KNOWLEDGE SHARING AND SUBSIDIARY R&D MANDATE DEVELOPMENT: A MATTER OF DUAL EMBEDDEDNESS.

Abstract

Sharing knowledge across borders has proven to be especially relevant to multinational corporations (MNCs). Foreign subsidiaries have become active players in these knowledge flows. However, the network effects of interacting with multiple agents on the evolution of the R&D role played by subsidiaries are still undeveloped. The present study focuses on changes in subsidiary capabilities and on the dynamic mechanisms by which their R&D role might evolve, especially, as a consequence of their interaction with a variety of knowledge networks. We examine this issue by conducting four longitudinal case studies of subsidiaries operating in Spain. Using an inductive approach to theory building, we develop a general theoretical framework considering the subsidiary's embeddedness in the knowledge networks within the MNC (internal) and within the host country (external). We find that evolving towards a competence-creating mandate is characterised by the simultaneous growth of embeddedness in both internal and external networks; otherwise, a subsidiary may gravitate away from upgrading its R&D role. Thus, the contribution of this paper is to present a dynamic model that sheds light on how internal and external knowledge embeddedness interact in generating outcomes for subsidiary R&D roles.

Keywords

Subsidiary; multinational; R&D; knowledge; role evolution; mandate; dual embeddedness.

1. INTRODUCTION

The role played by subsidiaries and their competitive position within their respective multinational corporations (MNCs) are perceived as being subject to change over time. Historically, headquarters was considered the only source of competitive advantage for an MNC and this was leveraged overseas by the transfer of knowledge to foreign subsidiaries (Dunning, 1981; Vernon, 1966). Recently, linked to the closer integration of subsidiaries into international networks, the latter have been able to generate new knowledge for the whole MNC. In fact, heterarchical (Hedlund, 1986) and transnational (Bartlett & Ghoshal, 1989) corporate models reflect the existence of an internal network within the MNC, where knowledge flows freely in all directions. At the same time, the metanational corporate model (Doz, Santos, & Williamson, 2001) emphasizes the emergence of the company's external network. A subsidiary, thus, absorbs knowledge through its business linkages with local partners, which represent an important source of technological competencies enabling it to contribute to the MNC's overall capabilities (Andersson, 2003). Thus, the ability to manage dispersed capabilities effectively within this 'double network' – comprising internal and external networks (Zanfei, 2000) – is seen as the key to an MNC's competitive advantage (Frost, Birkinshaw, & Ensign, 2002). At the MNC level, this double network implies managing a portfolio of scattered capabilities in multiple heterogeneous local contexts through the corporation's affiliate units, whilst devising strategies to embed these units as efficiently as possible in each of these multiple contexts (Meyer, Mudambi, & Narula, 2011). At the subsidiary level, it implies that each of the subsidiaries plays a differentiated strategic role within the global MNC network.

Focusing on R&D activities, the International Business literature has recently identified the emergence of technologically advanced foreign subsidiaries (Blomkvist, Kappen, & Zander, 2010). Today, we see foreign subsidiaries not only as knowledge receivers, or in the terminology of Cantwell & Mudambi (2005) as the performers of a 'competence-exploiting' role, but also as knowledge creators in a fully integrated network (Di Minin & Zhang, 2010), fulfilling what Cantwell & Mudambi (2005) label as a 'competence-creating' role. This shift is important, as recent research highlights the more active role played by subsidiaries in the globalization of innovation, while examining their influence on MNC innovative ability (Blomkvist et al., 2010; Phene & Almeida, 2008). R&D networking allows firms to benefit mutually from each unit's R&D competences (Pla-Barber & Alegre, 2007).

In this sense, the configuration of subsidiary R&D roles has become an issue of great interest in International Business research (see, for example, Bartlett & Ghoshal, 1990; Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; Gupta & Govindarajan, 1991; Kuemmerle, 1997; 1999; Pearce, 1992; Sachwald, 2008; von Zedtwitz & Gassmann, 2002). However, the research presents two major shortcomings: First, most of the studies take a static approach. Since they are primarily

concerned with identifying the specialized roles adopted by overseas R&D laboratories, they neglect the prior evolution of capabilities within the subsidiary that takes on this function (notable exceptions are Cantwell & Mudambi, 2005; Kim, Rhee, & Oh, 2011). But as the specific R&D role of a subsidiary is a direct outcome of this evolution, the way in which these capabilities are created must first be analysed. In this sense, it is widely acknowledged that technological capability building is the outcome of complex processes of interaction both within the firm and between the firm and external actors (Iammarino, Padilla-Perez, & Von Tunzelmann, 2008). This leads to the second shortcoming: many of the studies analyse the drivers of a subsidiary's R&D role in isolation and so neglect any network effect. Specifically, they identify three main factors in the configuration of strategic roles: task assignment by headquarters, the subsidiary's own choices and local environmental factors (Birkinshaw & Hood, 1998; Kim et al., 2011; Westney & Zaheer, 2001). However, less importance is attached to any underlying network effects, particularly those arising as a consequence of simultaneous engagement in internal and external networks.

While some authors have examined the effect of headquarters-subsidiary relationships and knowledge transfer between units of the MNC (Bartlett & Ghoshal, 1990; Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; Kuemmerle, 1997; 1999; Pearce, 1992; von Zedtwitz & Gassmann, 2002), others have examined the impact of local embeddedness (Andersson & Forsgren, 2000; Andersson, Forsgren, & Pedersen, 2001; Andersson, Forsgren, & Holm, 2002; 2007; Dörrenbächer & Gammelgaard, 2010). However, only a few recent studies have considered their simultaneous impact on subsidiary innovation, albeit not specifically on their evolving R&D roles (see, for example, Birkinshaw, Hood, & Young, 2005; Gammelgaard, McDonald, Stephan, Tüselmann, & Dörrenbächer, 2012; Garcia-Pont, Canales, & Noboa, 2009; Helble & Chong, 2004; Yamin & Andersson, 2011). Only Wang, Liu, & Li (2009) analyse the role of subsidiaries within their internal and external networks, although they do so separately and statically. In sum, despite the increasing interest in taking a double-network approach to study MNCs, the analysis of the interface between internal and external network embeddedness has not been fully applied to the R&D strategic roles of a subsidiary, and even fewer studies adopt a dynamic approach.

To fill this gap in the literature, we develop an integrated framework that includes the interaction effects of changes in internal and external network embeddedness on a subsidiary's R&D role from an evolutionary perspective of competence mandates. Building on Wang et al.'s (2009) study and taking Dörrenbächer & Gammelgaard's (2010) work as our starting-point, we examine subsidiary R&D evolution patterns by analyzing the distinction between competence-creating and competence-exploiting typologies of subsidiary R&D mandates (Cantwell & Mudambi, 2005). Hence, we respond to recent calls to investigate the simultaneous change experienced by internal and external networks in models of coevolution (Madhok & Liu, 2006; Nell, Andersson, & Schlegelmilch, 2010). We address

this issue by undertaking longitudinal case studies of four subsidiaries operating in Spain. Adopting an inductive approach to theory building (Yin, 1990), we find that the evolution towards a competence-creating mandate is characterized by the simultaneous growth of embeddedness in the local environment and in the corporate network; otherwise, a subsidiary may gravitate away from upgrading its R&D role. Thus, the main contribution of this paper is the development of a dynamic model that can illustrate how internal and external knowledge embeddedness interact to affect a subsidiary's R&D roles.

The paper is structured as follows: the next section develops our main theoretical argument regarding the interrelation between internal and external knowledge networks. Section three discusses our research methods. We then present the analyses and results of our case studies identifying four generic processes and developing propositions based on the underlying network drivers of each process. Finally, we present the inductively obtained model and highlight a number of conclusions and implications for future research.

2. THEORETICAL FRAMEWORK

2.1. External MNC network

The International Business literature has tended to emphasise the importance of environmental factors in determining MNC subsidiary roles and evolution (Birkinshaw & Hood, 1998; Cantwell & Mudambi, 2005; Kuemmerle, 1999; Pearce & Papanastassiou, 1999; Pearce, 1999). However, most of these studies treat the external context quite generally, seeing environmental forces just as a driver to concentrate R&D where local conditions are most conducive to technology creation (Cantwell & Kosmopoulou, 2001). In other words, most studies confide their interest in location issues at a country level and neglect firm-location interactions as a potential platform for leveraging environmental effects. In its relationships with local actors a subsidiary is exposed to new knowledge outside the organization and this knowledge constitutes one of the key inputs for developing and accumulating the capabilities required for technological and organisational innovation (Andersson et al., 2002). For example, Andersson, Björkman, & Forsgren (2005) report that external embeddedness has a positive impact on the development of products and processes in the MNC. Almeida & Phene (2004) suggest that a subsidiary's knowledge linkages with the host country have a positive effect on innovation in the subsidiaries of the MNC. And Santangelo (2009) concludes that local linkages creation is greater when subsidiaries have 'competence-creating scope' within the corporate organizational structure.

