

Understanding R&D Subsidiary Isolation in Knowledge-Intensive Industries: A Contingency Approach

Christopher Williams
Strategy and Marketing Section
Amsterdam Business School
Universiteit van Amsterdam
Roetersstraat 11
1018 WB Amsterdam
The Netherlands
Tel: 31-20-525 7385
Fax: 31-20-525 4182

Email: c.williams@uva.nl

Brigitte Nones
Joanneum Research Forschungsgesellschaft mbH
Institute of Technology and Regional Policy - InTeReg
Sensengasse 1
A-1040 Vienna
Austria
Tel: 43-1-5817520-2833
Fax: 43-1-5817520-2820

Email: brigitte.nones@joanneum.at

Understanding R&D Subsidiary Isolation in Knowledge-Intensive Industries: A Contingency Approach

ABSTRACT

This paper explores the issue of R&D subsidiary isolation within MNCs competing in knowledge-intensive industries. For MNCs competing in such industries, accessing knowledge and nurturing the innovative potential of R&D subsidiaries is vital for on-going survival. This, according to conventional theory, requires integration of the subsidiary within the national innovation system as well as within the MNC. Empirical findings, however, have shown that subsidiaries established abroad can become isolated, even in high-technology sectors. It is a weakness that this issue has attracted little attention by researchers. We address this by using a contingency approach to argue that organizational factors at corporate and subsidiary levels influence the perception of a subsidiary that it is isolated within both its local environment and within its MNC network. Specifically, we examine a sample of forty-five Austrian subsidiaries undertaking R&D in knowledge-intensive industries. The results provide equivocal support for propositions that MNC international experience, subsidiary R&D performance, subsidiary age since acquisition and subsidiary role (focus on early-stage R&D) are associated with higher integration and less isolation. Hence, corporate level factors and subsidiary level factors matter to the issue of R&D subsidiary isolation in knowledge-intensive industries. The theoretical and managerial implications of these findings are discussed, along with suggestions for future work.

Key words: Internationalization of R&D, isolated subsidiaries, MNC innovation, knowledge-intensive industries

1. INTRODUCTION

Knowledge sourcing is a major motive for the internationalization of Multinational Corporations (MNCs) (Dunning and Narula, 1995; Kuemmerle, 1997). This is particularly true in knowledge-intensive industries where accessing and developing R&D skills and expertise, including maintaining links with prominent knowledge centres such as universities and research institutions, is an essential part of MNC success. The central role of MNCs in R&D internationalization is widely acknowledged. Indeed, internationalization of R&D does not just influence or even alter the innovation and technology strategies of companies, it also enforces and changes the network of science around the world (Archibugi et al., 1999).

To cope with these new techno-socio-economic conditions, heterarchical structures have emerged (Hedlund and Rolander, 1990) and MNCs have built up a network of subsidiaries which target complementary knowledge seeking (Santangelo, 2002). Since geographical dispersion of innovation has considerably increased, the roles of subsidiaries and their intercommunication within the corporate organization structure and within the local environment in the host country has become crucial for the corporate success. The challenge to adapt geographically dispersed competencies and to expand into new fields is influenced by the tacit nature of knowledge and problems in knowledge transfer (Kogut and Zander, 1992; Zander and Kogut, 1995).

In the context of this geographic dispersion of R&D activity through heterarchical organization, MNCs have also faced challenges in terms of how internal organizational structures, processes and control mechanisms can be adapted for transnational management of innovation (Bartlett and Ghoshal, 1989). For an MNC competing in a knowledge-intensive industry, where environmental uncertainty and turbulence are high, the ability to configure the internal network of operations and R&D capabilities such that firm knowledge can be harnessed and appropriated for economic gain is critical. However, recent research has shown

how some remote subsidiaries, including R&D subsidiaries, can become poorly integrated (or isolated) in both internal and external environments – a major issue for MNCs competing in knowledge-intensive industries.

The objective of the paper is to look into why R&D subsidiaries in knowledge-intensive industries may become isolated. In particular, we explore the determinants of R&D subsidiary isolation, asking the question: what makes R&D subsidiaries in knowledge-intensive industries feel isolated? We tackle this question by developing a contingency approach that highlights the importance of fit between organization and environment. We gain insight from a questionnaire survey and secondary data linked to R&D subsidiaries in Austria. The paper is structured in the following way: Section 2 provides a theoretical background on knowledge-intensive industries as well as a short overview of R&D internationalization and the issue of subsidiary isolation. A contingency framework is proposed for explaining R&D subsidiary isolation and propositions are drawn. Subsequently, the data collection, sample characteristics and findings are presented in Section 3. Section 4 presents a discussion on the theoretical and managerial implications, as well as limitations and suggestions for future work.

The main contribution of this paper is to shed light on the phenomenon of R&D subsidiary isolation within MNCs competing in knowledge-intensive industries by identifying the existence of such subsidiaries and linking their perceived lack of integration to organizational factors at corporate and subsidiary level. Our findings suggest that MNC international experience, subsidiary role, subsidiary age since acquisition, and subsidiary R&D performance, all have the power to predict R&D subsidiary isolation. This provides support to the contingency approach, as well as to the knowledge-based view of the firm. Future work will attempt to broaden the sample, and use different operationalizations of internal organizational variables for assessing the determinants of isolation.

2. THEORETICAL BACKGROUND AND RESEARCH PROPOSITIONS

2.1 Environmental Uncertainty and Knowledge-Intensive Industries

Firms competing in industries such as pharmaceuticals, high technology manufacturing and telecommunications must engage in continuous knowledge creation and innovation, or face being left behind (Brown and Eisenhardt, 1997; Fines, 1998; Zahra and Garvis, 2000). They use the creation and exploitation of knowledge as the basis of competition, and compete by protecting existing knowledge stocks from erosion and continually and dynamically developing new knowledge stocks for exploitation (Kogut, 2000). Knowledge-intensive industries also extend to business services, where human-capital and expertise is vital in responding to changing demand, and where knowledge becomes the most important factor of production (Strambach, 2001). Such industries have also been described as knowledge-intensive (Arthur, 1996), hypercompetitive (D'Aveni, 1994) and high-velocity (Eisenhardt, 1989).

Such industries are - by their very nature – highly competitive and fast-moving, demanding a continual quest for replenishing and appropriating knowledge stocks through innovation and new product introduction (Fines, 1998; Brown and Eisenhardt, 1997). However, in such industries, difficulties exist in forecasting and assessing industry evolution (Grant, 1995: 255-292). Continual creation and diffusion of knowledge prevails as the basis of competition (Kogut, 2000; Eisenhardt, 1989; D'Aveni, 1994) and this produces an inherently uncertain environment in which firms have to continually adapt in order to compete (Lawrence and Lorsch, 1967; Jelinek, 1977).

