focusing on the internationalisation of technological innovative capabilities (Ariffin, 2010; Ariffin and Figueiredo, 2004), including its importance for innovative capabilities (Figueiredo, 2011) and absorptive capability (Belderbos et al., 2008). Somehow, these studies relate R&D offshoring to DC, considering that both innovative and absorptive capabilities are component factors of DC (Wang and Ahmed, 2007). Although it is important to consider the contribution of these articles to the discussion on the issue addressed here, the literature has not focused on the relationship between internationalisation of R&D and development of DC as a whole. It is also worth to mention that some other articles address the relationship between business internationalisation and DC, but without specifically focusing on the R&D function (Cantwell and Mudambi, 2005; Floriani et al., 2009; Zahra et al., 2006).

Considering the aforementioned context, it is clear the importance of understanding the relationship between DC and R&D internationalisation. In order to fill the existing theoretical gaps, the present study aims to answer the following question: How does R&D internationalisation influence the development of the company's dynamic capabilities?

Thus, the goal of this article is to investigate the influence of international R&D on dynamic capabilities. For doing so, it was sought to analyse the relationships between drivers of R&D internationalisation, coordination structure of international R&D, and integration of R&D units and three dimensions of DC, namely, capabilities to notice opportunities, learn, and readapt.

2 Theoretical framework, research propositions and conceptual model

The available knowledge and resources on R&D are important sources for the company to be able to develop new products, and thus adapt itself to the environment changes; that is, be able to develop DC (Helfat and Peteraf, 2003). According to Dunning and Lundan

(2010), DC involves the company's ability to create new products or services by restructuring its activities to achieve a better adjustment to the competitive environment. DC may be divided into three elements: capability to notice opportunities, capability to absorb opportunities, and capability to readapt or reconfigure whenever necessary (Teece, 2007, 2009).

The ability to sense, notice and adapt is related to the ability to explore, create, and interpret activities in order to identify new opportunities. This activity may be conducted through the exploration of new technologies or from the observation of market changes. However, this not only involves investments in research and reproduction of client needs, but also the understanding of existing unmet demands and the market structure evolution, including attention to innovations from suppliers and competitors (Teece, 2007, 2009; Wang and Ahmed, 2007).

Transforming the opportunity into business is considered by Teece (2007, 2009) as the ability to absorb, seize, learn, or make use of opportunities. This ability is called by Wang and Ahmed (2007) as absorptive capability, and it is portrayed by Cohen and Levinthal (1989) as the ability to recognise external opportunities, to understand them, and to develop them for commercial purposes. Generally speaking, this is the ability to assess and use external knowledge; that is, to learn from potential partners, to integrate that external information collected, and to transform it into a knowledge which is ingrained within the organisation – that is, the company's ability to benefit from external knowledge (Wang and Ahmed, 2007).

The capability of re-adaptation or reconfiguration is supported by the adoption of flexible and innovative structures and the integration and coordination of competencies in order to decentralise the actions from individuals (Teece, 2007, 2009). It also comprises aspects of learning, management of knowledge, and corporate governance (Teece, 2007, 2009). Another important source of re-adaptation is the existence of cooperation between companies and universities, which, according to Schartinger et al. (2002), involves direct relationship between companies and research centres for production of knowledge. Another dimension included in DC is the ability to readapt involves the management of knowledge, which consists in creating, retaining, transferring, and using tacit and explicit knowledge (Cepeda and Vera, 2007). With regard to governance, the company needs to establish a structure which constantly allows the business model to readapt and to be combined (Teece, 2007, 2009).

Wang and Ahmed (2007) incorporate the DC into the innovative capability, which refers to the ability of the firm to develop new products and markets by adopting a strategy based on innovative processes and behaviours. Bell and Figueiredo (2012) proposed a typology of four levels of progression of innovative capability:

1 Basic: minor adaptations and improvements, close to imitative adoptions.

2 Incremental/intermediate: relatively complex improvements and modifications to products, processes organisation, and systems.

3 Advanced: Catching up with the international technological frontier and closing in on leading global incumbents, perhaps with differing directions of innovation.

4 Overtaking incumbent innovators at the international frontier by cutting-edge innovation in products, production, and organisational processes and systems.

In this article, innovative capability will be treated within the reconfiguration capability.

