European International Business Academy Conference 2008 - Paper #71
Track: Technology Development and Innovation

Management Control and R&D Decentralization in Multinational Corporations

Brigitte Nones
Institute of Technology and Regional Policy
Joannum Research
Haus der Forschung
Sensengasse 1, 1090 Wien, Austria
Tel: +43 1 581 75 20-2833
Fax: +43 1 581 7520-2820
Email: brigitte.nones@joanneum.at

Sander van Triest
Amsterdam Business School
Universiteit van Amsterdam
Roetersstraat 11, 1018 WB Amsterdam, The Netherlands
Tel: 31-20-525 4163
Fax: 31-20-525 5092
Email: s.p.vantriest@uva.nl

Christopher Williams*
Amsterdam Business School
University of Amsterdam
Plantage Muidergracht 12, 1018 TV Amsterdam, The Netherlands
Tel: 31-20-525 7385
Fax: 31-20-525 4182
Email: c.williams@uva.nl

*Author for correspondence

Management Control and R&D Decentralization in Multinational Corporations

ABSTRACT

We analyze R&D decentralization in multinational corporations from a management control theory perspective. For international R&D within MNCs, this theory predicts that decentralization will be associated with research intensity in the subsidiary, lower interdependencies with other units, information asymmetry, and personnel controls such as rotation and transfer. We test this using questionnaire survey data elicited from heads of 138 R&D subsidiaries of MNCs located in Austria. We find support for hypothesized effects of research intensity, interdependencies and information asymmetry. However, the result for personnel controls is negative and significant, contradicting management control logic and implying that R&D decentralization in MNCs can be achieved through results-based mechanisms.

Key Words: R&D subsidiaries, decentralization, control

1 INTRODUCTION

The central role of MNCs in R&D internationalization is widely acknowledged (e.g. Brockhoff 1998; Archibugi *et al.* 1999). MNCs develop R&D capabilities outside of their country of origin in order to seek new knowledge for product and technology development, enabling them to build and sustain competitive advantage on a global basis (Dunning & Narula 1995; Kuemmerle 1997; Santangelo 2002). The geographical dispersion of innovation has increased considerably in recent years and the roles of MNC subsidiaries, the internal organization of subsidiaries, and their interaction within the local environment in the host country have become focal points for both MNC managers and researchers. A key challenge identified relates to the influence of the tacit nature of knowledge and problems in knowledge and practice transfer when leveraging and exploiting dispersed competences (Kogut & Zander 1992; Zander & Kogut 1995; Kostova 1999).

This in turn presents an issue of internal management control for MNCs. In the context of this geographic dispersion of R&D activity, MNCs face challenges in terms of how to organize and control their network of operations such that knowledge is created and exploited appropriately. A stream of literature has emerged highlighting how internal organizational structures, processes and control mechanisms can be adapted within an internal network of innovation within the MNC (Nohria & Ghoshal 1994; Malnight 1996; Nohria & Ghoshal 1997; Bartlett & Ghoshal 1998; Forsgren 2004). This network view emphasizes the key roles of controlling through normative integration and socialization, and by decentralizing decision-making into subsidiaries (Hedlund & Rolander 1990). Despite advances in the network view, there remains a gap in our understanding of the antecedents of decentralization, a key characteristic of the networked conceptualization of MNCs. This is especially relevant for the R&D

function of the MNC (Nobel & Birkinshaw 1998). Furthermore, there is a gap within the IB field in terms of a theoretical platform for analyzing and understanding R&D decentralization in MNCs.

The objective of the paper is to examine R&D decentralization in MNCs using established management control theory (Eisenhardt 1985; Brickley *et al.* 2001; Merchant & Van der Stede 2003; Abernethy *et al.* 2004). This theory stresses the importance of various factors on the decision to decentralize to lower levels of an organization, including task programmability, information asymmetry, interdependencies, and shared values (or social controls). Understanding how these factors play out in the internal R&D networks of MNCs can help in understanding the decentralization decision. Using questionnaire survey data elicited from heads of 138 R&D subsidiaries of MNCs located in Austria, we find support for the hypothesized effects of research intensity (role programmability), interdependencies (production and R&D) and information asymmetry (local environment vs. corporate). However, the result for shared values is negative and significant, contradicting management control logic and implying that R&D decentralization in MNCs can be achieved through non-personal controls. The main contribution of this paper is to highlight the utility of management control theory in understanding how decentralization is constructed in MNCs.

The paper is structured in the following way: Section 2 provides a theoretical background on R&D internationalization and, using management control theory, develops a model containing four hypotheses. Section 3 presents the methodology used to empirically test the model within R&D subsidiaries of MNCs. Section 4 presents the results, and Section 5 our discussion, including limitations and suggestions for future work.