The rate of industry change (also termed 'product clock speed') refers to the rate of new product introduction and product obsolescence (Fines, 1998; Nadkarni and Narayanan, 2007). High technology industries such as semiconductors (product clock speed 1 – 2 years) and personal computer manufacturing (product clock speed < 6 months) are amongst the

highest velocity industries (Brown and Eisenhardt, 1997; Fines, 1998). Where technological change is relatively high, and where there is likely to be a greater intensity of competition and product obsolescence (Eisenhardt, 1989; Brown and Eisenhardt, 1997), a firm may potentially gain by investing in R&D units in countries where the talent exists to undertake basic research and developmental work necessary to bring incremental and radical innovations to the market. As the location of R&D activity is very much dependent on availability of human capital, expertise and skills, firms often establish R&D subsidiaries in overseas locations where knowledge clusters exist and where benefits may accrue to the MNC as a result of participation in knowledge clusters and networks (e.g., with suppliers, customers, universities, research institutes, etc.).

2.2 Internationalization of R&D

Increasing attention has thus been paid to the strategic role of foreign R&D units in global organizations (Bartlett and Ghoshal, 1989; Nobel and Birkinshaw, 1998; Archibugi et al., 1999; Veugelers et al., 2005). The nature of FDI has shifted away from integrating low-wage locations, just to exploit home-base knowledge, to gaining a strong position in strategic markets, including seeking new knowledge (Dunning and Narula, 1995; Kuemmerle, 1997). Usually, these units are critical centres of knowledge and they have a long-term impact on the development of activities conducted by other corporate units.

Accordingly, subsidiaries that have already developed such specialized competence are considered as strategic subsidiary-centres, and hence they are designated as Centres of Excellence (CoE) (Birkinshaw & Hood, 1998; Holm & Pedersen, 2000). CoEs are subsidiaries that help to maintain or even increase the competitive advantage of the MNC by having a global or regional mandate in a specialized capacity. In this line, several scholars (e.g., Andersson et al., 2001) have pointed out that the unit's performance is dependent on its ability to obtain valu-

able resources from its environment. Helble and Chong (2004) also note the importance of R&D subsidiaries in maintaining a strategic role within the MNC.

The participation of subsidiary employees in networks of innovation involves their participation in knowledge flows. Both tacit and explicit knowledge flows in networks enable actors to increase their resource base and identify opportunities in collaboration with different types of actors, such as universities and research institutes (Jacobsson, 2002). This implies that embeddedness in the environment is an indispensable condition in order to acquire and exploit critical knowledge developed by external players. Andersson et al. (2002) differentiate between technical embeddedness and business embeddedness, describing technical embeddedness between firms as an interdependency between those firms in terms of technological and developmental activities (Andersson et al., 2002: 982). In this view, embeddedness is assumed to be developed over time and is treated as a strategic resource¹.

On the other hand, innovative R&D activities can still remain concentrated in the home country of an MNC (e.g., Doremus et al., 1998). In this model, technology transfers remain strong from headquarters to the foreign units, and units abroad are concentrated on local product adaptations. In this view, units established abroad are used to conduct adaptive engineering. This includes reproducing or adapting existing technological specifications in order to match local demand or local production conditions in a more effective and efficient way (Böhe & Zawislak, 2004). However, most of these units are not embedded well in the external network; they just acquire, retain, transform and transmit knowledge distributed by headquarters or other corporate units.

¹ These authors also emphasize 'overembeddedness', where too much interdependency can have a counterproductive, negative impact on subsidiary performance.

2.3 Subsidiary Isolation

It is by no means a foregone conclusion, however, that an MNC will gain advantage simply by setting up an R&D unit in a country where talent for innovation or adaptation is available. Knowledge and technology transfer problems can occur in internal R&D projects that are spread over international borders (Kuemmerle, 1997; Kostova, 1999) and this may negatively impact the implementation and commercialization of an R&D strategy. Given that knowledge-intensive industries such as personal computers, semiconductors and pharmaceuticals are global, the speed of environmental change and the possible sources of competition in host markets make these concerns especially acute for an MNC.

The industry competition and R&D internationalization literature cited above suggests that MNCs competing in knowledge-intensive industries depend on R&D subsidiaries to generate new knowledge that can be used as a basis of innovation and global competition. Thus we would expect R&D subsidiaries of MNCs in knowledge-intensive industries to be well integrated in both external and internal networks. Such subsidiaries utilize these networks in order to operate in a strategic competence-creating role (Cantwell and Mudambi, 2005). However, the issue of subsidiary isolation persists (Birkinshaw et al., 2004; Goodall and Roberts, 2003), and has recently been found to exist in R&D subsidiaries in Austria (Nones, 2005, 2006). Håkanson and Nobel (1998) also argued that such units exist, even in the field of R&D, and, furthermore, loosely linked R&D subsidiaries have recently been identified in Singapore (Helble and Chong, 2004).

Whilst Birkinshaw et al. (2004) found that differences in learning capabilities and in-group-out-group dynamics resulted in subsidiary isolation, Goodall and Roberts (2003) point to corporate hierarchy and the withholding of strategic information by headquarters managers. The paradox arises in R&D subsidiaries because one would expect learning capabilities and involvement with strategic information flows to be important aspects of the internal organiza-

tional environment from which R&D capability can be appropriated. Subsidiary isolation is defined here as the perception by a subsidiary that it is neither strongly integrated within its local market institutional environment, nor within its parent MNC network. In this sense, such a subsidiary can be considered standalone.

2.4 Proposition Development: A Contingency Approach

The possibility that R&D subsidiaries within an MNC competing in a knowledge-intensive industry may become isolated presents a paradox. On the one hand, the uncertain nature of the industry means R&D should be important to the MNC for sustaining a competitive position. On the other hand, allowing an R&D subsidiary to become isolated will mean important knowledge may not be tapped into in order to bring new products into the commercial domain. The question posed above (i.e., what makes R&D subsidiaries in knowledge-intensive industries feel isolated?) is therefore an important one, and one we believe may be investigated using a contingency approach.