In sum, the reason why some subsidiaries achieve better innovative performance than others operating in the same environmental context can be explained by the frequency, depth and quality of subsidiary

linkages to local partnerships. Thus, arguably, improvements in a subsidiary's R&D role depend upon effective integration within the local host country's environment rather than simply on siting activities in a munificent location (Cantwell, 2009). In other words, the potential of environmental factors as a source of competitiveness lies in a subsidiary's awareness of how to benefit from the welfare effects of the country's science base through a certain degree of embeddedness.

2.2. Internal MNC network

It is widely assumed that two of the key internal factors associated with subsidiary role development are subsidiary initiative-taking (Birkinshaw, 1997; Birkinshaw & Hood, 1998; Dörrenbächer & Gammelgaard, 2006), on the one hand, and parent company determinism in the allocation of mandates (Birkinshaw & Hood, 1998; Hood & Taggart, 1999), on the other. However, in terms of R&D roles, the mechanisms driving the evolution are not so straightforward: one argument advocates that subsidiaries with acknowledged advanced R&D mandates may enjoy higher levels of autonomy and, hence, lawfully display greater initiative (Birkinshaw & Hood, 1998; Birkinshaw et al., 2005; Delany, 2000). Nonetheless, a counter-argument claims, on the grounds of the strategic sensitiveness of knowledge-related activities, for tighter control from headquarters (Ambos & Schlegelmilch, 2007; Young & Tavares, 2004), which may act as a barrier to R&D role development through initiative-taking (Ambos, Andersson, & Birkinshaw, 2010). These inconclusive findings may reflect the mediating effect of the level of integration within the MNC network, i.e. the degree of internal embeddedness. The stronger the linkages that a subsidiary builds with its partners within that network, the greater will be its predisposition to share knowledge (Michailova & Minbaeva, 2012), which in turn will influence its subsequent R&D role. However, while not all subsidiaries are equally predisposed to launching or leveraging knowledge among other units of the MNC (Gold, Malhotra, & Segars, 2001), MNC headquarters can strengthen its control by creating an organizational setting (i.e. reshaping the internal MNC network) that is most conducive to knowledge sharing (Björkman, Barner-Rasmussen, & Li, 2004; Ciabuschi, Martin Martin, & Stahl, 2010; Foss & Pedersen, 2004), In this sense, the assignment of R&D roles, such as the establishment of a centre of excellence, is a deliberate mechanism available to headquarters to enhance knowledge development and sharing (Adenfelt & Lagerström, 2006).

Consequently, as previous studies highlight, the configuration of the internal network is an important issue in the development of subsidiary R&D roles within an MNC. The reason for this is that the relatively autonomous subsidiaries develop knowledge abroad and the internal network linkages are the channel by which such knowledge is made available to the rest of the MNC (Adenfelt & Lagerström, 2006). This in turn influences the internal strategic context for decision making in an

MNC (Garcia-Pont et al., 2009) and, thus, affects decisions regarding which subsidiaries to invest in and which to allocate mandates to (Bouquet & Birkinshaw, 2008).

2.3. Subsidiary double-network embeddedness: internal and external network

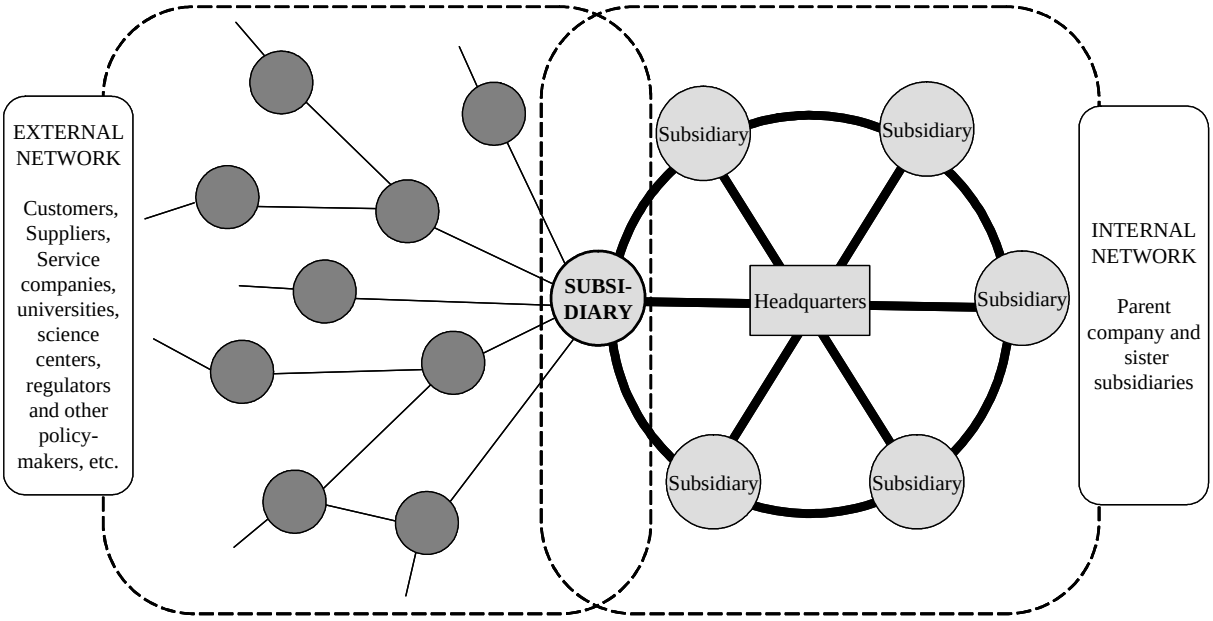
As noted before, subsidiary initiative and parent company determinism are more closely related than hitherto thought. Arguably, they are involved in a 'perpetual bargaining process' (Andersson et al., 2007). Subsidiary power in this relationship, as far as its R&D evolution is concerned, can be associated with the possession of knowledge-related capabilities and a favourable host country environment (Dörrenbächer & Gammelgaard, 2006). Subsidiaries strengthen their competitive position within the corporate group by accumulating over time the competencies needed for innovation (Figueiredo, 2011). This is possible through their entrepreneurial undertakings that tap into new opportunities in the local environment, i.e. subsidiary initiative (Birkinshaw, 1997; Rugman & Verbeke, 2001) and the acquisition of value-adding resources, especially knowledge, on which the rest of the MNC can draw (Birkinshaw et al., 2005). When these resources are unique and valuable for other units in the corporate group, a subsidiary can occupy a central position within the MNC network (Bouquet & Birkinshaw, 2008) and upgrade its power situation vis-à-vis the parent company (Forsgren, Holm, & Johanson, 2005). For Dörrenbächer & Gammelgaard (2006; 2011), a subsidiary's influence on the allocation of headquarters' mandates often depends on ownership of valuable resources that can be used when bargaining with headquarters. Luo (2005) emphasises that it is the quality and rarity of these resources that determines the likelihood of the subsidiary gaining corporate support and parent mandate assignments. The result is an increasing capacity to influence headquarters' R&D strategic decision-making in favour of the subsidiary's own interests (Ambos et al., 2010; Andersson et al., 2007). This is positively associated with gaining mandates so as to increase the scope for R&D evolution.

This somewhat circular argument provides important insights regarding the feedback loops between subsidiary initiative and headquarters determinism. Indeed, subsidiaries address their own future by balancing their own initiatives against requests from headquarters (Garcia-Pont et al., 2009). Headquarters' power within internal network relationships depends on formal authority. The parent company managers have the recognized legitimacy to organize the activity of the MNC by delegating business areas and strategic responsibilities to its dispersed subsidiaries overseas (Dörrenbächer & Gammelgaard, 2010), i.e. the allocation of mandates. This formal authority can be exerted through the use of different planning and control mechanisms, including the distribution of decision-making rights and the allocation of resources (Ghoshal & Bartlett, 1988), which constitute a major instrument in the hands of headquarters for changing subsidiary roles (Birkinshaw & Hood, 1998).

However, in the last decade, the shift towards 'supply-side' motivations to perform R&D operations overseas (Criscuolo, Narula, & Verspagen, 2005) has strengthened subsidiary autonomy to the detriment of headquarters control. MNCs have an increasing interest in the exploration of local knowledge and in accessing expertise complementary to the firm (Ivarsson & Jonsson, 2003; Santangelo, 2012). In such a situation, it is not easy for headquarters to manage and control knowledge development because of context specificity and information deficiencies (Ferner, 2000). Hence, subsidiary autonomy and initiative would appear necessary (Young & Tavares, 2004) to absorb knowledge effectively from the host country environment. Seen from this perspective, a subsidiary's external network can be considered a strategic source of knowledge and competitive advantage (Figueiredo, 2011; Uzzi & Lancaster, 2003) that can be exchanged with the parent company and sister subsidiaries (Ambos, Ambos, & Schlegelmilch, 2006). The logic of the arguments presented in these and other papers (see also Andersson et al., 2002; Andersson, 2003; Andersson et al., 2007) implies that headquarters allocates different R&D mandates to specific subsidiaries so as to tap knowledge linked to the host environments of these subsidiaries.