2 THEORY AND MODEL DEVELOPMENT

2.1 Decentralization in MNCs

Young and Tavares (2004) provide an extensive and in-depth review of the literature on decentralization and autonomy within international firms. They draw a distinction between decentralization (a headquarters delegating decision-rights to a subsidiary) and autonomy (the adopting of decision rights by a subsidiary through its own development) and cite Paterson and Brock's (2002) work in which autonomy within MNCs was found to be one of two most important contemporary issues within the MNC research (culture being the other). Paterson and Brock (2002) highlight an "increasing respect for autonomy" and link this to the growing realization that national and regional strategies, as opposed to global strategies can lead to higher economic rents for the MNC, and that entrepreneurship and initiative is increasingly encountered and analyzed at subsidiary level.

Autonomy has been seen as the result of an evolutionary process in which the subsidiary role develops over time, not just as a result of environmental influences and the resources and competences available to the subsidiary, but also an outcome of the headquarters' strategy, its willingness to distribute strategic responsibilities (Morrison & Roth 1993). Indeed, Egelhoff (1988) finds that headquarters' willingness to allocate strategic responsibility is central for the subsidiary's evolution. Moreover, strategic management research assumes that MNCs enjoy major advantages of accessing country- and firm-specific knowledge available in multiple, foreign locations (Kogut & Zander 1993). In this line scholars as for instance, Gupta and Govindarajan (1991) and Nohria and Ghoshal (1994) point out that autonomy is

positively related with the subsidiaries' knowledge creation and development. The idea behind this is that autonomy enhances the subsidiary's ability to learn from local knowledge and technology sources which are valuable not just for the subsidiary but for the MNC as a whole (Cantwell & Mudambi 2005). Accordingly, the degree of autonomy is decisive in the role the foreign R&D unit plays in the local innovation system, varying from "total dependent" to "total freedom" (von Boehmer 1995; Brockhoff 1998).

Autonomy allows subsidiaries to develop entrepreneurial cultures for themselves, and to be able to generate local initiatives (and knowledge) that ultimately become diffused into the wider MNC (Birkinshaw 2000; Boojihawon *et al.* 2007). This, in turn, may enhance local responsiveness and embedment of the subsidiary (Birkinshaw & Hood 1998). Where subsidiaries are allowed autonomy, they become more encouraged to create new competences for the MNC (Cantwell & Mudambi 2005). Ultimately, autonomy will lead to local knowledge creation, thus allowing the so-called 'reverse' transfer of knowledge to the MNC headquarters. Reverse knowledge transfer into headquarters is important because such knowledge may embody details of subsidiary initiative or organizational practices that may be re-used elsewhere within the MNC (Birkinshaw 1997; Jensen & Szulanski 2004). This stream of literature has highlighted how the headquarters is no longer seen as the main source of knowledge and competence to be transferred to overseas subsidiaries, but is instead a receiver of knowledge generated and coordinated throughout the subsidiary network (Gupta & Govindarajan 2000).

2.2 Management Control Theory and Decentralization of R&D

Decentralization, or the allocation of decision rights to lower-level managers, is a choice that a firm makes when designing its control system (Abernethy *et al.* 2004).

As benefits of decentralization, Brickley et al. (2001) see the effective use of local knowledge, conservation of management time and training and motivation for local managers. Costs of decentralization include incentive problems, coordination and failure costs, and less effective use of central information. The trade-off between costs and benefits means that choosing the appropriate level of decentralization is a major issue for management (Langfield-Smith *et al.* 2006). The optimal level of decentralization is highest in rapidly changing environments with respect to technology and markets, and there is considerable evidence that innovation and decentralization are positively related (Damanpour 1991; Nagar 2002).

Decentralization is often discussed in relation to diversification. Diversification refers to the grouping of activities in units based on business characteristics (products, geographic area), rather than functional characteristics such as sales, production, or support (Brickley *et al.* 2001; Grant 2005). Sometimes, decentralization is equated with diversification or internationalization (e.g., Blanc and Sierra, 1999). However, decentralization and diversification are not identical: decentralization refers to the extent to which responsibilities are assigned to lower levels in the organization, and the level of decentralization can differ relative to the level of diversification. For example, Christie et al. (2003) measure the level of decentralization as the 'relative use of profit and cost centers at the second level... profit centers are associated with more decentralization. The argument is simple. Cost center managers control either costs or revenues, but not both. Profit center managers make decisions about both revenues and costs.' Thus, rather than the number of different segments, either geographical or product-related, into which a firm has organized its activities, the question with respect to decentralization is the extent to which authority has been delegated to the segments (e.g., Gupta and Govindarajan, 1991, p 785).