Contingency theory posits that the internal organization of the firm, including characteristics such as form, structure and control mechanisms, should fit with, or be contingent on, the external environment of the firm in order for above-normal performance to be achieved (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Shetty, 1972). Important to our research question is the notion that firms competing in environments that are constantly changing (as is the case in knowledge-intensive industries) should be flexible enough adapt to the environment with changes to internal organization, technology and management (Jelinek, 1977). Morgan (1986), in his metaphor of the organization as an organism, highlighted the importance of requisite variety in this respect. This refers to the principle that internal control within the firm should be as “diverse as the environment with which it is trying to deal” (Morgan, 1986). Thus a modern day MNC that has allowed its subsidiaries to become isolated

has not found an effective or adapting organization and this will be an indicator of what Shetty (1972) calls an “organizational problem of a higher order” (Shetty, 1972: 45).

Nohria and Ghoshal (1997) extended the contingency approach to the case of the MNC with their depiction of the MNC as a ‘differentiated network’. In this view, the MNC consists of multiple nodes in dispersed locations, each with its own resource and capability endowment, that add value to the overall mission of the MNC by facilitating innovation. These authors provided insight into how the structure of HQ-subsidary relations should match the context of the subsidiary – a concept called *differentiated fit* (Nohria and Ghoshal, 1994). Differentiated fit allows for variance between subsidiaries in levels of local resources and environment complexities. Local knowledge becomes more important with increased environment complexity. Here, enforcing high centralization is not productive. What is required is that “the subsidiary be granted greater autonomy and flexibility in making decisions” (Nohria and Ghoshal, 1994: 493). As the level of local resources increases, high centralization may lead to resentment and the subsidiary becoming less receptive. A more appropriate structure here is to have increased formalization by means of which the HQ can “keep in check potential agency problems” (Nohria and Ghoshal, 1994: 493).

In Subramaniam and Watson’s (2006) view “...subsidiaries clearly differ as to how they share and coordinate their tasks.....profiles represent a select range of approaches to share and coordinate activities that appear to be internally consistent with the subsidiaries' own environments and resources.” (Subramaniam and Watson, 2006: 922). There must be a ‘fit’ between the subsidiary's profile and its interaction with environment in order to enhance performance.

Fit has a strong theoretical connection to the issue of subsidiary isolation. A likely reason for the perception by a subsidiary that it lacks integration within its local environment or within its own MNC network rests on the principle of requisite variety. Contingency theory

states that where internal organization allows for an appropriate requisite variety, a suitable fit between environment and organization has been achieved. In the case of a knowledge-intensive industry where the rate of change is high and where new product introduction and product obsolescence occur in relatively short periods of time (Fines, 1998; Nadkarni and Narayanan, 2007), internal organization should allow for flexibility and responsiveness within the control mechanisms by which subsidiaries are managed. This is accutely so for R&D subsidiaries on whose knowledge-generating capability the performance of the wider MNC depends.

We suggest a multi-level approach to explaining R&D subsidiary isolation via this contingency view. Firstly, we suggest that factors at the corporate (firm-wide) level of the MNC impact R&D subsidiary manager perceptions of isolation. Secondly, we suggest factors at the level of the subsidiary (i.e., within the specific subsidiary) will impact perceptions of isolation. Cantwell and Mudambi (2005) highlight the importance of corporate level and subsidiary level factors on subsidiary R&D. At a corporate level, these authors point to the issue of whether the R&D subsidiary was acquired, and whether it operates within or outside the main line of business of the MNC. At a subsidiary level, R&D subsidiary autonomy is found to be important for competence creation by the subsidiary (Cantwell and Mudambi, 2005).

We extend this by positing that, at both corporate and subsidiary levels, the scope of business functions (i.e., what the organization does), organizational experience (i.e., how long has the organization been performing these functions) and performance (i.e., how well the organization has performed these functions), all have the potential to influence internal requisite variety and thus the extent to which a subsidiary perceives itself to be isolated from the rest of the MNC. The conceptual model is shown in Figure 1.

*** Figure 1 ***

Firstly, at the corporate level, *the range of sectors* within which the MNC operates may impact R&D subsidiary isolation. As an MNC diversifies into new industry segments, the requirement for new sources of innovation and know-how will increase. The MNC will search for these sources wherever it can find them, e.g., in new locations (e.g., new R&D subsidiaries) and in new ways (e.g., in joint ventures and partnerships). Despite the likelihood that there will be some overlap between knowledge stocks provided by a focal R&D subsidiary and innovation within new business sectors during related diversification, the traditional and specific capabilities developed overtime by the subsidiary will be less important to the MNC as it considers new areas for growth. This will be especially apparent in unrelated diversification. This line of reasoning is consistent with the argument that MNCs are able to leapfrog development costs and acquire production ready innovations or research in progress (Roberts and Berry, 1985) in order to enter new business segments quickly.

Furthermore, the sheer *size of an MNC* may impact its ability to implement appropriate requisite variety within a knowledge-intensive industry. Larger MNCs that are highly internationalized with a presence in many overseas locations will, according to the contingency view, not have reached this advanced scale by luck alone. Competitive pressures in the environment would have forced the MNC out of business or into alternative business strategies and sectors, unless the MNC had developed the requisite variety to control its internal network of operations in a way that matches the complexity and flux of the external environment (Morgan, 1986). Thus we propose that size and international presence will be associated with a level of organizational learning regarding how to apply requisite variety in a way most appropriate to specific nature of the knowledge-intensive industry in which the MNC competes. As a result of this organization-wide learning, important R&D subsidiaries will not feel isolated and they

will be encouraged to have frequent interactions with headquarters and other peer subsidiaries, as well as within their national innovation system.

The *operating efficiency* of the MNC, as a performance measure of its ability to commercialize innovations emanating from its R&D units, will impact the degree to which an R&D subsidiary will feel isolated. Operating efficiency is an indicator of how able the MNC is to turn its knowledge stocks into end products and services that consumers are willing to purchase. In other words, an MNC with a good operating efficiency is capable of turning R&D output into sales. For this to be the case in a knowledge-intensive industry, appropriate requisite variety must be present. Where internal control mechanisms and normative relations are poor, the organization will be less able to tap into the sources of knowledge present in R&D subsidiaries, and this will be problematic given the need for rapid response and ongoing commitment to new product development that is present in a knowledge-intensive industry. Thus where differentiated fit has not been applied (Nohria and Ghoshal, 1994, 1997), the MNC will be less efficient at commercialization of innovation stemming from R&D units. Consequently, inappropriate requisite variety will provide impetus into a feeling of isolation within R&D subsidiaries. These points lead us to the following propositions:

P1: For an MNC competing in a knowledge-intensive industry, corporate level factors will determine the extent to which an R&D subsidiary perceives itself to be isolated.