Nevertheless, changes in a subsidiary's mandate depend not only on the endowment of the external environment but also on its potential to embed itself in the host country environment and to make local resources available to other MNC units (Andersson & Forsgren, 2000; Dörrenbächer & Gammelgaard, 2010). Thus, as Figure 1 illustrates, the subsidiary acts as a bridge for knowledge transfer between the host country environment and the international corporate network, including headquarters and peer subsidiaries (Forsgren et al., 2005; Giroud & Scott-Kennel, 2009). This means that subsidiaries are embedded, at one and the same time, in their own internal network, which includes headquarters and all the other MNC units, and in their external local network, which in the case of R&D activities involve other actors besides customers, suppliers and service companies, such as universities, science centres or regulators and other policy-makers. In this respect, Andersson et al. (2005) have shown the degree of local embeddedness to be an important indicator of a subsidiary's ability to create new knowledge, while Andersson et al. (2002) have empirically demonstrated that high external embeddedness can be correlated with an assignment of higher technological subsidiary mandates.

Figure 1: Subsidiary double-network embeddedness



Therefore, it seems reasonable to expect that a subsidiary's R&D role evolves according to changes in both its degree of external network embeddedness (so as to learn and assimilate knowledge from the host country environment) and its degree of intra-corporate embeddedness (allowing it to transfer its knowledge to the parent company and other subsidiaries). By focusing solely on the inter-organizational network, or only taking the intra-organizational network into account, is to see only *half of the picture.*

3. METHODS

Based on the ideas drawn from the preceding literature review, we explore the dynamics of internal and external embeddedness and the evolution in subsidiary R&D roles. Given the current standing of the extant theory regarding dual embeddedness, here we use a case-study approach to build an inductive model. Thus we analyse the dynamics of the R&D roles of four Spanish subsidiaries over time. Multiple-case studies of this kind, employing inductive methods, are well suited to the study of longitudinal change processes (Eisenhardt, 1989; Santos & Eisenhardt, 2005). Moreover, this methodology allows us to conduct a more in-depth investigation of the processes than would otherwise be possible if employing other methods (Eisenhardt, 1989; Yin, 1990), since it enables us to understand the relationships between individual units as well as the content of these relationships (Garcia-Pont et al., 2009).

3.1. Case selection

The four cases analysed in this article were selected from a database of 65 firms built in the framework of a research contract with the regional innovation agency (ACC10) of the Catalan Government (Spain)[1]. This agency launched several series of surveys of large Spanish companies between 2006 and 2010 aimed at analysing their role in the regional innovation system. Our study explores in greater detail the qualitative research material provided by this project.

In choosing the case studies we followed non-probabilistic criteria to ensure the selection of four subsidiaries that were of particular interest for our study (Eisenhardt & Graebner, 2007; Glaser & Strauss, 1968). The specific profile sought was delimited by six criteria: (1) the firm had to be a dominantly owned subsidiary, since the literature addressing subsidiary roles has tended to focus on such cases (Birkinshaw & Hood, 1998); (2) it had to operate in an R&D intensive sector, such as the Chemical and Pharmaceutical Industry, since such industries report a relatively high percentage of R&D departments in their Spanish subsidiaries, which indicates their forward-looking potential to exhibit a range of different R&D roles and their long-established tradition in the internationalization of research activities (Manolopoulos, 2006); (3) its MNC headquarters had to be located in an EU country, since membership of a 'deep' integration scheme, such as the EU (based on the regional convergence of economic structures and the establishment of common institutions and coordinated policies), has been found to affect subsidiary roles (Benito, Grøgaard, & Narula, 2003), especially at a disaggregated value chain level (Rugman & Verbeke, 2004; Rugman, Verbeke, & Yuan, 2011); (4) it had to be located in the same geographical area, thus presenting the same opportunities for becoming embedded within the local environment (Figueiredo, 2011), in this instance Catalonia, home to the largest concentration of the chemical industry (ranging from petrochemicals to biotechnology industries) in southern Europe and responsible for approximately 50% of Spain's chemical production (Arguimbau & Alegret, 2010); (5) it had to possess a long track-record of operating in Spain, with sufficient time to have established and developed deeply embedded relationships, given that effective partnerships require time and attention (Håkansson & Snehota, 1995); (6) it had to be a large company (in terms of the number of workers), since a subsidiary's size is an indication of its resources (Yamin & Andersson, 2011), and large subsidiaries can undertake a considerable range of R&D activities (from large R&D units to non-existent units).

[1] The reports were entitled 'R&D investment by the 50 largest companies in Catalonia I' (2007) and 'R&D investment by the 50 largest companies in Catalonia II' (2011). In addition to the four case studies analyzed herein, a total of 65 case studies were reported.

Having applied these six criteria to the 65 firms, 12 subsidiaries were found to meet the specified profile (six operating in the Pharmaceutical industry and six in the Chemical industry). By examining various documents (including industry publications, company reports, newspaper articles, previous case studies, etc.) we acquired the necessary background knowledge to narrow them down to just four. Eventually, we selected four subsidiaries that are paradigmatic of MNC motives for operating in Spain, i.e. two represented knowledge-seeking motives and two market-seeking motives. The rationale was that R&D strategies in competence-creating subsidiaries are supply-driven while those in purely competence-exploiting subsidiaries are demand-driven (Cantwell & Mudambi, 2005). Therefore, as established by the so-called theoretical sampling, the selection of cases was made in accordance with their expected contribution to the theory (Yin, 1990). Table 1 provides an overview of the four companies selected and their basic characteristics. To guarantee the anonymity of all respondents, the subsidiary names are withheld and all numbers are rounded. In line with the aim of the study, our unit of analysis is the companies' activities of technological innovation and not the subsidiary itself, since capability development does not proceed at a uniform rate for every activity in the value chain (Kim et al., 2011; Rugman et al., 2011), e.g. a subsidiary might play an active role in manufacturing but a receptive one in R&D.

Table 1. Characteristics of the four subsidiaries (case studies A-D)

Case study	Home country	Year of entry into Spain	Industry and activity	Nº of employees (2010)	Strategic orientation
Case A	Germany	Early 1970s	Chemical: engineering plastics	350	Knowledge-seeking
Case B	Netherlands	Late 1970s	Chemical/Pharmaceutical: cosmetics, hygiene and cleaning products	550	Market-seeking
Case C	Germany	Late 1960s	Chemical/Pharmaceutical: agrochemical and biotechnology	950	Market-seeking
Case D	France	Late 1960s	Pharmaceutical: dermocosmetics and medicines	450	Knowledge-seeking

3.2. Data collection and analysis

Data were gathered through face-to-face, semi-structured interviews conducted at the subsidiaries in two rounds. The first round was held in September 2006 and the second in June 2010. While the case study data included any relevant events occurring from the time of the establishment of the selected subsidiaries in Spain until 2010, we particularly scrutinized the changes that had occurred over the last ten-year period (between 2000 and 2010). As it can be seen in table 2, interviews were conducted with managing directors and top and middle R&D managers, and lasted, on average, 90 minutes. The interviewees were chosen on the basis of their first-hand experience of the phenomenon being studied (Wacheux, 1996). The interviews were recorded whenever possible and detailed notes were also taken.

Both records were usually transcribed within 48 hours, summarised chronologically and the key segments of the interviews highlighted and coded (Strauss & Corbin, 1998).