Because of the nature of innovative activities such as R&D, we would expect innovation and decentralization to be positively related. First, innovation involves activities with much specific knowledge, which is difficult to transfer. Next to this, if the innovative activities are related to local information (e.g., regional customer preferences), it is more effective to react to this information at the local level without referring to the internal hierarchy (Brickley et al., 2001; Christie et al., 2003). From a management control perspective, the relationship between the nature of R&D and decentralization levels can be explained from the control issues that arise from them. Tight control, in the meaning of detailed prescriptions, frequent monitoring, and detailed performance measurement, requires that the task that is controlled has certain characteristics, specifically, the task being controlled has to be measurable and programmable (Ouchi 1979; Merchant 1982; Rockness & Shields 1984; Eisenhardt 1985, 1988; Abernethy & Brownell 1997). If the task is low on programmability and on measurability, the possible control mechanisms are limited: control on actions (or behavior) or results are not possible, leaving personnel (or social) control as the main option. Typically, this is associated with higher decentralization: decision rights on what actions to take have to be delegated, since prescription is not possible. In general, the R&D process is not very structured, involving experimentation and creativity from individuals with specialized expertise (e.g. Kim et al., 2003, 331; Nagar, 2002, 384). As with the arguments with respect to specific local knowledge, this leads to the expectation that R&D and decentralization are positively related. However, we can take the management control arguments of measurability and programmability a step further by looking at the exact nature of the R&D activities on the continuum of basic research (very uncertain) to customer service (reactive, much less uncertain): basic research will be much less programmable and measurable,

reducing any possibilities of applying tight controls and increasing the likelihood of higher decentralization. This leads to the following hypothesis:

H1: The more basic the research within the R&D subsidiary of the MNC, the more likely the R&D subsidiary will be decentralized.

Next to the nature of the R&D activities, management control theory points towards determinants of decentralization, specifically information asymmetry and interdependencies. Information asymmetry exists if local managers have specific knowledge that is not available to headquarters management (Jensen and Meckling, 1992; Christie et al., 2003; Abernethy *et al.*, 2004). Information asymmetry can be reduced by increasing information exchange and monitoring activities. However, this is costly. Furthermore, it may entail opportunity losses from the subsidiary not being able to react quickly enough to local information: '...where market conditions and production technologies frequently change, the timely use of local knowledge is likely to be particularly important.' (Brickley *et al.*, 2001). Thus, in case of higher information asymmetry, allocating decision rights to the subsidiary will enable better performance. As such, we expect decentralization to increase when information asymmetry is larger. Thus,

H2: The higher the information asymmetry between an R&D subsidiary of the MNC and headquarters, the more likely the subsidiary will be decentralized.

Interdependencies refer to the extent that business units are dependent upon each other, for example because one is a supplier to the other, or because they both

work on the same development project (Thompson 1967; Fisher 1994). If units are more dependent upon each other, coordination becomes more important, and thus decision rights should be handed down limitedly (Milgrom & Roberts 1992; Fisher 1994; Abernethy *et al.* 2004). This mitigates the risks of sub-optimization, where individual units make decisions that benefit their own performance at the cost of the organization's overall result. Following this,

H3: The greater the interdependencies are between an R&D subsidiary of the MNC and other units of the MNC, the less likely the subsidiary will be decentralized.

Hedlund and Rolander (1990) proposed the MNC structure as a heterarchy that supports decentralized experimentation, providing a basis of effective knowledge management through combination rather than hierarchical division (Hedlund 1994). Central to this logic is the control of decentralized units through normative integration and the sharing of values. The shared values approach involves instilling a common set of norms and values as a basis for control. It draws from literatures such as internalization of values in a social system (Parsons 1956), the normative organization (Etzioni 1965), strong cultures (Deal & Kennedy 1982), reducing opportunistic behaviour (Ouchi 1980), and understanding and internalizing organizational goals (Eisenhardt 1985). A common set of values with respect to goals enables subsidiaries to use their knowledge "to pursue the interests of the MNC as a whole and not just their partisan interests" (Nohria & Ghoshal 1994). Shared values legitimize local decision making without dispensing with any form of centralization or formalization. Ways of actually implementing shared values include rotation and transfer of managers (Edstrom & Galbraith 1977), extensive and open communication among the

dispersed units of the MNC (Martinez & Jarillo 1989), and extensive socialization and communication aimed at building trust. Consequently,

H4: The greater the shared values between the R&D subsidiary of the MNC and other units of the MNC, the more likely the R&D subsidiary will be decentralized.