P1a: The more diversified the MNC, the more likely an R&D subsidiary will perceive itself to be isolated.

P1b: The greater the international experience of an MNC, the less likely an R&D subsidiary of the MNC will perceive itself to be isolated.

P1c: The greater the operating efficiency of the MNC, the less likely an R&D subsidiary of the MNC will perceive itself to be isolated.

Secondly, at the subsidiary level, we expect role to be important (Bartlett and Ghoshal, 1989). The *proportion of early-stage research and development* activities conducted by an R&D subsidiary (as a fraction of its overall activity set) will impact appropriateness of requisite variety in terms of its relationship within the MNC and therefore its perceptions of isolation. By early-stage research, we refer to basic research and product development, as opposed to process improvements (e.g., in manufacturing and production) or incremental innovation (e.g., smaller-scale product enhancements). Such early-stage research is aimed more at radical innovation. Scientists and engineers engaged in early-stage research will require access to universities and research institutes, as well as to suppliers of components and other technical and scientific equipment. They are more likely, therefore, to develop close ties and inter-linkages with these external actors.

Given that knowledge-intensive industries are fertile grounds for radical innovations (Dosi, 1982; Eisenhardt, 1989) and are populated with a myriad of small and medium-sized enterprises capable of challenging the dominant logic of the industry with new technology, a mandate given to a subsidiary to conduct early-stage R&D will be made under an assessment of the availability of tangible and intangible assets within the subsidiary (including human capital) likely to yield radical innovation. This charter and endowment will not be given to all subsidiaries within the MNC (including other R&D subsidiaries) and will be interpreted by the focal R&D subsidiary employees as an appropriate application of requisite variety.

Additionally, for acquired R&D subsidiaries, the *age since acquisition* will have a bearing on perceptions of isolation. As Roberts and Berry (1985: 5) highlighted: “In contrast to internal development, acquisition can take weeks rather than years to execute...[offering] a much lower initial cost of entry into a new business”. However, problems of higher learning distance, moral hazard and adverse selection problems may stifle progress towards appropria-

tion of rent during an acquisitive strategy (Hoskisson and Busenitz, 2002). Motivational issues stemming from suspicion and a lack of trust amongst employees on the side of the acquired R&D subsidiary may arise due to new ways of working, new branding, layoffs and other changes implemented by the new parent company. It may take many years to overcome these barriers and encourage acquired R&D subsidiaries to perceive that internal control mechanisms are appropriate and valuable to them. It may require a turnover of more established staff before new attitudes and mindsets start to prevail within the subsidiary. There may be resistance against new parent company managers because of entrenched mindsets and established opinions on the best way of working. Whilst expatriate managers have a role to play in overcoming these problems (Edström and Galbraith, 1977), it may take many years for the principle of requisite variety to be applied appropriately for a newly acquired subsidiary.

Finally, we expect the local *R&D performance* of the subsidiary to impact its perceptions of isolation within the MNC network. In the same way that corporate performance will be indicative of a fit between organization and environment (Nohria and Ghoshal, 1997: 187-191), subsidiary-level performance in terms of R&D output will be a result of appropriate internal control mechanisms. R&D subsidiaries with an acceptable or above-average performance in this respect, will be aware of what is required of them. Their output (e.g., in the form of patented technology) will be sufficient for the MNC to further grant them a mandate to continue and grow in terms of their charter (Birkinshaw, 2000), and, as this will be achieved at the expense of other subsidiaries (or investment options) available to corporate headquarters, this will show that the firm's technology is successful at buffering shocks and uncertainty in the environment (Jelinek, 1977). We can thus assume that R&D subsidiaries that have an acceptable or above-average performance are able to have a greater influence within the MNC network, are better connected to external sources of knowledge, and therefore do not feel isolated within either of these networks. These arguments lead to the following propositions:

P2: For an MNC competing in a knowledge-intensive industry, subsidiary level factors will determine the extent to which an R&D subsidiary perceives itself to be isolated.

P2a: The more early-stage research conducted by an R&D subsidiary, the less likely the R&D subsidiary will perceive itself to be isolated.

P2b: For acquired R&D subsidiaries, the higher the age since acquisition, the less likely the R&D subsidiary will perceive itself to be isolated.

P2c: The stronger the R&D performance of the subsidiary, the less likely it will perceive itself to be isolated.

The key contingencies underpinning these propositions are summarized in Table 1.

*** Table 1 ***

3. METHOD AND FINDINGS

3.1 Data Collection

The sample frame in this study consisted of subsidiaries of MNCs operating in the medium and high-technology industries. These industries, including chemicals, electronics, pharmaceuticals and telecommunications are generally characterized as knowledge-intensive and are also widely internationalized. They are the pillars in economic growth, especially in economies which are quite small. A structured questionnaire to R&D heads was used to study foreign subsidiaries engaged in R&D in Austria in 2002 (Nones, 2005). The wider objective of the survey was to investigate the roles foreign companies take up in a small open economy (Nones, 2005). Following several interviews with managers in R&D subsidiaries in Austria, a pilot questionnaire was developed and issued. Following feedback and minor modification to wording, a full survey was implemented by postal questionnaire. In order to assess subsidiary

isolation, the survey enabled the measurement of the level of subsidiary integration within the company group and within the external environment: items on the questionnaire were designed to assess links to both internal and external actors.

The two primary questions on internal integration and external embeddedness in the questionnaire were consistent with the view that communication and participation in internal and external networks are important for R&D subsidiaries (Helble and Chong, 2004; Blomqvist et al., 2004). This was also consistent with Andersson et al. (2007) who argue: “the higher the degree of relational embeddedness, the more extensive the interaction” (Andersson et al. (2007:38). Firstly, how often does the Austrian subsidiary's R&D unit have contact with other (corporate) units? The range of possible answers included: daily, weekly, monthly, more seldom, and not relevant. The following items were considered: the headquarters, other R&D units of the MNC in Austria, other R&D units of the MNC established abroad, marketing/ distribution units of the subsidiary in Austria, marketing/ distribution units of the MNC established abroad, production units of the subsidiary in Austria, and production units of the MNC established abroad. Secondly, how often does the Austrian subsidiary's R&D unit have contact with actors from its external environment? The items included here were: customers in Austria, customers abroad, suppliers in Austria, suppliers abroad, competitors in Austria, competitors abroad, public R&D institutions/ universities in Austria, and public R&D institutions/ universities abroad. The indicators on integration/ embeddedness were calculated as presented in Nones (2005). Isolated subsidiaries were defined as those whose value of integration and of embeddedness were below the mean average for the sample.