The capability of innovation improves the company's competitiveness by reducing costs, increasing productivity, shortening lead-time and producing better products, regardless of its orientation towards international or domestic markets (Ariffin and Figueiredo, 2004). It is important to make it clear that organisations need to build and use the three dimensions of capabilities, and simultaneously employ them to succeed.

The internationalisation of R&D activities has two main motivations: those directed to market and those directed to technology (Florida, 1997). Market-oriented companies seek R&D internationalisation in order to customise their products and to work in partnership with local manufacturers, thus allowing inclusion of subsidiaries in the markets and consequently identification of local preferences, which in turn enables product penetration. On the other hand, technology-oriented companies seek R&D internationalisation not only to develop new products and new technologies, but also to have access to qualified technical manpower, obtain information on local science and technology, and work in partnership with scientists and the technological community (e.g., universities) (Florida, 1997).

Corroborating the Florida's (1997) idea, Schmiele (2012) states that there are several discussions on internationalisation motivators; however, they can be basically classified into two aspects: knowledge exploitation and knowledge augmentation. Companies which internationalise their R&D activities and are driven towards knowledge exploitation gain a competitive edge through the exploration of their technological competencies in other markets. Alternatively, companies seeking knowledge augmentation set their R&D units in environments called 'knowledge pockets', which is characterised by a highly qualified workforce.

Teece (2014) states that one of the pillars supporting the DC is the development of assets with valuable, rare, inimitable, and non-substitutable (VRIN) characteristics, which are mainly based on innovation. They may be easily reached when there are R&D units spread worldwide. Interspersed R&D units support the creation of capabilities in different locations. If they are properly integrated, they may result in new products and in organisational DC (Teece, 2014). In order to investigate the relationship between R&D internationalisation motivators and DC, a first proposition (P1) was formulated: Organisations which internationalise R&D activities are oriented towards increasing their knowledge to develop DC.

The increasing internationalisation and strategically diversified R&D activities have been creating management challenges for multinationals which compete globally. Monitoring geographically spread opportunities is a hard task, and in order to do it, companies must develop efficient internal mechanisms which enable transference of knowledge, thus contributing to converting ideas into marketable products more quickly (Gerybadze and Reger, 1999).

Subsidiaries of companies may be used for monitoring and accessing knowledge abroad. R&D will tend to be higher in subsidiaries that acquire competence-creating mandates as opposed to those that acquire competence-exploiting. It is also stronger when the subsidiary is located in a regional centre of technological excellence, when it has built up a higher degree of subsidiary-level capabilities for independent initiatives, and when the parent group encourages network formation (Cantwell and Mudambi, 2005).

In addition, this should essentially involve a balance between corporate coordination and the units' autonomy (Florida, 1997). Dias and Salerno (2009) state that decentralisation of the R&D activities is influenced by the need to boost the development

of products and by the quality of the relationships between parent companies and subsidiaries. For the authors, the coordination definition, which is more or less decentralised, is influenced by organisation strategy, branch characteristics, and relationship between units. According to Boehe (2007), the narrower the relationship between subsidiaries and their environmental agents, the more they contribute to the organisation's innovation network, making the innovation activity more relevant. Moreover, differently from what one may expect, decentralised units must create ways of transferring more standardised knowledge when it is related to the worldwide spread of R&D activities, since cultural and institutional differences between countries prevent tacit knowledge from being efficiently transferred if informal communication structures are adopted (Ecker et al., 2013). Thus, even in decentralised R&D units, there is a need to adopt formal and structured communication through the use of information technology.

Companies adopting international R&D coordination structures based on the integration between units, including a less centralised coordination in the parent company, seem to have better structures to develop DC, especially abilities of re-adaptation, which are closely related to the company's coordination structures. This happens because organisations aimed to develop DC must establish a structure for constantly allowing re-adaptation and combination of the business model through the adoption of flexible and integrated coordination structures which ensure capabilities are decentralised (Teece, 2007, 2009). Furthermore, establishing a decentralised structure leads top managers to be closer to new technologies, clients, and market, as stated by Teece (2007, 2009). That being said, the second proposition (P2) support the following idea: Companies adopting decentralised R&D coordination structures with integrated management create possibilities to develop DC.