3 METHODOLOGY

3.1 Sample

The analysis is based on a survey undertaken in Austria in 2002. Initially, several interviews with CEOs, R&D and IT managers of foreign-owned MNCs located in Austria were conducted. The purpose of these initial interviews was to explore R&D subsidiary roles and integration within networks of R&D in both host country and outside the host country. The target frame of all foreign-owned MNCs with R&D activities in Austria was then constructed using data assembled via the Hoppenstedt® database and the Austrian register of companies. The Hoppenstedt® database includes data on the ownership, as well as the activities of the MNC in Austria. Two criteria were used: (1) that the units were foreign-owned subsidiaries with at least 50% share and (2) that the subsidiary contained a dedicated R&D function.

In total, 272 questionnaires were sent to heads of the R&D units of which 138 usefully completed. All respondents were executive-level decision makers. A significant part of the sample was subsidiaries operating in medium - high tech (i.e., knowledge-intensive) sectors: the chemical / pharmaceutical industries (17%), electronics (15%), mechanical and engineering sectors (14%), and automotive

industry (12%). In total, 64% of the subsidiaries in the sample were obtained through acquisition.

3.2 Operationalization of variables

Table 1 shows the constructs and questionnaire items used in the analysis.

Decentralization. The questionnaire items used here aim at establishing the influence of headquarter management on the subsidiary's decisions with respect to its R&D activities. The level of decentralization is captured by asking the respondents about who makes key decisions with respect to the subsidiary's R&D activities. This is done on a scale of 1 to 5 from headquarters alone (1) to subsidiary alone (5), with combined decision making in between (cf. Gordon and Narayanan 1984, Gates and Egelhoff 1986, Moers 2006).

Nature of Subsidiary R&D. We asked respondents to indicate which category their activities could be classified (Rockness & Shields 1984). Respondents could allocate a total of 100% to each of four categories: basic research, development of new products and services, development of existing products and services, and customer service. Research intensity was measured as a weighted sum of these categories, with basic research receiving a weight of 4, down to customer service with a weight of 1. So if a respondent had indicated 20% basic research, 40% new product development, 10% existing product development and 30% customer service, it received a research intensity score of 250.

Information Asymmetry. We model information asymmetry in two ways: (1) by measuring local knowledge and (2) by the information flow between subunit and headquarters. Local knowledge, i.e., the extent to which the subsidiary gathers information itself, is a form of specific knowledge (Jensen & Meckling 1992; Brickley *et al.* 2001; Nagar 2002). This specific knowledge contributes to information

asymmetry, and this will lead to higher decentralization, since it is difficult to control activities when there is high specific knowledge and information asymmetry. On the other hand, the intensity of intra-firm communication is a reverse measure of information asymmetry. If the subsidiary communicates more with other units in the organization, information asymmetry will be reduced. Thus, we have a positive and a negative measure of information asymmetry. Note that information asymmetry is often measured using questions about who is more knowledgeable about aspects of the subsidiary's performance, and technical capabilities (Dunk 1993; Abernethy *et al.* 2004). Communication intensity was measured by asking how often the R&D unit has contact with organizational units (headquarters, production facilities), and with outside parties such as customers, competitors, and universities.

Interdependencies. We measure interdependencies at two levels: the subsidiary as a whole, and interdependencies with respect to R&D activities. Since some R&D units in the sample are part of a subsidiary (and not stand-alone research centers), there can be intra-organizational flows of products and services. We call this product interdependency. It is measured by asking about the share of purchases from other MNC units, and the share of sales to other units. For the R&D interdependency, we used three items to measure the joint cooperation in R&D units within the MNC.

Personnel Controls. Personnel controls are created by interaction and training programmes. We asked for the importance of personnel rotation programmes and job training to R&D employees, as well as for travel by the R&D unit's employees and visits from other R&D units. Personnel controls can be used to establish shared values within the MNC and are typically a means of countering the divergent preferences of the subsidiary employees and headquarters. By installing shared values through

mutual contact with other R&D units, the dangers of subsidiary R&D units improving their own performance at the expense of the wider organization can be decreased.