Forty-five cases captured by the survey are analysed here – representing all respondents whose parent MNC competes in a knowledge-intensive industry. Additional firm-level data on the parent MNCs were collected from annual reports. The key characteristics of the sample for the recent study are as follows: 42% of the subsidiaries operate in the chemical

industry, 40% in electronics, about 14% in the telecommunication/ IT, and 4% in the pharmaceuticals. Most of the cases belong to company groups which are owned by European shareholders. Nonetheless, nearly one third originates in the US. The share of parent MNCs located in German-speaking countries is 40%. There are no missing values in the sample for the integration and embeddedness measures. The sample characteristics are shown in Table 2.

*** Table 2 ***

With an average of 696 employees, the sampled subsidiaries in the study are quite large; SMEs seem to play a minor role. This does not reflect the real picture of Austria as it is determined by a wide-spread SME-structure. Nonetheless, the mix of high/ medium-tech industries analysed are representative. In total, the subsidiaries analysed employ 31,314 people including some of the largest companies operating in Austria.

The prominent role of MNCs as a driving motor of the internationalization of R&D is widely acknowledged. Looking at Austria, about 21.5 % of R&D expenditures are financed from abroad. In monetary terms, EUR 1.134 billions were spent on R&D by foreign companies and foreign institutions (e.g., the European Union) in 2004. Regarding total R&D expenditures of the private business sector, about one third is financed by foreign sources, mainly by foreign companies. In comparison to other OECD countries this percentage is rather high.

Indeed, Austria can boast of having attracted such a considerably high number of MNCs performing R&D; this might be seen as a success story of Austrian S&T policy. However, because of the accelerating pace of technological progress, global innovation strategies such as global knowledge sharing, sourcing and liaisons have become more important, and similarly, cost and management considerations have forced MNCs to re-centralize and concentrate their R&D activities. As a consequence, S&T policy is confronted with fears that

R&D leading companies may relocate their headquarters' competencies and R&D facilities one day.

3.2 Measures

The measures were taken either from the questionnaire survey or from the parent company reports, accessed and verified through LexisNexis™ company profiles, The Major Companies Database™, and Worldscope™.

Isolation indicator: each R&D subsidiary was flagged as being isolated if its score on both the internal integration scale and the external embeddedness scale were less than the mean for each of those scales (derived from questionnaire survey, 1=isolated, 0=integrated).

MNC diversification was measured by counting the range of sectors as indicated by the number of primary SIC codes of the parent MNC (company reports).

MNC international experience was constructed as a scale item from two variables, size (number of worldwide employees, standardized) and number of foreign subsidiaries (standardized) (Alpha = 0.77) (company reports). Larger MNCs that are more internationalized are more likely to have higher levels of experience of foreign markets than smaller, less internationalized MNCs (Johanson and Vahlne, 1977). Internationalization “is a matter of learning” (Eriksson *et al.*, 1997: 353) and MNCs' internationalization is thus an important mechanism for gaining knowledge about foreign business and institutions (Eriksson *et al.*, 1997).

MNC operating efficiency was calculated as the ratio of global turnover to worldwide number of employees (company reports).

Subsidiary role (early-stage R&D) was constructed as the combined percentage of total activity estimated by the respondent on the survey to be performed as basic research or product development (as opposed to process improvements or internal post-launch support services for the MNC). This was captured as a percentage.

Subsidiary age since acquisition was calculated only for subsidiaries that had been acquired (as opposed to greenfield sites) (survey). This was measured in absolute years.

Subsidiary R&D performance was constructed as a scale from two items, R&D output (number of patents produced by the subsidiary in the last five years, standardized) and R&D employees (absolute count of R&D employees, standardized) (survey, Alpha= 0.73). Whilst patents are well established as a measure of R&D performance (e.g., Almeida and Phene, 2004), subsidiary size can also indicate an ability to outperform rivals due to a broader base of tacit knowledge and a greater scope for embedment in host countries than smaller subsidiaries (e.g., Frost, 1998).

3.3 Analysis and Results

Due to the relatively small sample size it was not possible to run regression tests (e.g., a binary logistic regression) with the subsidiary isolation indicator as the main dependent variable. We used t-tests and Kruskal-Wallis χ^2 tests comparing the organizational variables across the two groups (isolated vs. integrated). The main findings are shown in Table 3. Two of the organizational variables are seen to be significantly different between the integrated and isolated subsidiary groups. These were MNC international experience ($t=2.08$, $p=0.05$) and subsidiary R&D performance ($t=1.96$, $p=0.06$). In both cases, the means were higher in the integrated subsidiary group, providing support to *P1b* and *P2c*. In addition, two of the organization variables are seen to vary in their means across the two groups, although the differences are not significant. These were subsidiary role (early-stage R&D) ($t=0.74$, $p=0.47$) and subsidiary age since acquisition ($t=1.10$, $p=0.28$). In both of these cases, the means were higher in the integrated subsidiary group, but due to the equivocal nature of the result, only partial support can be claimed for propositions *P2a* and *P2c*. The final two organizational variables, MNC diversification and MNC operating efficiency, were highly insignificant between the

two groups and therefore no support is found for *Pla* or *Plc*. For all of these variables, as expected, the non-parametric Kruskal-Wallis test also yielded a significant χ^2 for both MNC international experience and subsidiary R&D performance.

*** Table 3 ***

4. DISCUSSION AND CONCLUDING REMARKS

4.1 Implications for Theory

Our findings provide some support to the contingency approach for analyzing the relationship between environment and organizational structure and control within MNCs, whilst also providing support to the knowledge-based view of the firm. Firstly, in terms of contingency theory, the findings demonstrate how performance is achieved as a result of an appropriate fit between organization and environment within an MNC (Nohria and Ghoshal, 1997: 189) at the level of the subsidiary. Our data shows clearly that well-integrated subsidiaries have a higher R&D performance than isolated subsidiaries. Additionally, international experience at the level of the MNC (constructed as a composite of size and count of foreign subsidiaries) appears to matter to perceptions of isolation. The ability to apply requisite variety within the MNC is therefore likely to depend on the learning that the MNC has undertaken through many years of international expansion. The experience gained as a result of incremental expansion (Johanson and Vahlne, 1977) would have enabled the MNC to build a capability in assessing and implementing control mechanisms appropriate to the levels of market and asset commitment in a given country. In this way, the experiential approach to internationalization is important to contingency theory when applied to the MNC.