Ester et al. (2010) analysed the influences of R&D on the development of DC, considering different management formats: greenfield venture, R&D internationalisation through acquisitions, establishment of partnerships, and outsourcing. Their research demonstrated that alliances with foreign and greenfield companies contribute positively to the development of dynamic competencies, especially companies in developing countries. To reinforce this idea, Doz et al. (2001) state that the future success of emerging multinationals, including the Brazilian ones, will depend more and more on their ability to have access to knowledge outside the subsidiaries and parent company by joining it with the capability of their global operation networks.

When specialised abilities are achieved and the producers of new technologies or new knowledge are located throughout the world, the companies spread their R&D units (Chiesa, 1995). With the internationalisation process, the competitive edge may come not only from the parent company, but also from the articulation and mobilisation of innovation activities developed in the subsidiaries (Cantwell and Mudambi, 2005). Therefore, the companies' innovative capability started to depend on their ability to raise resources and create ventures from their various subsidiaries to integrate capabilities and balance specific resources, thus generating innovations to be explored globally (Chiesa, 2000).

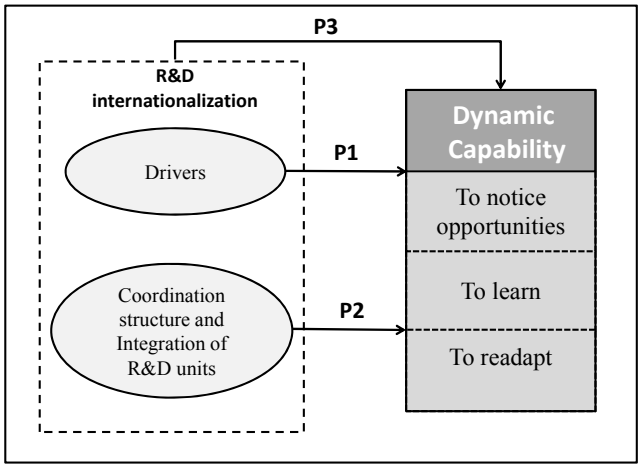
Lawson and Samson (2001) support the idea that traditional activities are not rich sources of innovative capability, because more and more frequently they end up not being able to meet the demands from consumers due to their constant requirements and the shortened life-cycle of the products. Thus, companies must adopt ways of exploiting external innovation sources through internationalisation, alliances, partnerships, and

contact with clients and suppliers (Lawson and Samson, 2001). In this way, the company's internationalised units may play an important role in the creation of technology and in seizing innovation opportunities in their operating environments (Teece, 2014). It is also worth to consider that a positive impact on a subsidiary's innovative performance depends on its previous accumulation and constant upgrading of its capabilities (Figueiredo, 2011).

Innovation needs the cooperation of the units in different environments to provide better possibilities for creation of DC through exploitation of processes and business models from different regions (Teece, 2014). Thus, the R&D distribution through the world may be seen as a phenomenon, which supports the creation of capabilities in different locations, which, if properly integrated, may result in new products and in distinctive organisations capabilities. This leads us to the third proposition (P3): Internationalised R&D units foster the development of DC.

A theoretical framework was used for development of the conceptual model of this research, as shown in Figure 1.

Figure 1 Conceptual model of the research



Source: The authors

3 Methodology

Considering the relevance of the topic, this research seeks to analyse the relationship between R&D internationalisation and DC. Because this issue has not been widely investigated, this is an exploratory research. In order to validate and ensure the study is more accredited, the methodology adopted was the case study – its application is more relevant in environments where context and phenomenon are not clearly separated, which is the case for R&D internationalisation and development of DC. It is also necessary to point out that this study was conducted through the analysis of multi-cases to describe, comprehend, and interpret the complexity of each case separately.

According by Yin (2010), a protocol was developed with enough conditions, mentions, and procedures to enable replication of the study. The interview script was

prepared to gather data for checking the propositions raised in the literature. Thus, based on the references used in this article, the script was developed as seen in Table 1.