Table 2. Interviewees profile (case studies A-D)

Case study	First interviews round: September 2006	Second interviews round: June 2010
Case A	▪ Managing director ▪ R&D Coordinator & MDI Process Engineer	▪ Managing director ▪ R&D Coordinator & MDI Process Engineer ▪ Lead Investigator, Defect Elimination
Case B	▪ President ▪ Technical Manager	▪ President ▪ Technical Manager
Case C	▪ Managing director ▪ Phytosanitary, Dispersions, Styropor Laboratory Chief	▪ Phytosanitary, Dispersions, Styropor Laboratory Chief ▪ Phytosanitary, Dispersions, Styropor Laboratory Technician ▪ Deputy Manager For Production
Case D	▪ Managing director ▪ R&D Director	▪ R&D Director ▪ Lead Investigator for medicines

To ensure reliability, we adhered to a research protocol that established the sequence of steps to follow and the topics to cover (Yin, 1990). Specifically, the interview script was designed so as to ascertain the 'story' of the subsidiary's R&D activities in the beginning, middle and end phases, identifying any critical incidents of change in the light of the theoretical framework presented (Flanagan, 1954), keeping track of all changes in internal and external network relationships during these incidents, and recording how these differed from 'intervening' periods of (relative) stability (Turner, 2011). Overall, respondents were asked to provide an overview of the subsidiary's technological innovation activities in Spain from the time of their arrival. Later, respondents were asked to describe the dynamics associated with the subsidiary's linkages including the quantity, scope, and quality of the network relationships over time. In seeking to keep an account of past events and to integrate them into a coherent whole, we used narrative techniques to construct the story. The use of narrative analysis has proved useful in longitudinal field research for examining processes of organizational change (Miles & Huberman, 1994; Pentland, 1999), especially those that involve a 'how' question, which requires a 'process theory' explanation based on a story or historical narrative of the temporal sequence of events that unfold as an organizational change occurs (Van de Ven & Huber, 1990). This procedure serves to identify the main outcomes of each period (beginning, middle and end phases) and highlights the logical connections between factual events (Garcia-Pont et al., 2009). Furthermore, narrative analysis provides a powerful sense-making tool that helps to create new meanings through storytelling (Bruner, 1991; Reissner, 2005; 2011; Silverman, 2006). The narratives of the key events in the history of each subsidiary are recorded in the following section.

Specifically, we ascertained the network embeddedness type by indirect methods of assessment. Thus, rather than asking interviewees to classify their internal and external network relationships directly, we

identified, from their storytelling, the 'revealed attributes' of the embeddedness that showed not only the frequency of the most relevant linkages but also their content and quality. This research strategy proved advantageous for various reasons. First, individuals tend to provide less persuasive inputs through indirect evidence than they do through direct evidence (Kantola, Karwowski, & Vanharanta, 2005) and, second, it mitigates the subject bias commonly present in self-definition (Dessler, 2003).

Next, we identified the type of network linkages based on the descriptors in Figueiredo's (2011) framework[2]. Figueiredo (2011) operationalizes degrees of embeddedness as sources of subsidiaries' capabilities according to the intensiveness of knowledge in the linkages. Previous contributions have tended to categorize embeddedness into an absent/weak or present/strong relationship. However, if embeddedness is assumed to develop over time, it should be treated as a continuous variable rather than as a dichotomy (Dacin, Ventresca, & Beal, 1999). Figueiredo's (2011) framework overcomes this drawback and allows progressive levels of knowledge-intensive linkages to be graduated. This ranking of linkage types, in its extremes, is closely related to earlier gradations reported in the literature. Table 3 summarizes the relationship between Figueiredo's (2011) framework and these degrees of embeddedness.

Table 3. Framework for assessing the quality of subsidiaries' linkages in dual embededdness

Low	DEGREE OF INTERNAL LINKAGES		High
Arm's length	**Learning for production**	**Learning for intermediate innovation [a]**	**Research and development**
Business-type linkages based on the sales of goods and services involving no element of building capability	Knowledge acquisition to enhance capabilities to adapt product models and adopt new production systems	Knowledge acquisition to create or enhance capabilities to create new product models and new production systems	Knowledge acquisition and sharing based on collaborative research, development and design of new products, processes, components based on new technology
Operational embeddedness [b] (Garcia-Pont et al., 2009)		Capability embeddedness [b] (Garcia-Pont et al., 2009)	Strategic embeddedness [b] (Garcia-Pont et al., 2009)

Low	DEGREE OF EXTERNAL LINKAGES		High
Arm's length	**Minor adaptation, modification [a]**	**Joint adaptation, modification**	**Joint research**

[2] It is important to stress that originally, according to the research design, the identification of network ties had to carried out based on the descriptors in the 'tailored typology of technology-centred inter-organisational links' provided by Ariffin (2000). However, the later apparition of the Figueiredo's (2011) framework, which is more knowledge centred and fits better to the aims of the study, encouraged us to adopt this later model instead of the one initially planned. As Figueiredo's (2011) classification was mainly built on the Ariffin's (2000) model, the transition from the former to the later risked a marginal cost in terms of losing information, for a potential gain in terms of internal validity.

Informal and/or one-off type of interactions based on minimum exchange of information	Exchange of information with local organizations for simple improvements in process efficiency or products without changing their functionality.	Acquisition and sharing knowledge with local organizations for basic and intermediate innovation activities	Collaborative efforts on different types and degrees of research, development and design of new products and processes, and joint problem-solving involving high degrees of trust and complexity.
Arm's-length relationships [b] (Andersson et al., 2002) Arm's-length ties [b] (Uzzi, 1996; Uzzi & Lancaster, 2003)			Technical embeddedness [b] (Andersson et al., 2002) Embedded ties [b] (Uzzi, 1996; Uzzi & Lancaster, 2003)

Source: Adapted from Figueiredo (2011)

[a] These degrees of embeddedness have been redefined and adapted to the present study.

[b] Examples of alternative subsidiary internal/external type linkages existent in the international business literature.

In turn, we analysed subsidiary R&D role changes based on the distinction between competence-creating and competence-exploiting typologies of subsidiary R&D mandates (Cantwell & Mudambi, 2005). Table 4 yields some examples of explicit competences underlying this dichotomy of subsidiary types.

Table 4. Framework for assessing competence-creating and competence-exploiting mandates

Competence-creating subsidiary mandate	**Competence-exploiting subsidiary mandate**
Knowledge/competences of a more novel nature relative to the current practices in the MNC:	Knowledge/competences of a more duplicative nature relative to the current practices in the MNC:
Cutting-edge research (basic research)	Product quality improvement, licensing and assimilating new imported product technology
Applied research into new product generations	
Development of new products or components	Equipment stretching, process adaptation and cost saving, licensing new technology
Research into new materials and new specifications	
New product design	Assimilation of product design, minor adaptation to market needs, replication of fixed specifications
Development of prototypes	Debugging, balancing, quality control preventive maintenance, assimilation of process technology
Major improvements to machinery	

Source: Adapted from Lall (1992) and Cantwell & Mudambi (2005)

In constructing the stories of the four case studies, we have successively iterated between extant theory and the data, seeking explanations in existing conceptual frameworks and making comparisons with similar empirical results (Pettigrew, 1997). Whenever doubts concerning interpretation arose, respondents were contacted again and clarifications were sought (Yin, 1990). To further enhance validity, the interview information was triangulated (Eisenhardt, 1989; Yin, 1990) by drawing on the

company's own or external secondary sources. Additionally, since the study relies on several respondents per R&D unit at different times we juxtaposed and compared the stories and impressions of the informants (Moschieri, 2011). Finally, two external researchers read the cases independently to form their own judgement and to corroborate the final interpretations made from the raw data (Moschieri, 2011). This procedure ensures the consistency of this indirect method of assessment.

4. ANALYSIS AND RESULTS

In this section, we discuss the four narratives in which the key events, which emerged as being relevant in the interviews, are structured and connected into a meaningful whole. By scrutinising these narratives, a detailed picture is formed of how internal and external embeddedness interact to generate outcomes in the evolution of the subsidiaries' R&D role over time. Subsequently, we reconciled these evolutions with concepts drawn from the literature and integrated them into the following four narratives.

4.1. Case A: The 'increasingly-embedded' subsidiary, evolving towards a competence-creating mandate

Situation at outset

The establishment of this subsidiary in Spain in the early 1970s was a strategic response to a policy of import substitution industrialization. Its creation reflected the desire to supply Spain's industrial sectors - at that time in full expansion - with intermediate chemical products, the importation of which was hindered by the prevailing autarchic environment. As a result, the Spanish subsidiary barely undertook any R&D, being primarily concerned with production. It then marketed these products exclusively in the domestic market.

The MNC's R&D operations were concentrated in the home country, and the socio-political situation of Spain did no more than reaffirm the ethnocentric attitude of the head office, fostering the concentration of the corporation's R&D activities in the group's headquarters (Gassmann & von Zedtwitz, 1999). The Spanish subsidiary acted as an executor or implementer of the technology developed in the central laboratories, and maintained a hierarchical relationship of subordination in the face of the assignment of production projects from the company headquarters. As the managing director explained '*we were confined to adapt products and processes to the Spanish market without any possibility of developing our own innovations*'. That is to say, subsidiary played a competence-exploiting role.

At the internal level, the information flows between headquarters and the subsidiary comprised commands intended to control the subsidiary, and were virtually devoid of any learning component. At the external level, the subsidiary's interactions within the local market were characterised by a minimal exchange of information and included no elements that might lead to the building of technological capabilities. Thus, in this beginning phase, the subsidiary maintained 'arm's-length' type linkages in both its internal and external knowledge networks.