The finding that subsidiary R&D performance is higher within well-integrated subsidiaries also supports the notion that knowledge creation and transfer within the MNC network is

important as a source of competitive advantage (Gupta and Govindarajan, 2000; Kogut, 2000). It suggests that critical knowledge assets, unique bundles of knowledge and expertise that provide the basis of strategic renewal through new product development, are only useful in a competitive sense if they can be transferred to those locations within the MNC network that are able to commercialize and market the resulting product (Kostova, 1999). The managerial problem of allowing R&D subsidiaries to become isolated is thus an acute one. Both inputs into the subsidiary (e.g., in terms of market trends, consumer preferences and product composition) as well as outputs from the subsidiary (e.g., interim research results, prototypes, cost estimates etc.) are at best delayed and at worst, hindered, because of inappropriate control, lack of communication and inadequate communication channels.

4.2 Managerial Implications

These results have implications for managers of MNCs competing in knowledge-intensive industries, both at the headquarters and subsidiary level. At headquarters level, managers should be sensitive to our finding that larger, more internationalized MNCs are associated with well-integrated R&D subsidiaries. We argue that smaller and less internationalized MNCs have not developed the internal capability to apply requisite variety and do not control R&D subsidiaries in a way that makes them feel integrated. Headquarter managers in such MNCs should consider making attempts to communicate more frequently with R&D subsidiary managers, apply normative integration as well as formalization and centralization within the control mechanism, and assess how well the R&D subsidiary is integrating with actors in its external environment. It may be the case that smaller MNCs have less established R&D subsidiaries in general, and such subsidiaries may need assistance in building external linkages as well as focusing internally on core R&D activity and inter-unit communications.

At the subsidiary level, managers should be cognizant of our finding that subsidiary R&D performance and level of integration with internal and external actors are highly correlated. Not only does this suggest that performance and growth in charter and mandate for the subsidiary can be achieved through above-normal performance, it also suggests that managers have to work on an on-going basis on internal communication flows in both internal and external contexts in order to create new opportunities for knowledge sharing and appropriation. Subsidiary managers presiding over poor performance may need to reconsider the level of integration and utility of existing relationships with internal and external actors if they are to improve their performance. Examples of best practice may be found elsewhere within the MNC, or within the wider industry, either in the host country or in nearby countries.

4.3 Limitations and Suggestions for Further Research

This study has a number of limitations that must be pointed out, and these provide the basis on which we are planning further work to identify the causes of R&D subsidiary isolation within MNCs competing in knowledge-intensive industries. The first limitation relates to sampling. We have only taken data from one country and we have a relatively small sample that does not allow a full regression test to be conducted. Secondly, our choice of variables has been guided by the contingency approach and has concentrated at the organizational level. However, the contingency view also stresses the importance of adaptability in internal control mechanisms (e.g., centralization, formalization, normative integration) as well as differentiation in subsidiary role as a basis for implementing appropriate requisite variety (Nohria and Ghoshal, 1994, 1997; Bartlett and Ghoshal, 1989). These were not explicitly tapped into with our model and data. Thirdly, our operationalization of organizational variables utilized secondary data sources. There is a risk that these sources do not tap into the underlying organizational contingencies impacting requisite variety and perceptions of isolation. Finally, we do

not differentiate between technical embeddedness and business embeddedness as Andersson et al. (2002) do, and we focus on frequency of contact, as opposed to depth of contact.

As this is part of an on-going line of enquiry, we hope to address these issues in continuing work. In particular, increasing the sample size using additional cases captured during the 2002 survey in Austria (Nones, 2005) will facilitate a full regression model. We also suggest using qualitative techniques and additional survey instruments to examine perceptions of control mechanisms, knowledge flows, and relational aspects – such as trust and depth of contact - between subsidiary and headquarter managers. This may also extend to language as a potential barrier to communication and transfer of tacit knowledge out of foreign R&D subsidiaries (Welch et al., 2005).

REFERENCES

- Almeida, P. and Phene A. (2004) 'Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation', *Strategic management Journal*, 25(8-9): 847-864.
- Andersson, U., Forsgren, M., Holm, U. (2001) 'Subsidiary embeddedness and competence development in MNCs – a multi-level analysis', *Organization Studies*, 22(6): 1013-1034
- Andersson, U. and Forsgren, M. and Holm, U. (2002) 'The strategic impact of external networks: Subsidiary performance and competence development in the multinational corporation', *Strategic Management Journal*, 23(11): 979-996.
- Andersson U., Holm, D.B. and Joahnsen, M. (2007) 'Moving or doing? Knowledge flow, problem solving, and change in industrial networks', *Journal of Business Research*, 60: 32-40.
- Archibugi, D., Howells, J. and Michie, J. (1999) *Innovation Policy in a Global Economy*, Cambridge: Cambridge University Press
- Arthur, B. (1996) 'Increasing returns and the new world of business', *Harvard Business Review*, 74(3): 100-112

- Bartlett, C.A. and Ghoshal, S. (1989) *Managing Across Borders: The Transnational Solution*, Harvard Business School Press, Boston.
- Birkinshaw, J., *Entrepreneurship in the Global Firm*, London: Sage 2000
- Birkinshaw, J. and Hood, N. (eds) (1998) *Multinational Corporate Evolution and Subsidiary Development*, London: Macmillan
- Birkinshaw, J., Monteiro, F. and Arvidsson, N. (2004) 'Knowledge flows within multinational corporations: why are some subsidiaries isolated?', *AIM Research Working Paper*, 008-August-2004
- Böhe, D.M. and Zawislak, P.A. (2004) 'R&D roles in subsidiaries of multinational companies: when does the institutional environment matter?' *Paper for DRUID Summer Conference*, 2004, Denmark
- Brown, S.L. and Eisenhardt, K.M. (1997) 'The art of continuous change: linking complexity theory and time-paced evolution in relentlessly shifting organizations', *Administrative Science Quarterly*, 42: 1-34
- Burns, T. and Stalker, G.M. (1961) *The Management of Innovation*, London: Tavistock.
- Cantwell, J. and Mudambi, R. (2005) 'MNE competence-creating subsidiary mandates', *Strategic Management Journal*, 26: 1109-1128.
- D'Aveni, R.A. (1994) *Hypercompetition: Managing the Dynamics of Strategic Maneuvering*, New York: The Free Press
- Doremus, P.N., Keller, W.W., Pauly, L.W., Reich, S. (1998) *The Myth of the Global Corporation*, Princeton University Press
- Dosi, G. (1982) 'Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change', *Research Policy*, 11(3): 147-162
- Dunning, J.H. and Narula, R. (1995) 'The R&D activities of foreign firms in the US', *International Studies of Management and Organisation*, 25, 39-73
- Edström, A. and Galbraith, J. (1977) 'Transfer of Managers as a Coordination and Control Strategy in Multinational Organizations', *Administrative Science Journal*, 22: 248-263.
- Eisenhardt, K.M. (1989) 'Making fast strategic decisions in high velocity environments', *Academy of Management Journal*, 32(3): 543-577
- Eriksson, K., Johanson, J., Majkgard, A., and Sharma, D.D. (1997) 'Experiential knowledge and cost in the internationalization process', *Journal of International Business Studies*, 28(2): 337-360.