Table 1 Structure for development of the script used in interviews

Dimensions of analysis	*Measurement*	*References*
Capability to sense, notice, adapt the opportunity	• Practices that encourage knowledge exchange between R&D units • Team training practices for absorption of external knowledge • Adapted coordination structure • Integration of R&D units	Cohen and Levinthal (1989), Florida (1997), Cantwell and Mudambi, (2005), Wang and Ahmed (2007), Teece (2007, 2009), Dias and Salerno (2009)
Capability to size, learn, absorb	• Check for the main factors that motivate internationalisation • Practices for monitoring market, consumers, suppliers and competitors • Practices for monitoring exogenous development in science and technology	Florida (1997), Wang and Ahmed (2007), Teece (2007, 2009), Schmiele (2012)
Capability to reconfigure/readapt	• Analysis of the coordination structures • Practices for management of knowledge and organisational learning • Number of partnerships and external alliances • Number of published patents • Number of new products created through R&D internationalisation	Lawson and Samson (2001), Schartinger et al. (2002), Cepeda and Vera (2007), Wang and Ahmed (2007), Teece (2007, 2009), Bell and Figueiredo (2012)

In order to validate the interview script, two pilot-interviews were conducted with a R&D director and a R&D manager in one of the companies. In the pilot-interview, the need to interview people from different hierarchical levels in the R&D labs was identified as they had distinct knowledge about internationalised R&D activities. Thus, the script was segmented into four parts:

1 company description

2 drivers of R&D internationalisation

3 coordination structure

4 subsidiary roles.

Two Brazilian multinationals were chosen according to the following criteria:

1 to have internationalised R&D activities

2 to be in dynamic and high technology industries (Zahra et al., 2006)

3 to have facilitated contact with executives.

In case 1, the organisation is a multinational operating in the industrial automation sector and headquartered in the State of São Paulo. The company was founded in 1974. Internationalisation started in 1989, and in 2000 the organisation set subsidiaries in the USA, Mexico, Germany, France, Singapore, and China. In 2013, the organisation was present in over 90 countries. In case 2, the company provides services in the IT area, mainly system consulting and integration, development of solutions, outsourcing for applications and infrastructure, and others. It was founded in 1987 and initiated its internationalisation in 1996 in Argentina. The organisation had a profit of 2.11 billion in 2013, being present in 33 countries.

In-depth interviews were then conducted with executives of both companies. Besides the interview in locus, further contacts were made via e-mail and telephone to request clarification and additional information. In the company represented in case 1, two R&D directors and two R&D engineers were interviewed during November, 2013. In case 2, the interviews were conducted with the global operation vice-president and two PMO, including governance managers, who work directly with innovative projects within the organisation. The interviews were conducted in January 2014. Sources of secondary data were used, such as scientific articles on R&D internationalisation published by the companies; the companies' official websites to collect information such as history, operating countries, product portfolio; institutional presentations on internationalisation and innovation made available by the companies; and patent records obtained through Thomson Innovation Patent Export.

Finally, data were initially treated with full transcription of the recorded interviews in order to preserve the interviewees' answers and allow further analysis of the content. This was followed by the start of the process to interpret the data, which aimed to find broader meanings for the answers obtained and to link them to other data. The systematisation of data was also part of that step, so those data could be analysed more specifically (Lakatos and Marconi, 2009). In that phase, the analysis of content was used as methodology because it aims to obtain interpretation of both communication and information through an objective, systematic, and quantitative description of the content of the messages (Bardin, 2008).

4 Results and discussion

Case studies were carried out to analyse the previously presented propositions. Understanding whether the motivators for R&D internationalisation are related to the development of DC was discussed in this study, specifically the first Proposition 1 (P1), which considers that organisations internationalising their R&D activities are driven to increase knowledge to develop dynamic capabilities. Considering the case 1, the internationalisation of R&D units was stimulated by two factors: the crisis of *Pro-Álcool*, and more strongly, the move of one of the R&D researchers (who was also the owner) to the USA. He started researching and networking there. The unit is located in an environment which is supportive of innovation and close to several important suppliers, which strongly contributes to strengthening the innovation within the organisation. According to one interviewee (the R&D director, case 1, 28th November, 2013), "the idea was: instead of staying in Brazil waiting for the competitors to come to our market, we'll go to theirs, so we can learn how to fight them there".

When case studies were analysed, one could observe that the company of case 1 was already developing DC right from the start of internationalisation. As the main objective from this organisation was to exploit technological opportunities and increase knowledge (Florida, 1997; Schmiele, 2012), it was necessary to quickly develop the ability to notice new technological opportunities in the host country through the participation in international fairs and meetings for standardising the techniques in the field. It was also necessary to structure R&D coordination methods, routines, and processes of R&D activities before globalisation, which characterised the development of the absorption capability. Thus, the organisation could absorb the innovative practices deeply rooted within it and put them into action, that is, using the same projects and promoting research exchange experience.