Evolution in R&D activity

In the nineties, as the Spanish market became more important and as a result of the MNC committing itself to the production of engineering plastics (a more sophisticated product with lower volumes of production and greater added value obtained from the transformation of more widely consumed commodity plastics), the Spanish subsidiary undertook its first innovative activities, specifically involving this new product. In managing director's words, '*the rationalization of international production enabled the site of Catalonia to specialize and begin to develop their own technological know-how in engineering plastics'*. This facilitated technology transfer from the headquarters in order to serve more competitively a national market that was becoming increasingly more attractive (Beise, 2004; Howells, 1990; Kuemmerle, 1999).

A crisis in one of the MNC's business units in 2002 marked a turning point in the company's R&D strategy. In the first stage, between 2002 and 2004, the central laboratories in Germany were restructured and an externalization process was initiated within the same country. In a second stage, in the years after 2005, an off-shoring of its R&D activities was begun based on the principle of locating laboratories close to the company's centres of production around the world. This process culminated in 2008 with a network of laboratories managed from the headquarters in Germany, but based on a policy of competing centres. At the MNC level, this meant the end of the ethnocentric attitude of the managers at headquarters and the introduction of a mechanism for the competitive assignment of resources internally. Thus, the location of R&D activities shifted in responds to strictly to the criteria of the technology supply of the various sites.

As a result, the subsidiary's technological strategy steered a different course in three senses: first, it took initiatives to improve learning and innovation through 'scouting' and the development of close ties with Spain's leading R&D centres. The introduction of an internally competitive mechanism for the distribution of responsibilities allowed the Spanish subsidiary to develop an awareness of its own R&D capacities vis-à-vis those of the other subsidiaries, and this forced it to seek out the knowledge and learning needed to develop its capabilities in the local environment. To do this it established increasingly stronger ties of collaboration with local agents, thus forging 'joint-research' type linkages. '*Before 2002 the relationships with local universities and research centres was trivial,*

limited only to isolated cooperation agreements; however, at the moment these collaborations have become a key factor to attract new R&D investment to our site', stated R&D coordinator. Consequently, in the terms employed by Figueiredo (2011), the subsidiary conscientiously increased its external embeddedness as part of its 'strategic asset-seeking strategies'.

Second, the subsidiary's strategy shifted as it sought to provide useful competences and knowledge assets to the rest of the units in the firm: its strategy was based on creating, over time, a 'research and development' type linkage, which involved the sharing of knowledge with the MNC as a whole. In other words, the subsidiary exploited the internal technological asset interdependencies through such means as the accumulation of proprietary knowledge. Thus, the subsidiary managed its internal embeddedness by means of exerting influence over the allocation of resources and mandates (Garcia-Pont et al., 2009).

Finally, the subsidiary sought to defend itself at the parent office and obtain the recognition of headquarters, this recognition being essential to increase its influence and occupy a central position within the corporate network through initiative-taking (Ambos et al., 2010). The subsidiary wilfully utilized its critical linkages with key external actors that the other corporate units could not otherwise access (Dörrenbächer & Gammelgaard, 2010) as a key source of its bargaining strength (Andersson et al., 2007) in the mandate assignment processes. In fact, to convince headquarters to locate its basic R&D activities in the country, the R&D coordinator drew on three main arguments: *"the talent of the country's team of scientists, the excellence of the local research centres with which we collaborate and the backing of the host government in the form of subsidies and financing for R&D"*.

In this strategic shift, the then R&D coordinator played a leading role. The senior manager's efforts in promoting boundary-spanning interaction with external entities (Geletkanycz & Hambrick, 1997), as well as his background characteristics (Hambrick & Mason, 1984), were influential in the subsidiary's strategic choices and performance. First, his environmental scanning practices can be related to the subsidiary's differential means of competing (Hambrick, 1982). In this instance, joint research with advanced R&D centres and universities was possible thanks to the fact that the R&D coordinator had more than five years' experience as a researcher in these institutions, a PhD in chemistry and a long track record teaching on several university training programs. As himself retells: '*My past experience makes me more proactive to collaborate with universities and research institutions and provided me with an overview of the best specialist in each field*'. Moreover, the manager's German-Spanish origins meant he was able to share the values of both the MNC's headquarters and those of the local environment, which facilitated knowledge transfer within the internal network (Sekiguchi, Bebenroth, & Li, 2011) and provided additional bargaining power in the internally competitive mandate allocation processes. Thus, in line with the upper-echelons perspective (Hambrick & Mason, 1984; Hambrick,

2007), this executive's profile greatly influenced the interpretation of the situation and the choices made and, in turn, affected the evolution in the subsidiary's R&D roles.

Table 5. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedess	Arm's length	Increase	Research and Development
External type embeddedness	Arm's length	Increase	Joint research

Current situation

Since 2010, the Spanish subsidiary has been one of the most competitive in the corporation in terms of applied research and technological development applied to the production of engineering plastics. Thanks to the results of its applied research, achieved jointly with external scientific institutions in the local environment, the Spanish subsidiary currently supplies innovations to the entire corporation. Hence, building strong linkages of trust with the host country's actors has been vital for developing critical resources and knowledge assets for the other units in the organization (Andersson et al., 2001, Andersson et al., 2002; Dörrenbächer & Gammelgaard, 2010). Thanks to this work the subsidiary has finally been granted recognition in the form of a competence-creating mandate. However, the group's basic research continues to be conducted essentially in German centres, complemented by a small number of centres in other countries including the US, Japan and, prudently now, in China. The inclusion of the first two countries responds to the logic of the triadization of technology (Archibugi & Iammarino, 2002; Meyer-Krahmer & Reger, 1999), while that of China responds to the need to integrate emerging economies onto the world map of R&D (Edler, 2008; Thursby & Thursby, 2006).

In the long term, the management of the Spanish subsidiary has a clear goal: to ensure that headquarters recognizes the superior capabilities developed in its research of engineering plastics and, consequently, to be given the opportunity to open a basic research centre in Spain. The managing director of the Spanish subsidiary is well aware that '*to survive we need to attract more R&D activity'*, and to do so, *'we need to seduce our parent office'* adds the R&D coordinator. That is, gaining headquarters attention through internal linkages (Bouquet and Birkinshaw, 2008). Moreover, the Spanish subsidiary has a deeply rooted culture of entrepreneurship and it has always extended itself beyond headquarters' mandates. The evidence presented here is very much in keeping with the upper echelons theory, which establishes that executives' values and personalities greatly influence their interpretations and affect their strategic choices (Hambrick & Mason, 1984; Hambrick, 2007), and also with most studies that offer empirical support for the positive relationships established between initiative-taking and external embeddedness (see, for example, Birkinshaw et al., 2005; Gammelgaard et al., 2012; Young & Tavares, 2004).

Thus, the fact that this Spanish subsidiary has taken the initiative to exploit external networks and to enhance its potential for using and generating new knowledge, as well as, to ensure the dissemination of technological capabilities back to the parent company, so as to manipulate dependencies and exert influence over the allocation of mandates, has enabled the subsidiary to evolve towards a competence-creating mandate.

Hence:
Proposition 1: The more a subsidiary increases its external and internal network embeddedness, the greater is its likelihood of evolving towards a competence-creating mandate.

4.2. Case B: The 'decreasingly-embedded' subsidiary, experiencing a mandate-depletion process

Situation at outset

When this subsidiary was created in Catalonia in the late 70s, it had its own R&D department, dedicated primarily to developing products for the Spanish market. The subsidiary supplied the local market with a highly diverse consumer product range comprising all kinds of soaps and detergents, toiletries and cosmetics, as well as food products that shared a common technology base with its other products (for example, margarines). The mission of the R&D department was to oversee the production and marketing activities of the subsidiary in the foreign country and to launch new and differentiated products on the local market. As the president of the Spanish subsidiary said, '*we had total freedom to decide which products manufacture and commercialize providing that we had good financial results'*. In keeping with this multi-domestic strategy, the policy of the parent company was to reproduce the value chain in the various subsidiaries with the aim of ensuring a rapid and effective response to the characteristics of local demand and to any changes in it. As such, the creation of a competence-exploiting R&D unit was a response to the attractiveness of the market and to the exploitation of a technological advantage created in the country, (a process of internationalisation that is supported by Kuemmerle, 1999; Patel & Pavitt, 1991; Patel, 1995, among others). It implied the need to maintain contacts, on the one hand, with internal agents so as to produce the models transferred from headquarters ('learning for production' type linkages) and, on the other, with external agents so as to carry out minor adaptations to local market requirements ('minor adaptation, modification' type linkages).