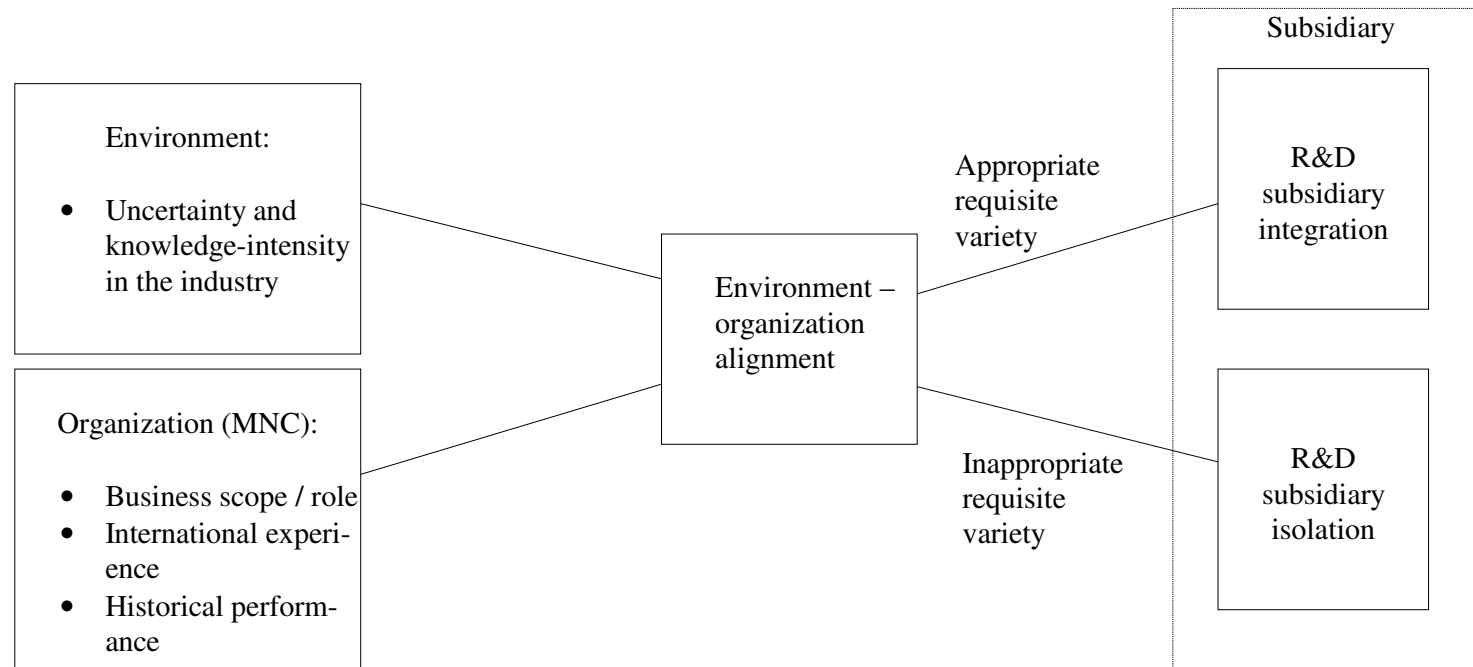
- Fines, C.H. (1998) *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*, Reading, MA: Perseus
- Frost, T.S. (1998) *The geographic sources of innovation in the multinational enterprise: U.S. subsidiaries and host country spillovers, 1980-1990*, unpublished Ph.D. thesis
Massachusetts Institute of Technology.
- Goodall, K. And Roberts, J. (2003) 'Only connect: teamwork in the multinational', *Journal of World Business*, 38(2): 150-164
- Grant, R.M. (1995) *Contemporary Strategy Analysis*, Blackwell Publishing: Cambridge, MA
- Håkanson, L. and Nobel, R. (1998). Organizational Characteristics and Reverse Technology Transfer. *Competitive Paper for the EIBA 24th Annual Conference*, Jerusalem
- Hedlund, G. and Rolander, D. (1990) 'Action in heterarchies – new approaches to managing the MNC' in Bartlett, C.A., Doz, Y.L. and Hedlund, G. (eds.) *Managing the Global Firm*, Routledge: London, pp. 15-46
- Helble, Y. and Chong, L.C. (2004) The importance of internal and external R&D network linkages for R&D organisations: evidence from Singapore. *R&D Management*, 34(5): 605-612.
- Holm, U. and Pedersen, T. (2000) 'The Centres of Excellence Project – Methods and some Empirical Findings' in Holm, U. and Pedersen, T. (eds.) *The Emergence and Impact of MNC Centres of Excellence*, London: Macmillan
- Hoskisson, R.E and Busenitz, L.W. (2002) 'Market uncertainty and learning distance in corporate entrepreneurship entry mode choice', in M.A. Hitt, R.D. Ireland, S.M. Camp and D.L. Sexton (eds.) *Strategic Entrepreneurship: Creating a New Mindset*, Blackwell Publishing: Oxford, pp. 151-172
- Jacobsson, S. (2002) 'University – industry relations', *Science and Public Policy*, 29: 345 - 365
- Jelinek, M. (1977) 'Technology, organizations, and contingency', *Academy of Management Review*, 2(1): 17-26
- Johanson, J. and Vahlne, J-E. (1977). 'The internationalization process of the firm – a model of knowledge development and increasing foreign market commitments', *Journal of International Business*, 8(1): 23-32
- Kogut, B. (2000) 'The network as knowledge: Generative rules and the emergence of structure', *Strategic Management Journal*, 21(3): 405-425