In case 2, on the other hand, the company's internationalisation was basically driven by two factors. Firstly, there was the need to run business from Brazilian branches that were spread throughout the world, and secondly, there was the possibility to occupy new markets. Thus, the main objectives were to achieve new market opportunities, run business from clients who were also internationalising, and stop depending on only one market and consequent competitive pressure. It is evident that, at that first moment, the organisation's reasons for internationalisation aimed to exploit new markets (Florida, 1997). However, over the last two years, the organisation of case 2 has been building strategies to foster its R&D activities and innovation. As result, the decision to open new units is motivated by aspects such as scientific knowledge and technological structure available in the region. Therefore, cities/regions hosting universities and/or other technology companies are taken into account. Nowadays, the reason for internationalisation is driven by technology and knowledge competitive edges, aiming to develop innovation capabilities. A good example is the acquisition of a research unit in Singapore because of the region's high specialisation in software technology.

Also in case 2, it was observed that the organisation had started its internationalisation by aiming mostly at the exploitation of new markets. The life cycle presented by Cantwell and Mudambi (2005) is observed in this multinational, that is, after a while with internationalised R&D activities for adjusting to new local markets, the organisation reached a certain maturity level and gradually became oriented towards the exploitation of innovative environments. When the company opted for market-oriented internationalisation, it was created the possibility to develop a perception ability to sense opportunities for exploitation of new markets, which allows already-existing products or services to be still produced and sold, but for a different market. With regard to the absorption/seize ability, the organisation also needed to establish some routines for exchange of information among the units, but in a centralised way through the parent company as the activities were standardised by the main unit in the State of São Paulo. Later, they had to be followed by the remaining units, which hindered the innovative capability in the organisation (Lawson and Samson, 2001) because the sources always ended up being the same. The innovation in the company has been going through a process of maturity. One can say that, with this strategic organisational shift, the company was forced to rethink ways to manage its R&D units by strengthening partnerships with universities and better monitoring the market and technological trends to strongly develop its abilities to notice and absorb.

Considering the cases studied, the first proposition (P1) was confirmed. It became clear that in case 1 the organisation managed to exploited new sources of technology

through the internationalisation of R&D. The company fostered the development of DC by creating R&D coordination structures and partnership with suppliers as well as by participating in industry events. In case 2, however, we observed a later development of DC as in the beginning the subsidiaries had exploited the market rather than the sources of knowledge and technology.

With regard to coordination structures for R&D projects, the second proposition (P2) was evaluated, that is, companies with integrated management and adopting internationally-decentralised R&D coordination structures were observed to create possibilities to develop DC. In case 1, the company was guided by an internal general development plan (GDP), which was prepared to seek organisational strategy. The preparation of GDP is carried out every four years and undertaken by different organisational levels, such as departments of technology, software, support, sales, management, and market analysis, in a joint effort of the parent company and its subsidiaries.

It was also evident that GDP have been losing strength over the past few years, and the units have become more and more autonomous as they plan their R&D strategies in such way to take into account the technologies available, thus depending less and less on the parent company. Despite the existence of GDP to coordinate R&D activities, units are autonomous to develop projects not provided by GDP. In this scenario, the structure adopted by the company considers that R&D coordination is more decentralised, ensuring more autonomy to the units so that they can develop R&D activities regarding their production needs with less coordination through GDP.

With regard to the integration of units for development of R&D projects, in general, the teams are formed by members in the very unit despite their different specialties. The projects are not developed by integrated units, primarily due to cultural differences in the team; nonetheless, there is a huge exchange of finished products, which go through adaptations to meet the market demands from the different units.

In case 2, on the other hand, the company has a centralised R&D structure where there is still a need to centralise the decisions from the parent company, even when international innovation sources are used. Its R&D coordination structure is still in progress. A ‘global innovation area’ is being implemented, aiming to coordinate and organise all R&D activities. This area will be responsible for tracking market, universities, and fairs for innovation opportunities. In addition, the company seeks to reduce rework, thus avoiding different units from spending resources in the development of similar projects, and also ensures that everybody is aware of the new projects that can be implemented for different purposes. One weakness lies in the lack of use of partnerships with universities as sources of innovative solutions, since these are sought through a more applied investigation within the organisation rather than using the full potential offered by the universities. The company aims to involve more than one unit when developing projects. This happens because of the maturity and experience of some units in specific business areas, which makes them take part in the project. One example of this is the relationship between the units from the USA and Mexico, which complement each other with distinct and specific competencies.