Evolution in R&D activity

In the year 2000, the strategy of the parent company regarding the group's R&D activities acquired a decidedly global outlook. In the words of the president of the Spanish subsidiary: '*At the start of the*

year 2000, the company began, under its current growth plan and a project of unification, to implement a global restructuring process aimed at reducing the multiplicity of trade and firm names. This was followed by a rationalization at the international level of all departments'. The globalization of R&D activities resulted in the elimination of the R&D departments of its subsidiaries, including that in Spain, and the creation of Regional Development Centres and Global Development Centres, which when they coincided in the same centre, were given the name of Centres of Excellence. These contribute to the corporations overall process of innovation and their outcomes generate applications for different countries. The search for scale economies (De Meyer, 1993; Pearce & Papanastassiou, 1999), combined with historical motives (Granstrand, Hakånson, & Sjölandera, 1993) led to the concentration of its R&D activities in just a few centres, some of excellence, located in the MNC's country of origin (the Netherlands) and a number of others that the company incorporated by acquisition (located mainly in Germany). The specialization of the centres of excellence was by technology rather than by product categories, so as to maximize synergies and technical economies of scale. Thus, very different products, such as foodstuffs and hygiene products, might be the responsibility of the same R&D unit in the MNC if they have the same base technology.

This centralization process of the R&D activities meant the Spanish subsidiary lost its ties with the rest of the corporate units. In the words of the technical manager: '*If all decisions are taken at parent office, you do not need anything from anyone else but managers at headquarters*'. Thus, the subsidiary's ties with the group were limited to flows of information to headquarters that were terminated as soon as the necessary specifications for the adaptation of a product to the local market were given. The headquarters became the interlocutor of the subsidiary with the other units in the group as far as R&D were concerned: '*The subsidiary might have an idea, but its development is undertaken in a centre of excellence for the global market and always at the request of headquarters, never at that of the subsidiary*'. Furthermore, in the new global strategy the legitimacy to have a voice in the wider corporate group came to be conditioned by the unit's financial turnover, and in this case, '*a 5% share of the European turnover did not grant very strong powers of negotiation*'. Thus, the subsidiary's internal embeddedness became characterized by the so-called 'arm's-length' relationship, that is, by business-type linkages based on sales of products and services involving no element of building capability (Figueiredo, 2011).

As regards the subsidiary's external embeddedeness, business network studies have shown that giving a subsidiary little leeway can lead to a low level of external interaction (Birkinshaw et al., 2005; Gammelgaard et al., 2012; Young & Tavares, 2004). This is precisely what has happened to this subsidiary. It pays little attention to the potential of its domestic environment in terms of R&D, since any initiatives it seeks to take in this activity in the value chain are nearly always vetoed. According to

the subsidiary's president, '*it is difficult to be innovative when all initiatives are essentially global*'. Therefore, the limited role of the subsidiary as regards R&D and the lack of initiatives to improve this situation in the past, largely condition the small degree of interaction with the local environment in this area (resulting in 'arm's-length' type linkages). The result is that the limited involvement of the subsidiary with its local scientific environment has inhibited the effects of technological dynamism in the local setting, preventing the absorption of external knowledge and the development of competences in the subsidiary itself (Frost, 2001). In short, the subsidiary has clearly evolved towards an 'arms-length' external linkage according to Figueiredo's (2011) classification.

Table 6. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedness	Learning for production	Decrease	Arm's length
External type embeddedness	Minor adaptation, modification	Decrease	Arm's length

Current situation

Since 2010, the role of the Spanish subsidiary has been reduced to sales operations (the distribution and promotion of products) and trade marketing (presentation and packaging). The role of the subsidiary as regards R&D is limited, on the one hand, to the adaptation of products to the local market by identifying tastes and preferences, but not implementing these adaptations, and on the other, to the observation and monitoring of its closest competitors in order to report back to headquarters. Those individuals linked to innovation activities are now referred to as 'Support Teams' and they are dedicated to providing local support on technical issues of product adaptation that are completed in other units of the MNC. The innovative process is based on what the MNC calls 'baskets of global innovation', from which the Spanish subsidiary chooses the products they wish to launch in the local market. Having selected a product, they choose a marketing and communication campaign designed globally which they believe to be best suited to the Spanish market and they give the necessary specifications for product adaptation (preferences, local legislation, etc.), which is always carried out in the centres of excellence in other countries. According to the president of the Spanish subsidiary, '*Our previous freedom has been drastically cut not only at the innovation activity but also in other value chain activities. As a result we have clearly lost voice and power within the international corporation… but there is nothing to do against globalization*'.

Consequently, the underdeveloped nature of the subsidiary's network exchange with both its parent company and partnerships in its local environment has triggered the gradual depletion of the subsidiary's R&D role, and led eventually to the complete removal of this activity from the value chain; in other words, it has resulted in mandate depletion. Here, the subsidiary lost its mandate as a

consequence of a global rationalization program, in a context, *ceteris paribus*, in which other subsidiaries with higher levels of embeddedness have been able to acquire and share knowledge more effectively.

Hence:

Proposition 2: The more a subsidiary's external and internal network embeddedness decreases, the greater is its likelihood of evolving towards mandate depletion.

4.3. Case C: The 'prevailing-internally embedded' subsidiary, evolving towards a competence-exploiting mandate

Situation at outset

Since the creation of the subsidiary, in the late 1960s, decisions regarding R&D have been highly centralized in company headquarters and concentrated in the company's large international research centres. Specifically, the core of these activities is concentrated in two points: in the home country of the parent company, Germany, where the focus is on the group's traditional research areas, namely basic chemistry, chemical engineering and plastic raw materials; and, in the United States, where the laboratories undertake research in areas where the competitive advantages of the country can be best exploited (thanks to the availability of its technical infrastructure and qualified staff). This is the case of agrochemistry, pharmaceutical research and biotechnology. The search for scale (De Meyer, 1993; Pearce & Papanastassiou, 1999) and agglomeration economies (Cantwell & Janne, 1999), and the ethnocentric attitude of headquarters (Gassmann & von Zedtwitz, 1999) account for this policy of the concentration of R&D activities in a small number of centres (in Germany and in the US), the main one being the MNC's home country. In the words of the managing director, '*our German headquarters did not expect any valuable contribution derived from a Spanish subsidiary. They only thought of Spain as a country with low wages that represented an important opportunity market to cover*.'

In this context, the site in Catalonia was classed from the outset as a production centre. The mandate assigned to the Spanish subsidiary, in common with that assigned to the company's other plants in other countries, was to contribute to the global optimisation of operations through low-cost production and the minimization of delivery times to the local market. Thus, in the field of R&D, the site in Spain only applied the knowledge transferred from the German headquarters to its local factory, and the only interaction it enjoyed with rest of the group was in relation to the sale of goods and services. As such, the subsidiary's interactions with the internal organizational network were based on 'arm's-length' type linkages. In turn, the degree of company centralization resulted in a substantial distance between the Spanish subsidiary and its local market, resulting in weak knowledge ties with local organizations.

In short, the subsidiary maintained 'minor adaptation, modification' type linkages with the external organizational network.

Evolution in R&D activity

The great diversification undergone by the chemical industry, and the restructuring of the organisation initiated by the MNC group in the nineties into business units and by regions, intensified competition between the subsidiaries as they sought to attract the manufacturing of new products to their respective industrial sites. This competition was seen by the Spanish subsidiary to place it at a marked disadvantage vis-à-vis its other sister subsidiaries located in countries with lower labour and material costs. Hence, to gain an advantage in the productive sector, the subsidiary chose to carry out technology development activities applied to chemical production or what those responsible for R&D within the subsidiary called '*applied research to production*'. These were the only innovation activities that the headquarters allowed them to undertake. As the managing director said, '*providing more cost competitiveness and more value added in manufacturing was the only way to survive within the MNC*'. The subsidiary's strategy which was designed to enable it to become a key player at the production level was based upon three pillars: first, the subsidiary fostered internal knowledge transfer channels among the company's plants, in particular with the laboratories operating in other units, so that they might access any useful corporate knowledge to help them in the internal manufacturing competition. Second, the subsidiary combined the knowledge transferred from headquarters and from the other units in the group with its own knowledge in order to improve production. Third, the subsidiary's production managers were encouraged to bargain internally within the MNC to obtain projects and products. Thus, here, to use the terms employed by Garcia-Pont et al. (2009), the subsidiary changed its limitations by developing a strategy based on its internal embeddedness. This process led the subsidiary to develop 'learning for production' type linkages over time. As a consequence, the level of capabilities developed by the local subsidiary consisted mainly in changes to its process technology and enhanced efficiency based on its experience from conducting existing tasks. Indeed, '*some efficiencies developed at this site have been exported successfully to the rest of the MNC*', stress the deputy manager for production. However, as Yamin & Andersson (2011) point out, increased internal embeddedness promotes the development of existing areas of competence within the MNC.