Construct name, description and reliability	Items
Decentr: decentralization, alpha = .844	On a scale of 1 (Decided at HQ) to 5 (decided independently by sub): (1) Appointment of R&D unit's manager in Austria (2) Formulation of standards for technical documentation at the R&D unit (3) Development of new products and/or processes at the R&D unit (4) Participation in transnational projects (5) Investments in the R&D unit (6) Approval of the R&D unit's budget
ResNat: nature of research activities, formative	Respondents were asked to allocate 100% to four R&D activities, nature was measured as the weighted sum: (1) Basic research * 4 (2) Research into new products / processes * 3 (3) Development of existing products / processes * 2 (4) Service activities * 1
ProdInterdep: production interdependency, formative	Sum of the percentage of products transferred internally from other units, and to other units of the corporation, both on the following scale: 1 = 0%, 2 = 1 – 5%, 3 = 6 – 10%, 4 = 11 – 20 %, 5 = 21 – 40%, 6 = 41 – 70%, 7 = 71 – 100%
ResInterdep: R&D interdepedency, formative	On a scale of 0 (Does not happen) to 5 (Very important) (1) 24 hr R&D between units (2) Simultaneous R&D, engineering, and production (3) Parallel R&D activities between units
LocalInfo: local information, alpha = .768	On a scale of 0 (Does not happen), 1 (Rarely), 2 (Monthly), 3 (Weekly), 4 (Daily), frequency of contact between the R&D unit and: (1) Austrian customers (2) Foreign customers (3) Austrian suppliers (4) Foreign suppliers (5) Austrian competitors (6) Foreign competitors (7) Austrian research institutes and universities (8) Foreign research institutes and universities
OrgInfo: information flow within organization, alpha = .717	On a scale of 0 (Does not happen), 1 (Rarely), 2 (Monthly), 3 (Weekly), 4 (Daily), frequency of contact between the R&D unit and: (1) Headquarters (2) Other R&D units in Austria (3) R&D units abroad (4) Marketing / distribution in Austria (5) Marketing / distribution abroad (6) Production units in Austria (7) Production units abroad
PersContr: personnel control, alpha = .806	On a scale of 0 (Does not happen) to 5 (Very important / frequently) (1) Personnel rotation programme (2) Job training programme

Construct name, description and reliability	Items
	(3) Travel of R&D employees to other R&D units (4) Visits from employees of other R&D units
LnEmpl: log of employees	Log of total number of employees at the subsidiary

Table 1 Variable description

There is a risk of common method bias from using the single-respondent self-reported questionnaire (Podsakoff et al., 2003). We checked for common method bias using Harman's single factor test (Podsakoff and Organ, 1986). With the scale items represented in Table 1 entered into an un-rotated factor analysis, the variance for the first factor was 21% (out of 70% variance for all emerging factors having an eigenvalue >1). Although this does not completely eliminate the problem, we expect common method bias will not affect the interpretation of the results.

3.3 Descriptive and Inter-correlation Information

Table 2 summarizes the descriptive information for the variables of interest. This shows good variation in the variables.

	N	Theoretical range	Mean	Stand dev	Minimum	Maximum
Decentr	129	1 – 5	3.49	.96	1.00	5.00
ResNat	137	100 – 400	241.23	42.82	110.00	400.00
ProdInterdep	135	1 – 14	7.20	2.84	2.00	13.00
ResInterdep	137	0 – 5	1.78	1.23	.00	5.00
LocalInfo	136	0 – 4	2.02	.86	.00	3.86
OrgInfo	137	0 – 4	1.74	.65	.50	3.38
PersContr	137	0 – 5	2.58	1.25	.00	5.00
LnEmpl	137		5.59	1.31	2.08	9.21

Table 2 Descriptive statistics of variables.

Table 3 shows the inter-correlations between the variables. The bivariate correlations are partly in line with expectations. Research intensity, interdependencies and

organizational information have the expected sign and are significant. Research interdependency has strong correlations with the information variables, as may be expected. However, personnel control does not appear to be a determinant of decentralization, but rather the opposite.

	Decentr	Res Nat	Prod Interdep	Res Interdep	Local Info	OrgInfo	PersContr
ResNat	0.182*						
ProdInterdep	-0.209*	-0.029					
ResInterdep	-0.180*	0.226**	-0.039				
LocalInfo	-0.010	0.139	0.079	0.382**			
OrgInfo	-0.244**	0.092	0.162^{+}	0.385**	0.549**		
PersContr	-0.311**	0.126	0.195*	0.431**	0.406**	0.515**	
LnEmpl	-0.029	0.254**	0.091	0.285**	0.101	0.227**	0.332**

Table 3 Bivariate correlation; ** $p < .01$, * $p < .05$, $^{+}$ $p < .1$.

4 RESULTS

To analyze our hypotheses, we regress the dependent variable Decentr on all explanatory variables, including a control variable LnEmpl which controls for subsidiary size.

	Expected sign	Coefficient	*t*-value
Constant		3.088**	5.587
ResIntens	+	.004*	2.237
ProdInterdep	–	–.053^{+}	–1.822
ResInterdep	–	–.151^{+}	–1.971
LocalInfo	+	.356*	2.393
OrgInfo	–	–.200^{+}	–1.672
PersContr	+	–.202*	–2.510
LnEmpl	?	.059	.912
n		126	
Adjusted R^2		.176	
F		4.813**	

Table 4 Regression Results; ** $p < .01$, * $p < .05$, $^{+}$ $p < .1$.