Sill in case 2, because of the centralised coordination structure, the company has not created possibilities to foster the ability to readapt. Due to its lack of structure flexibility, the organisation ends up adjusting more slowly to the environment. This also explains the restructuring the company is going through regarding the coordination of R&D activities after being internationalised for so many years. On the other hand, the organisation

presents a better integration among the units, which includes the development of joint projects supervised by the parent company, thus fostering the organisation's ability to absorb. With the joint development activities, the units develop abilities to assess and use external knowledge for integration of the data collected in order to fit the information into a deeply-rooted knowledge within the organisation; that is, they develop the ability to absorb more strongly (Wang and Ahmed, 2007).

Considering the second proposition (P2), companies seeking to develop these capacities need to adopt decentralised structures in such way that top managers can be closer to new technologies, clients, and market (Teece, 2007, 2009). When the company internationalises its R&D activities in different markets, it needs to become more flexible through the adoption of an R&D coordination to foster the exploitation of the environment in which the subsidiary is installed (Cantwell and Mudambi, 2005). Also, it is necessary to give researchers more freedom to innovate, stimulate the exchange with R&D engineers, and create ways to transfer knowledge and strategies to quickly respond to changes in the environment, as seen in case 1. This flexibility allows different demands to be met by the organisation, which develops the ability to readapt (Teece, 2007, 2009). Another important point is the ability to integrate units, which means to carry out projects in partnership and develop expertise in exchange continuously, thus ensuring development of innovative capacity (Figueiredo, 2011). From this perspective, the integration of R&D units was better analysed in case 2. Despite its centralised coordination in the headquarters, the company performs innovative projects involving knowledge from several subsidiaries of R&D.

Generally speaking, it is necessary to evaluate whether internationalised R&D units can foster the development of DC, which is the third proposition (P3). One may conclude that R&D internationalisation is a rich source for development of DC because it is an organisational strategy joining the search for external opportunity sources and development of innovations. In fact, innovation is one of the most solid bases for developing DC (Peteraf et al., 2013) as it is possible to create assets with VRIN characteristics; that is, assets which are VRIN for the organisation (Prahalad and Hamel, 1990; Teece, 2014). Another factor pointed out by researchers is the exploitation of external knowledge and innovation sources by means of alliances, partnerships, or even through internationalisation (Lawson and Samson, 2001; Teece, 2014; Wang and Ahmed, 2007).

The company's ability to notice was analysed whether internationalising the R&D activities has created new sources to exploit opportunities to innovate. In order to do that, there was an effort to identify primary internationalisation motivators, market-monitoring practices, consumers, suppliers, and competitors. With regard to motivation, one organisation is aimed at a market-oriented internationalisation (case 1), whereas the other is aimed at technology (case 2). However, the DC requires VRIN characteristics, which are easily attained when it is based on technological innovation. That is, for internationalisation of R&D activities to increase the innovative competencies, companies create processes to ensure the exploitation of the environment and to identify new opportunities more quickly.

A good example of this is the company of case 1, whose R&D internationalisation was aimed to increase knowledge and technologies. The organisation established contact with suppliers, took part in fairs, trained its employees, and participated more actively in standardisation meetings in the sector. Consequently, there was the development of the

ability to search for solid new opportunities being offered throughout the country. The company which internationalised its R&D activities for knowledge increase adopted more effective practices to seek information and opportunities. In case 1, the organisation made an effort to tighten the bonds between the host country's primary suppliers and encouraged the participation of its employees in standardisation fairs and meetings. On the other hand, in case 2, the company took advantage of being close to the region's culture to develop new services aimed at the local client. In addition, they seek new opportunities by establishing partnerships with universities and entering high-technology centres, such as in Singapore.