By contrast, the subsidiary's external embeddedness was characterized by informal or one-off types of interaction based on the minimum exchange of information (Figueiredo, 2011), that is to say, by the 'arm's-length' relationships. Over time, the level of centralization of R&D decision-making has been progressively increased thus reducing the freedom of the Spanish subsidiary to act in this area, to the point that when the MNC needs to establish contacts with a Spanish university, institute or research centre '*it does so directly from Germany and the subsidiary plays no part in the process*' according to

the subsidiary's management. The support from the host government in the form of incentives and funding for R&D, allows the subsidiary to justify and legitimise the resources it dedicates to process innovation before company headquarters, even though the latter does not consider the exploitation of this link for attracting greater mandates to the Spanish site a priority. Therefore, its efforts to develop competence through internal embeddedness have undermined the subsidiary's efforts to develop competence in externally embedded networks. The latter evidence is in line with Yamin & Andersson's (2011) findings.

Table 7. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedness	Arm's length	Increase	Learning for production
External type embeddedness	Minor adaptation, modification	Decrease	Arm's length

Current situation

Since 2010, the subsidiary has gained a high reputation across the MNC, based upon its manufacturing excellence in plastic raw materials and agrochemical manufacturing, both of which are now carried out exclusively at the Spanish site for the whole group. The frequent and intense interactions with its internal counterparts have allowed the subsidiary both to acquire and show off its competences developed in the innovation processes (optimisation of layout designs, leading production technology, self-developing equipment, etc.), since these activities help it conduct its tasks in the production area (an activity for which its legitimacy is now fully recognised) in its struggle to attract new products. In the words of the laboratory chief, '*although the subsidiary has never been given the opportunity to develop its R&D capabilities, not to mention the chance to open a research centre so that it might be designated as a production centre, the subsidiary has managed to introduce process innovations*', adding that many of the group's other units around the world '*do not even undertake this process development activity*'. However, focusing on internal network linkages has allowed the subsidiary to tailor the current practices of other MNC units and to trim back on its efforts to develop external network relationships, and thus, develop new knowledge for the entire MNC.

Consequently, this third case study reveals that by focusing only on internal knowledge embedded relationships a subsidiary may be able to enhance its existing competences within the MNC and to develop knowledge of a more 'replicative nature'. This means that the efforts to enhance its capabilities, independent of its relations with the environment, have allowed the Spanish subsidiary to have its competence-exploiting mandate be recognised within the MNC group.

Hence:

Proposition 3: The more a subsidiary increases its internal network embeddedness to the detriment of its external network embeddedness, the greater is its likelihood of evolving towards a competence-exploiting mandate.

4.4. Case D: The 'prevailing-externally embedded' subsidiary, evolving towards an isolated mandate

Situation at outset

The first ventures mounted by the French MNC in Spain date back to the late 1960s, at a time of considerable industrial protectionism and the strict regulation of the chemical and pharmaceutical sectors by government authorities. To protect domestic firms, direct imports were prohibited and foreign companies were required to buy and manufacture raw materials in Spain. In this context, in order for the French MNC to enter the Spanish market it purchased an autochthonous laboratory that was operating in Barcelona. Thanks to this transaction, the company could introduce its activities in Spain.

The strict regulations imposed by the health authorities at that time, meant all products had to be adapted to the prevailing legislation in Spain. This was the role of the Spanish subsidiary, which focused its efforts on developing process and, to a much lesser extent, product innovations based on the knowledge transferred from headquarters. Subsidiary purely replicated fixed specifications and designs extant in the MNC, performing a competence-exploiting mandate. Therefore, the set of technological knowledge relations between the subsidiary and the headquarters were mainly concerned with manufacturing issues, i.e. they maintained 'learning for production' type linkages, while interaction with local agents was very much a secondary concern, maintaining with them transactions solely based on economic considerations, without any exchange of information other than that of prices, i.e. 'arm's length' type-linkages. As the managing director said, '*at that moment we had to make so much effort to assimilate and adapt processes and products from the parent company that we even could not think about the possibility of developing our own innovation'*.

Evolution in R&D activity

A change in government policies supporting industrial development had considerable repercussions on the situation and on the R&D strategies of the French MNC in Spain. Between the eighties and the nineties, the 'Development of Pharmaceutical Research Plan' was implemented, also known as the *FARMA* Plan. The plan sought to stimulate the sector by increasing expenditure in R&D in the pharmaceutical industry and was structured in three stages: (I) 1986-1990; (II) 1991-1993; (III) 1994-

1996. The subsidiary was incorporated into the second stage of the plan (1991-1993), which meant the designation of resources from headquarters for the creation of its own R&D centre.

As the director of R&D explained, '*At first, the company joined this plan to lend its support to the subsidiary and to boost its growth in the Spanish market, but then, over time, the centre acquired a certain maturity and experience, accumulating knowledge that gradually led to the dominance of a particular technology and the subsidiary became a strategic centre for the MNC'*. In other words, the allocation of resources from headquarters to exploit the advantages offered by the FARMA plan gave the subsidiary the opportunity to develop new R&D capabilities. This course of events fits within the framework provided by the organizational learning paradigm (De Meyer, 1992; Zander, 1997).

For the French MNC, the country's access-related knowledge resources have had, from the outset, a major influence on the decision to locate and maintain an advanced R&D centre at its Spanish site. Because of the complexity of the technology used in the subsidiary's R&D activities, it focuses on applied research and resorts to external ties for the use of certain pieces of equipment and for conducting the final stages of clinical development. *'This requires a need for collaboration with local research institutions'*, pointed the lead investigator for medicines. Furthermore, the scientific dynamism of the local business environment, measured by the presence of large chemical and pharmaceutical corporations undertaking preclinical and clinical research with which the Spanish subsidiary cooperates to optimize its product research cycle, has been vital to the development of new R&D capabilities; *'keeping in touch with local cutting-edge scientific institutions have become the cornerstone of our development'*, emphasised the director of R&D. The subsidiary's ability to embed itself in the local technical milieu and to develop 'joint research' type linkages with external counterparts has become of paramount importance in fostering its further development. In such cases, the subsidiary's knowledge-sharing network is likely to have its geographical locus in the host country environment (Frost, 2001). This is in line with Andersson et al.'s (2007) 'paradoxical effect of external embeddedness': a high degree of external embeddedness denotes a subsidiary that is largely involved in long-term local linkages, with the possible result that issues external to the MNC are prioritised, rather than investing time and resources on maintaining relationships within the MNC.

The context specificity of the knowledge created at the subsidiary level raised a high barrier to knowledge transfer (Andersson et al., 2002), which led, as far as its research activities were concerned, to a reduction in the subsidiary's relationships with the rest of the corporate units, resulting in 'arm's length' type linkages. This downward trend in internal embeddedness was stimulated, according to the director of R&D, by the '*laissez faire*' attitude that the management at headquarters adopted regarding the subsidiary's R&D activities. This was an opportunity that the subsidiary took advantage of to accumulate experience, scientific knowledge and distinctive capabilities in the domain of a specific

technology outside the company's core business. Thus, the subsidiary became a specialist in the field of new drug delivery systems. '*As we were the only multinational unit that owned the know how about NDDS* [new drug delivery systems] *and this line of research was a hope of future for the parent company, we were free to make our own decisions'*, stated the lead investigator for medicines. However, this degree of specificity made this subsidiary a kind of outlier (Andersson et al., 2007), because it creates technologies that are difficult to apply in other corporate units (Asakawa, 2001). According to Frost (2001), in extreme cases such as this, where the subsidiary is the only competent centre for a particular technology, there may exist few ties with the corporate counterparts, thus triggering the subsidiary to evolve towards an isolated mandate.

Table 8. Evolution in the subsidiary's linkages in dual embeddedness

	Situation at outset Before 2000	Evolution 2000-2010	Current situation 2010
Internal type embeddedness	Learning for production	Decrease	Arm's length
External type embeddedness	Arm's length	Increase	Joint research

Current situation

In 2010 the Spanish subsidiary was the largest in the group and the only one with its own R&D centre outside the MNC's home country. '*The Spanish subsidiary is the only exception to the policy of concentration of R&D in the (French) hexagon*', noted the R&D director of the subsidiary. The continuous reinforcing of the external embeddedness by the subsidiary in order to create its own new competences at the expense of transferring them to other units, has turned it into the only competent centre within the firm for a particular technology, new drug delivery systems, even though, it has led to its isolation from the organization of which it is a part. This process corresponds to that of the so-called mandate isolation.

Hence:

Proposition 4: The more a subsidiary increases its external network embeddedness to the detriment of its internal network embeddedness, the greater is its likelihood of evolving towards a geographically isolated mandate.