The regression has an adjusted R^2 of .176, and is significant at $p < .01$. We see that all coefficients are significant at $p < .10$ or less except for the control variable LnEmpl, which controls for size. Also, all coefficients are in the expected direction with the exception of PersContr.

5 DISCUSSION

5.1 Implications of these Findings

The results suggest that decentralization of R&D activities can be explained using management control logic, despite the idiosyncratic nature of R&D activities. If activities are more easily programmable (in the case of late-stage, lower research intensive activity), fewer decision rights are allocated. Similarly, interdependencies lead to lower decentralization, and information asymmetry is managed by placing decision rights with the R&D subsidiary: more local information requires a decentralized approach, whereas more intra-firm communication reduces the asymmetry, leading to lower decentralization. However, we find that personnel controls that encourage shared values are not associated with higher decentralization. Whereas management control logic suggests that less programmable activities can be controlled by having appropriately qualified employees (training) who frequently interact (visits) and are versatile (rotation), this is not a mechanism that is reflected in our findings. Our findings suggest that giving subsidiaries more decision rights is associated with lower personnel controls.

By applying management control theory to the international R&D function of MNCs, we assume the R&D subsidiary to exist as an organizational unit that headquarter managers have to exercise control over. The management control literature has some well-established results on decentralization. At the organizational

level, this literature identifies two main drivers of decentralization: information asymmetry and interdependencies (Bushman *et al.* 1995) (Baiman *et al.* 1995; Brickley *et al.* 2001). Furthermore, with respect to the focal unit's activities, the type of control mechanism that can be used in managing these activities suggests that the highly uncertain nature of R&D tasks influences the level of decentralization (Rockness & Shields 1984, 1988; Abernethy & Brownell 1997; Nagar 2002). Our findings support this theory and demonstrate the utility of management control logic in analyzing control problems within large international firms.

Despite this, we also find a very interesting result with respect to the role of personnel controls and the sharing of values implied through personnel controls. This variable appears to have a negative and significant impact on decentralizing to R&D subsidiaries. One possible explanation for this could be the limitations of management control theory within an international R&D context. Personnel controls are much harder, more costly to implement in international organizations in general than domestic ones. For example, cultural and institutional differences may prevent the efficient transfer of tacit knowledge that informal communications should allow. Transferring and rotating staff across countries and continents has a financial cost that will encourage MNCs to look for alternative ways of communicating and sharing knowledge with a remote R&D subsidiary.

In addition, MNCs that internationalize R&D might actually prefer to use results based controls (e.g., patent and innovation performance) rather than personnel controls. In this sense, the emphasis made by management control theory on personnel and social controls is de-emphasized. In practice, MNC headquarters are interested in performance and will proceed with measuring the performance of

subsidiaries to which they have delegated decision rights on the basis of quantifiable and measurable indicators.

Another implication of this finding is that personnel rotations, visits and job transfers have a rather different function with the R&D network of the MNC. Rather than being used as a basis of control and as a way of enabling decentralization without incurring the costs of delegating decision rights, they may be seen more as a mechanisms to develop the individual careers of those involved. Career development and promotion opportunities will be more conspicuous as a result of transfer; the social network of the individual within the MNC is broadened. In this view, what we have operationalized here as personnel controls, might actually be mechanisms to develop key R&D individuals in terms of their careers within the MNC.

5.2 Limitations and Avenues for Future Research

There are a number of limitations in the current research. Firstly, the data collection was only carried out in one, relatively small developed country. Secondly, MNCs were only chosen from technology-intensive manufacturing sectors; the service sector was not included. This sampling strategy will limit the generalizability of the findings. Thirdly, our data collection instrument utilized self-reported measures, and only from R&D heads, rather than various levels of subsidiary and HQ managers. Future research could address these issues by including more sectors and countries within the sample and by collecting data from multiple respondents with the MNC and the subsidiary. Indeed, a productive avenue for future research would be to access key individuals within R&D subsidiaries of MNCs in order to explore in more detail the relationship between different forms of management control for information asymmetric and decentralized R&D units. In particular, such work should also take into account the personal goals and specific functions of staff within R&D units. To

this end, interviews or detailed case studies would be beneficial. Such an approach could also establish relationships between management control and international R&D and performance, both at the R&D unit level, as well as the MNC level.