- Kogut, B. and Zander, U. (1992) 'Knowledge of the firm: combinative capabilities, and the replication of technology', *Organization Science*, 3(3): 383-397
- Kostova, T. (1999) 'Transnational transfer of strategic organizational practices: a contextual perspective', *Academy of Management Review*, 24: 308-324
- Kuemmerle, W. (1997) 'Building Effective R&D Capabilities Abroad', *Harvard Business Review*, 75 (March-April), 61-70.
- Lawrence, P.R. and Lorsch, J.W. (1967) *Organization and Environment: Managing Differentiation and Integration*, Boston: Graduate School of Business, Harvard University
- Morgan, G. (1986) *Images of Organizations*, Sage Publications: London
- Nadkarni, S. and Naraynan, V.K. (2007) 'Strategic schemas, strategic flexibility, and firm performance: the moderating role of industry clockspeed', *Strategic Management Journal*, 28: 243-270
- Nobel, R. and Birkinshaw, J. (1998) 'Innovation in multinational corporations: control and communication patterns in international R&D operations', *Strategic Management Journal*, 19(5): 479-496
- Nohria, N. and Ghoshal, S. (1994) 'Differentiated fit and shared values: alternatives for managing headquarters-subsidiary relations', *Strategic Management Journal*, 15(6): 491-502
- Nohria, N. and Ghoshal, S. (1997) *The Differentiated Network: Organizing Multinational Corporations for Value Creation*, Jossey-Bass: San Francisco, CA
- Nones, B. (2005) 'The characteristics of foreign R&D units of MNCs in Austria: Some empirical evidence on Gupta and Govindarajan's model', *Proceedings of the 31st European International Business Academy Annual Conference*, Oslo, Norway
- Nones, B. (2006) 'Standing alone – is it just bad luck or rather strategy? The perspective from foreign R&D units', *Proceedings of the 32nd European International Business Academy Annual Conference*, Fribourg, Switzerland
- Roberts, E.B. and Berry, C.A. (1985) 'Entering new businesses: Selecting strategies for success', *Sloan Management Review*, 26(3): 3-17
- Santangelo, G.D. (2002) *Innovation in Multinational Corporations in the Information Age: The Experience of the European ICT Industry*, Cheltenham, Northampton: Edward Elgar
- Shetty, Y.K. (1972) 'A contingency model of organizationan design', *California Management Review*, 15(1): 38-45

- Strambach, S. (2001) 'Innovation processes and the role of knowledge-intensive business services (KIBS)', in K. Koschatzy, M. Kulicke, A. Zenker (eds.) *Innovation Networks: Concepts and Challenges in the European Perspective*, Springer, pp. 53-68
- Subramaniam, M. and Watson, S. (2006) 'How interdependence affects subsidiary performance', *Journal of Business Research*, 59: 916-24.
- Veugelers, R., Dachs, B., Mahroum, S., Nones, B., Schibany, A. and Falk, R. (2005) 'Internationalisation of R&D: Trends, Issues and Implications for S&T policies', *Background Report for the Forum on the Internationalisation of R&D*, Brussels, March, 29-30, 2005
- Welch, D., Welch, L., and Piekkari, R. (2005) 'Speaking in tongues: the importance of language in international management processes', *International Studies of Management and Organization*, 35(1): 10-27.
- Zahra, S.A. and Garvis, D.M. (2000) 'International corporate entrepreneurship and firm performance: The moderating effect of international environmental hostility', *Journal of Business Venturing*, 15(5): 469-492
- Zander, U. and Kogut, B. (1995) 'Knowledge and the speed of the transfer and imitation of organizational capabilities: An Empirical Test', *Organization Science*, 6: 76-92

FIGURES

Figure 1 – Contingency model of R&D subsidiary isolation within a knowledge-intensive industry



TABLES

Table 1 –Multilevel contingencies in understanding R&D subsidiary isolation

Organization	Environment at Corporate Level (Knowledge-intensive industry)	Environment at Subsidiary Level (Expectation to generate new knowledge for commercialization)
Business Scope	Competing in a broad range of business sectors, particularly where R&D output is not transferable from one business unit to another, may result in a lack of strong focus in any one given segment	A subsidiary whose role is more early-stage R&D (basic research, basic product development) will have won resource commitment and investment from the parent company in order to conduct this research; this commitment will be indicative of a willingness to draw on the results of the subsidiary's R&D
Experience	A large international presence and many years of experience of operating abroad will have developed the internal processes and routines to be able to integrate remote R&D subsidiaries into the internal knowledge network	R&D subsidiaries that have a longer history of operating within the ownership structure of the MNC will have had more time to integrate outwards into the MNC and allow its employees to be linked into corporate networks and trustworthy relationships, compared to newer subsidiaries, particularly newly acquired subsidiaries
Performance	An MNC that is performing well will be able to appropriate knowledge produced in its R&D subsidiaries and its performance will be an indicator of its ability to commercialize its R&D output in response to the rapid changes in the industry	An R&D subsidiary that is performing well in an R&D capacity will not be isolated because the parent MNC would have utilized its output MNC to respond to demand and changes in the environment

Table 2 – Characteristics of the sample (number of cases in parenthesis)

Industry (N=45)	Home Country (N=45)	Host Country (N=45)
Chemicals (19)	Germany (14)	Austria (45)
Electronics (18)	USA (12)	
Telecommunications (6)	Netherlands (4)	
Pharmaceuticals (2)	Switzerland (4)	
	France (3)	
	Denmark (2)	
	United Kingdom (2)	
	Australia (1)	
	Belgium (1)	
	Finland (1)	
	Sweden (1)	

Table 3 – Organizational variable means and t-tests between integrated and isolated subsidiary groups

	Integrated Subsidiaries			Isolated Subsidiaries			t-test ^a	Sig.	Kruskal-Wallis χ^2	Sig.
	N	Mean	s.d.	N	Mean	s.d.				
MNC diversification	28	3.71	2.55	17	3.76	2.08	-0.07	0.94	0.08	0.76
MNC international experience (2 items, Alpha = 0.77)	23	0.22	1.10	13	-0.32	0.41	2.08	0.05	2.99	0.08
MNC operating efficiency	27	343	498	16	339	516	0.02	0.98	0.01	0.93
Subsidiary role (early stage R&D)	28	49%	25%	17	43%	30%	0.74	0.47	0.73	0.39
Subsidiary age since acquisition	17	13.88	19.34	9	7.89	8.32	1.10	0.28	0.32	0.57
Subsidiary R&D performance (2 items, Alpha = 0.73)	28	0.15	1.1	17	-0.25	0.07	1.96	0.06	5.60	0.02

a. t-test equal variances not assumed