5. DISCUSSION AND THEORETICAL DEVELOPMENT

Based on the preceding case analyses, it becomes clear that dual embedding allows subsidiaries to gain access to knowledge from different sources and then to reverse these knowledge flows with their internal and external counterparts (Tallman & Chacar, 2011). Therefore, changes in the quality of the linkages developed by a subsidiary can lead to differences in the level of absorption, creation and

sharing of knowledge and, thereby, to possible changes in their level of competences and their contributory R&D roles. As a result of changes in the degree of knowledge embeddedness (increasing or decreasing) within subsidiary networks (internal or external), four patterns of R&D role evolution can be identified: (1) Gaining an R&D competence-creating mandate, (2) Risk of R&D mandate depletion, (3) Gaining an R&D competence-exploiting mandate, and (4) Risk of geographical R&D mandate isolation. Figure 2 presents the general framework derived from these interactions between the different degrees of internal and external knowledge embeddedness.

Figure 2: Subsidiary R&D role development from a double-network perspective

		External network	
		Decreasing embeddedness	**Increasing embeddedness**
Internal network	**Increasing embeddedness**	Gaining an R&D competence-exploiting mandate	Gaining an R&D competence-creating mandate
	Decreasing embeddedness	Risk of R&D mandate depletion	Risk of geographical R&D mandate isolation

Specifically, we find that the evolution towards a competence-creating mandate is a response to the simultaneous growth in knowledge embeddedness in the local environment and within the corporate network; otherwise, when the rise in either internal embeddedness or external embeddedness prevails, a subsidiary may gravitate, respectively, towards a competence-exploiting mandate or a situation of geographical isolation in terms of mandate assignment. By contrast, when there is a fall in the degree of both internal and external embeddedness, the subsidiary faces the risk of depletion in its R&D mandate.

These results allow us to advance in the general theoretical development of the field and to complete previous explanations as to how external embeddedness might affect subsidiary R&D activities. It has been stressed that a subsidiary's external embeddedness is a good predictor of the role that subsidiary might play within the overall MNC network (Garcia-Pont et al., 2009), particularly with regard to the level of its contribution to the technological and strategic renewal of the MNC group (see, for example, Andersson & Forsgren, 1996; Andersson & Forsgren, 2000; Andersson et al., 2002; Andersson et al., 2005; Forsgren et al., 2005; Frost, 2001; Ghoshal & Bartlett, 1990; Nell et al., 2010;

Schmid & Schurig, 2003). However, these studies are at times incomplete, as they do not offer an integrated explanation of how a subsidiary's external relationships impact on the evolution of its R&D roles. While some authors report that externally embedded subsidiaries provide access to a variety of competencies and, thus, perform an advanced R&D role (Andersson & Forsgren, 2000; Andersson et al., 2001; Andersson et al., 2002; Frost et al., 2002), others suggest that external embeddedness might drive a wedge between the subsidiary and its MNC, and thereby disrupt its contribution to the MNC as a whole (Andersson et al., 2007; Mudambi & Navarra, 2004), resulting in what Jarillo & Martínez (1990) labelled as an autonomous strategic role for the subsidiary. Although, since Bartlett & Ghoshal's (1989) pioneering work, the existence of an internal MNC network of subsidiaries has implicitly been assumed, internal embeddedness has not been thoroughly examined in R&D subsidiary role research. Thus, it is our belief that the concept of internal embeddedness may represent the 'missing link' between studies of external embeddedness (Andersson & Forsgren, 1996; Andersson & Forsgren, 2000; Andersson et al., 2002; Andersson et al., 2005; Forsgren et al., 2005; Frost, 2001; Ghoshal & Bartlett, 1990; Nell et al., 2010; Schmid & Schurig, 2003) and knowledge-based notions of a subsidiary's contribution to the competitive advantage of the MNC (Frost, 2001; Ghoshal & Bartlett, 1990; Rugman & Verbeke, 2001). Thus, this article contributes to network theory by analysing dual embeddedness and its implications for the evolution of the R&D role of subsidiaries, concluding that internal embeddedness can explain the differences in the effects of external embeddedness on R&D roles.

6. CONCLUSIONS

The main contribution of this paper has been to develop a model that illustrates how internal and external network embeddedness interact to generate specific outcomes in the evolution of subsidiaries' R&D roles. The dynamic approach adopted is particularly appropriate given that internal and external embeddedness evolve in a path-dependent process (Gulati, Nohria, & Zaheer, 2000), thus resulting in an idiosyncratic pattern of development in the R&D roles that each subsidiary adopts. Indeed, most network studies conducted to date lack this dynamic perspective (Rugman & Verbeke, 2001). Furthermore, we have assessed the quality and types of linkages in terms of their knowledge intensity. This approach sheds fresh light on our understanding of network embeddedness, answering the call in the literature for more attention to be dedicated to examining the scope and quality of network relationships (Giroud & Scott-Kennel, 2009).

These findings are useful in furthering our understanding of how best to manage and frame the dynamics of the dual-embeddedness of subsidiaries' R&D roles, and their subsequent contribution to MNCs' competitive advantage. Hence, this study is of managerial relevance to both subsidiary managers and MNC headquarters. For subsidiary managers, the model highlights an important strategy

by which they can purposely set about upgrading their R&D role within the MNC. Although most of the network literature associates the development of external embeddedness with the genesis of the evolution in a subsidiary's R&D role, managers should also seek to develop internal embeddedness so as to exploit dependencies and influence the assignment of mandates. In short, a subsidiary can shape its own evolution by enhancing both its internal and external knowledge embeddedness. For MNC headquarters, if internal and external embeddedness are properly managed, these network linkages facilitate their task of seeking advantages originating in the global spread of the firm. Managing embeddedness allows headquarters to exploit its existing assets more effectively within the multinational (an asset-exploiting strategy), and to tap into new market opportunities and new technology (an asset-seeking strategy). If we shift the focus from the perspective of headquarters to that of the subsidiary, these strategies have obvious parallels with the subsidiary's competence-exploiting and competence-creating roles as depicted in our dynamic model. In short, MNC headquarters can promote different sources of knowledge by devising strategies aimed at embedding or disembedding their subsidiaries in the internal and external corporate networks.

Several limitations of this study should be noted. First, in this article, we have developed theoretically grounded predictions regarding the effects of changes in the interactions between internal and external network embeddedness on a subsidiary's R&D roles. However, we do not fully explore the optimal balance between the development of external and internal embeddedness, nor do we examine the consequences of over-embeddedness (Nell & Andersson, 2012) or of network redundancy (Nell, Ambos, & Schlegelmilch, 2011). Future research needs to analyse in greater depth the specific nuances of dual embeddedness.

Second, the present study has focused on four subsidiaries located in Spain with a carefully determined profile. As such, the context of this study is quite specific and the explanatory power of our findings may be limited to this particular country, industry, or type of company, and even more, to the fact that the research has been conducted in a 'backward-moving economy'. Since 2008 Spain has seen a sharp fall in its GDP growth rate. Furthermore, most of the research to date has been devoted to analysing either subsidiaries in developed economies or, more recently, those in developing countries. Hence, an analysis conducted in a situation of economic downturn may well be of relevance. Evidence from similar economies would enable us to devise new patterns for international involvement in the current complex economic situation. Future research needs to undertake quantitative studies with a broader sample and a more heterogeneous technological setting. This would allow us to strengthen the inductively obtained model described here.

Third, this study has paid only limited attention to the impact that senior executives and top management teams can have in shaping the relationships of the subsidiary inside and outside the

MNC. Yet, our findings in relation to the 'increasingly-embedded' subsidiary (case A) suggest that senior managers operate in a social context that spans organizational boundaries, and that the type of linkages developed by a subsidiary is dependent upon the background characteristics of these managers. Therefore, the upper-echelons perspective (Carpenter, Geletkanycz, & Sanders, 2004; Hambrick & Mason, 1984; Hambrick, 2007) can further our understanding of how subsidiary dual-embeddedness becomes a reflection of its top-management team, and as such our consideration of the evolution in the subsidiaries' R&D roles is incomplete and needs to be extended.

Finally, we have assumed that the subsidiary acts as a bridge in the knowledge transfer between the host country and the international corporate network. This implicitly means that all MNCs' ties to the foreign host country are articulated through their subsidiaries (Nell et al., 2010). However, the case studies reported here, in particular the 'prevailing-internally' embedded subsidiary (case C), show that headquarters can also maintain their own network linkages with the subsidiary's local environment. Indeed, a recent study claims that headquarters are also embedded in their subsidiaries' external networks (Nell et al., 2010). In the light of this claim, more attention needs to be paid to these linkages. However, despite the aforementioned limitations, this study, by focusing simultaneously on internal and external network embeddedness, provides some initial insights in helping us to see *the fuller picture.*

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