The second aspect which is considered for the DC is the company's absorption capability (Teece, 2014). One concludes that, when companies internationalise their R&D activities, they need to develop some abilities to ensure information exchange among units. To ensure the absorption capability after starting the R&D internationalisation, there was an effort to exchange researchers so that they could swap experiences. With regard to the coordination structure, the company of case 2 presents a more centralised coordination as its absorption capability ends up being managed by the parent company; that is, the parent company creates standardised transference processes, thus hindering the development of the ability to notice opportunities. The absorption capability was also observed to be greatly influenced by the integration among units. In fact, when R&D units develop integrated projects they are forced to develop methods to exchange information and knowledge-absorption methods which are being produced outside the unit, whether it is a parent company or a subsidiary. This scenario was observed in the company of case 2, which is capable of developing projects involving more than one unit under supervision of the parent company.

The ability of reconfiguration consists of the company's ability to adapt to the market dynamism. When organisations internationalise their R&D activities through less centralised coordination structures, they develop a higher ability to respond to the market dynamism. In case 1, the company had initially adopted a development plan to coordinate R&D activities, but they noticed that a high level of centralisation made the organisation very inflexible and slow to innovate. As a result, the plan gradually lost momentum, and the organisation started developing in a less centralised way, consequently increasing the participation of R&D units in innovation decisions.

In case 2, the company presents a centralised R&D structure although there was a certain dissatisfaction about it, since the standardisation imposed by the Brazil's unit supports the coordination but hinders the ability to adapt to the constant environment changes. With that in mind, the organisation is structuring a global innovation area to foster the exchange of knowledge among units and to ensure that no projects are developed twice. It is undeniable that when companies become internationalised, they develop an ability to readapt. However, when they internationalise their R&D activities, they can adjust themselves to the environment based on innovation as reaching abilities with VRIN characteristics are more difficult.

Knowledge management practices were also analysed to observe the company's ability to readapt. The company's flexibility to adjust to frequent environment changes is related to the way the organisation manages knowledge. In case 1, in order to ensure that knowledge is transmitted, the managers must prepare reports in the end of each project describing all knowledge developed. In case 2, the company makes use of an online support system which is fed with data by researchers and developers, thus ensuring the

transmission of knowledge among the units. Besides that tool, the need to establish a global innovation area was noticed to avoid rework. The adoption of these processes demonstrates the company's concern with knowledge, which is being generated and shared. In case 1, the interviewees made it very clear that the US subsidiary plays a strategic role regarding the registration of patents: "This unit officially concentrated all patents of the company. The company also follows this strategy to protect its inventions in the world's biggest market" (interview with the R&D Director, case 1, 28th November 2013).

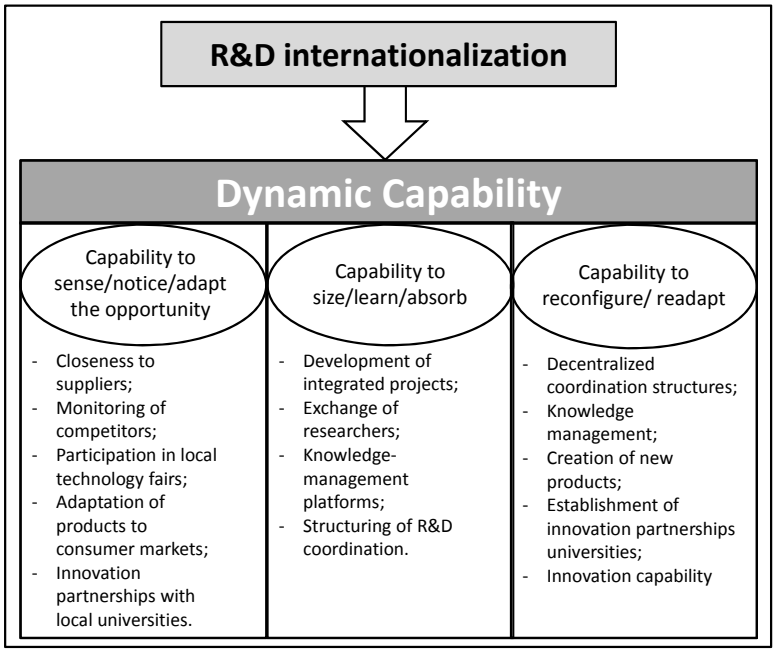
By analysing its patents, it was observed that the company patented two technologies from its foundation in 1974to the start of its R&D internationalisation in 1990. After the R&D internationalisation, the organisation acquired 25 patents from 1995 to 2005. As expected, only the two first patents were registered in Brazil, with protection only regarding this country. The remaining ones, even with Brazilian inventors, had their registrations filed in the USA, with protection regarding the USA and Brazil. The company of case 2 stated that there is no strong culture to file for patents, especially because the company considers itself more of a developer than a researcher. However, the USA's R&D unit, which was recently incorporated, had already such a culture, so they continue applying for patents. Because this US company was recently incorporated, there is no published patent with case 2 as applicant.