6 References

Abernethy, M.A., Bouwens, J., van Lent, L., 2004. Determinants of control system design in divisionalized firms. The Accounting Review 79, 545-570

Abernethy, M.A., Brownell, P., 1997. Management control systems in research and development organizations: the role of accounting, behavior and personnel controls. Accounting, Organizations and Society 22, 233-248

Archibugi, D., Michie, J., Howells, J., 1999. Innovation Policy in a Global Economy. Cambridge University Press, Cambridge.

Baiman, S., Larcker, D.F., Rajan, M.V., 1995. Organizational design for business units. Journal of Accounting Research 33, 205-229

Bartlett, C.A., Ghoshal, S., 1998. Managing Across Borders: The Transnational Solution. Harvard Business School Press, Boston.

Birkinshaw, J., 1997. Entrepreneurship in multinational corporations: the characteristics of subsidiary initiatives. Strategic Management Journal 18, 207-229

Birkinshaw, J., 2000. Entrepreneurship in the Global Firm. Sage Publications, London.

Birkinshaw, J., Hood, N., 1998. Multinational Subsidiary Evolution: Capability and Charter Change in Foreign-Owned Subsidiary Companies. The Academy of Management Review 23, 773-795

Boojihawon, D.K., Dimitratos, P., Young, S., 2007. Characteristics and influences of multinational subsidiary entrepreneurial culture: The case of the advertising sector. International Business Review 16, 549-572

Brickley, J.A., Smith Jr., C.W., Zimmerman, J.L., 2001. Managerial economics and organizational architecture. McGraw-Hill, Boston.

Brockhoff, K., 1998. Internationalization of research and development. Springer, Berlin.

Bushman, R.M., Indjejikian, R.J., Smith, A., 1995. Aggregate performance measures in business unit manager compensation: the role of intrafirm interdependencies. Journal of Accounting Research 33 Supplement, 101-128

Cantwell, J., Mudambi, R., 2005. MNE competence-creating subsidiary mandates. Strategic Management Journal 26, 1109-1128

Christie, A.A., Joye, M.P., Watts, R.L., 2003. Decentralization of the firm: theory and evidence. Journal of Corporate Finance 9, 3-36

Damanpour, F., 1991. Organizational innovation: a meta-analysis of effects of determinants and moderators. Academy of Management Journal 34, 555-590

Deal, T.E., Kennedy, A.A., 1982. Corporate Culture. Addison-Wesley, Reading, MA.

Dunk, A.S., 1993. The effect of budget emphasis and information asymmetry on the relation between budgetary participation and slack. The Accounting Review 68, 400-410

Dunning, J.H., Narula, R., 1995. The R&D Activities of Foreign Firms in the United States. International Studies of Management & Organization 25, 39-73

Edstrom, A., Galbraith, J.R., 1977. Transfer of Managers as a Coordination and Control Strategy in Multinational Organizations. Administrative Science Quarterly 22, 248-263

Egelhoff, W.G., 1988. Organizing the multinational enterprise: an information-processing perspective. Ballinger, Cambridge, MA.

Eisenhardt, K.M., 1985. Control: organizational and economic approaches. Management Science 31, 134-149

Eisenhardt, K.M., 1988. Agency- and instutional-theory explanations: the case of retail sales compensation. The Academy of Management Journal 31, 488-511

Etzioni, A., 1965. Organizational control structure. In: March JG (ed.) Handbook of Organizations. Rand McNally, Chicago, pp. 650-677.

Fisher, J., 1994. Technological interdependence, labor production functions, and control systems. Accounting, Organizations and Society 19, 493-505

Forsgren, M., 2004. The use of network theory in MNC research. In: Mahnke V & Pedersen T (eds.) Knowledge flows, governance and the multinational enterprise: frontiers in international management research. Palgrave MacMillan, Basingstoke.

Gordon, L.A., Narayanan, V.K., 1984. Management accounting systems, perceived environmental uncertainty and organization structure: an empirical investigation. Accounting, Organizations and Society 9, 33-47

Grant, R.M., 2005. Contemporary strategic analysis. Blackwell, Malden, MA.

Gupta, A.K., Govindarajan, V., 1991. Knowledge Flows and the Structure of Control within Multinational Corporations. The Academy of Management Review 16, 768-792

Gupta, A.K., Govindarajan, V., 2000. Knowledge flows within multinational corporations. Strategic Management Journal 21, 473-496

Hedlund, G., 1994. A Model of Knowledge Management and the N-Form Corporation. Strategic Management Journal 15, 73-90

Hedlund, G., Rolander, D., 1990. Action in heterarchies—new approaches to managing the MNC. In: Bartlett CA, Doz YL & Hedlund G (eds.) Managing the Global Firm. Routledge, London, pp. 15-46.