In this article, we consider innovation capacity within the capacity of reconfiguration. Considering the typology by Bell and Figueiredo (2012), we conclude that the R&D internationalisation in case 1 increased the level of innovation capacity from 'incremental' to 'leading word'. Initially, the company performed R&D activities based on domestic technology sources, which hindered its position towards competitors. The company had engineers and researchers who worked predominantly in product and processes improvement aimed to adequately serve the customers. After the internationalisation of its R&D activities, the company not only began to exploit different technological sources, but also established partnerships with local suppliers and research institutions. These changes strengthened both launch of new products and redesigning of products and processes. According to the interviewees, the improvement of the company's innovation capacity was due to the coordination structure adopted by them, ensuring high flexibility and decentralisation of activities.

It was also noticed a progression of the innovation capacity in case 2. R&D was initially 'incremental/intermediate', with incremental improvements in the services offered to customers. With the R&D internationalisation, the organisation began to further exploit the needs of its customers around the world by using some external sources of technology, which is at a level between 'advanced' and 'word leading' (Bell and Figueiredo, 2012). However, we observed a strong centralisation of R&D activities in the headquarters, which eventually plasters partnerships for innovation, autonomous development of new product, exploitation of new sources of technology, and therefore the company's innovation capacity. Thus, we observed that the company of case 1 was more successful than that of case 2 in developing the reconfiguration ability.

In short, the objective of this study was to verify how R&D internationalisation influences the development of DC dimensions. Figure1 summarises the results found, relating them to some practices stimulated by R&D internationalisation according to the three primary components in DC.

Figure 2 Influence of R&D internationalisation on the development of DC



Source: The authors

5 Implications and limitations

The study has some implications for managers who wish to develop DC through R&D internationalisation. They must consider that flexible and decentralised R&D coordination structures may ensure greater autonomy to subsidiaries. Despite the autonomy, it is important to have integration between the units for exchange of knowledge and innovation to allow greater development of technology in the organisation as a whole. Finally, processes and structures encouraging the exploitation of partnerships with universities, research institutes and suppliers are extremely relevant for identifying both new opportunities and as advanced technology sources.

As one of the study limitations, the relationship between the approaches was observed by considering only the parent company's perspective, that is, the subsidiaries were not interviewed. Another limitation was the restricted number of Brazilian companies with internationalised R&D activities in highly-dynamic markets.

As a contribution to further research, one suggests that the subsidiary's perspective regarding R&D internationalisation and development of DC should be evaluated. Besides these aspects, another contribution would be a research on companies from both developing and developed countries in order to compare the influence of R&D internationalisation on the development of DC. Finally, it is also possible to suggest a longitudinal study to follow up the development of DC during a given period of time.

6 Conclusions

Therefore, one concludes that R&D internationalisation is a rich source for development of DC because it helps structure processes and assets which create more possibilities to detect new market and technological opportunities, improve the exploitation conditions, and manage environment changes properly. In addition, when organisations internationalise their R&D activities, they further extend their technological sources and develop the ability to innovate as a whole. However, the path, that is, the choices for coordination structures, the reasons for R&D internationalisation, the strategic role played by the subsidiary, and the organisational history can support more or less strongly the development of DC. Therefore, the main conclusion from this article is that organisations who become internationalised to increase their technological knowledge by decentralising and integrating R&D coordination structures are more likely to succeed to develop abilities of DC, namely, to notice, to absorb, and to readapt.

This paper's findings extend the understanding of how companies may improve their dynamics capabilities through international R&D. Thus, it sheds light on the qualitative nature of R&D management and on its impact to the company's progress. For this, the research has combined concepts from the literature on dynamic capabilities and international business focused on R&D offshoring. These literatures have hardly been used in combination. It is also worth to highlight that this study provided comprehension on the perception of the headquarters on the subsidiaries impacts to advance of companies.

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