Jensen, M.C., Meckling, W.H., 1992. Specific and general knowledge, and organizational structure. In: Werin L & Wijkander H (eds.) Main currents in contract economics. Blackwell, Oxford, UK.

Jensen, R., Szulanski, G., 2004. Stickiness and the adaptation of organizational practices in cross-border knowledge transfers. Journal of International Business Studies 35, 508-523

Kogut, B., Zander, U., 1992. Knowledge of the firm: combinative capabilities and the replication of technology. Organization Science 3, 383-397

Kogut, B., Zander, U., 1993. Knowledge of the firm and the evolutionary theory of the multinational corporation. Journal of International Business Studies 24, 625-645

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, 61-70

Laffont, J.-J., Martimort, D., 1998. Collusion and delegation. RAND Journal of Economics 29, 280-305

Langfield-Smith, K., Thorne, H., Hilton, R.W., 2006. Management accounting: information for managing and creating value. McGraw-Hill Australia, North Ride.

Malnight, T.W., 1996. The transition from decentralized to network-based MNC structures: an evolutionary perspective. Journal of International Business Studies 27, 43-65

Martinez, J.I., Jarillo, J.C., 1989. The evolution of research on coordination mechanisms in multinational corporations. Journal of International Business Studies 20, 489-514

Melumad, N., Mookherjee, D., Reichelstein, S., 1992. A theory of responsibility centers. Journal of Accounting and Economics 15, 445-484

Merchant, K.A., 1982. The control function of management. Sloan Management Review 23, 43-55

Merchant, K.A., Van der Stede, W.A., 2003. Management control systems: performance measurement, evaluation and incentives. Prentice Hall, Harlow.

Milgrom, P., Roberts, J., 1992. Economics, organization and management. Prentice-Hall, Englewood Cliffs, NJ.

Morrison, A.J., Roth, K., 1993. Developing global subsidiary mandates. Business Quarterly 57, 104-110

Nagar, V., 2002. Delegation and incentive compensation. The Accounting Review 77, 379-395

Nobel, R., Birkinshaw, J., 1998. Innovation in multinational corporations: control and communication patterns in international R & D operations. Strategic Management Journal 19, 479-496

Nohria, N., Ghoshal, S., 1994. Differentiated fit and shared values: alternatives for managing headquarter-subsidiary relations. Strategic Management Journal 15, 491-502

Nohria, N., Ghoshal, S., 1997. The differentiated network: organizing multinational corporations for value creation. Jossey-Bass, San Fransisco.

Ouchi, W.G., 1979. A conceptual framework for the design of organizational control mechanisms. Management Science 25, 833-848

Ouchi, W.G., 1980. Markets, Bureaucracies, and Clans. Administrative Science Quarterly 25, 129-141

Parsons, T., 1956. Suggestions for a Sociological Approach to the Theory of Organizations-I. Administrative Science Quarterly 1, 63-85

Paterson, S.L., Brock, D.M., 2002. The development of subsidiary-management research: review and theoretical analysis. International Business Review 11, 139-163

Podsakoff, P.M., Organ, D.W., 1986. Self-reports in organizational research: problems and prospects. Journal of Management, 12, 531-544.

Podsakoff, P.M., MacKenzie, S.B., Lee, J-Y., Podsakoff, N.P., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. Journal of Applied Psychology, 88, 879-903.

Rockness, H.O., Shields, M.D., 1984. Organizational control systems in research and development. Accounting, Organizations and Society 9, 165-177

Rockness, H.O., Shields, M.D., 1988. An empirical analysis of the expenditure budget in research and development. Contemporary Accounting Research 4, 568-581

Rodríguez-Duarte, A., Sandulli, F.D., Minguela-Rata, B., López-Sánchez, J.I., 2007. The endogenous relationship between innovation and diversification, and the

impact of technological resources on the form of diversification. Research Policy 36, 652-664

Santangelo, G.D., 2002. Innovation in multinational corporations in the information age: the experience of the European ICT industry. Edward Elgar, Northampton.

Thompson, J., 1967. Organizations in action. McGraw-Hill, New York.

von Boehmer, A., 1995. Internationalisierung industrieller Forschung und Entwicklung. Deutscher Universitätsverlag, Wiesbaden.

White, R.E., Poynter, T.A., 1984. Strategies for foreign-owned subsidiaries in Canada. Business Quarterly, 59-69

Young, S., Tavares, A.T., 2004. Centralization and autonomy: back to the future. International Business Review 13, 215-237

Zander, U., Kogut, B., 1995. Knowledge and the speed of the transfer and imitation of organizational capabilities: an empirical test. Organization Science 6, 76-92