

INNOVATION AND CONTROL IN THE MULTINATIONAL FIRM: A COMPARISON OF POLITICAL AND CONTINGENCY APPROACHES

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This study focuses on control mechanisms used by multinational corporations (MNCs) to manage their extra-national R&D units. Drawing on both the literature on organizational power and contingency theory, this study develops and empirically tests a set of hypotheses aimed at explaining how headquarters control their overseas R&D units. Data collected from 134 R&D units of German MNCs serve to test the hypotheses. Results highlight the importance of the units' R&D mandate and its interdependence in explaining control mechanisms. Moreover, they indicate a relatively weak predictive power of political approaches compared to contingency approaches. Copyright © 2007 John Wiley & Sons, Ltd.

INTRODUCTION

A large amount of corporate learning takes place in R&D units. Traditionally, companies used to locate these units in close proximity to headquarters and their control was of no major concern for most managers (Brockhoff, 1998; Reger, 1999). More recently though, R&D units are increasingly dispersed internationally and the issue of finding appropriate control instruments has moved up on the agenda of R&D managers (Granstrand, Hakan-son, and Sojlander, 1992; Pearce and Singh, 1992; Asakawa, 2001; Ambos and Schlegelmilch, 2004; Medcof, 2001; Gerybadze and Reger, 1999; De Meyer and Mizushima, 1989). The strategic imperative for maintaining control is evident (cf. Medcof, 2001): internationalization of R&D increases the risk of duplication of work by different sites, endangers the organization to drift away from

its strategic focus, and spurs the risk of leakage of proprietary technology. But, despite the growing number of publications on the management of globally dispersed technology networks (Asakawa, 1996; Ambos and Schlegelmilch, 2004; Bartlett and Ghoshal, 1990; Pearce and Singh, 1992; Behrman and Fischer, 1980; Brockhoff and Schmaul, 1996; Cheng, 1994; De Meyer and Mizushima, 1989; Nobel and Birkinshaw, 1998; Stock, Greis, and Dibner, 1996) there seems to be only little consensus on what could be termed 'best practice' (Medcof, 2001).

Several undertakings have emphasized the role of communication (e.g., De Meyer and Mizushima, 1989), decision-making autonomy (e.g., Brockhoff and Schmaul, 1996; Behrman and Fischer, 1980), the use of project teams (Ambos and Schlegelmilch, 2004; Mendez, 2003) or have come up with differentiated models including socialization, formalization, and centralization (e.g., Nobel and Birkinshaw, 1998; Reger, 1999). These modes of control have been linked to a variety of contingencies, starting with the size of the R&D unit (Schmaul, 1995), its local embeddedness (Andersson and Forsgren, 1996), or its strategic mandate (Nobel and Birkinshaw,

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1998). Each of these studies added greatly to our knowledge on the management of R&D units. However, as we will argue in this paper, the isolated treatment of individual contingency variables and the lack of a unifying theoretical framework in most of these studies have inhibited further advancement and integration of this emerging field.

This study draws on two theoretical streams, notably contingency theory and the literature on organizational power,¹ to explain the mechanisms used to control overseas technology units. Both perspectives have been widely used and applied in a more general context of the multinational corporation (MNC) (Ghoshal and Nohria, 1989; Gupta and Govindarajan, 1991, 1994; Andersson and Forsgren 1996; Medcalf, 2001; Nobel and Birkinshaw, 1998). Similarly, both perspectives show a great potential to unify many of the aforementioned contingencies into one framework. Yet, to our knowledge, little effort has been made to empirically establish the usefulness of these theories in the context of international technology networks. Contingency theory emphasizes the (task) context of organizational subunits and suggests a differentiated response to diverging contextual demands. According to this view, control becomes a function of the task context a unit faces. In contrast to contingency theory, the literature on organizational power builds its predictions on the premise of subunit power (Medcalf, 2003; Doz and Prahalad, 1991; Astley and Sachdeva, 1984). Power differentials and conflicting goals of individual subunits influence the way headquarters can control their (powerful) subsidiaries. The two perspectives are not mutually exclusive; i.e., in some instances the task context of a subunit can be a source of power, but, as we will show in this paper, the predictions of both theories are not always identical. Indeed, in some cases both theoretical perspectives lead to conflicting predictions, which makes a comparison particularly interesting.

¹ In this paper we use the terms '(intra-)organizational power' (cf. Astley and Sachdeva, 1984), and 'political approaches' (Forsgren and Pedersen, 2000) to refer to the collective literature on power in organizations, in contrast to contingency theory that emphasizes the unit's task context rather than its power. We only use the term 'resource dependency theory' or other labels when making an explicit statement grounded in that theory; i.e., when referring to organizational power stemming from resource dependencies as opposed to other sources (e.g., network centrality).

We attempt to contribute to the literature in three ways. First, on a general level, we address the need for a more thorough testing of theories and frameworks available to international management scholars, which has been emphasized by several researchers (Doz and Prahalad, 1991; O'Donnell, 2000; Medcalf, 2001). Second, by drawing on both contingency theory and the political view of the firm, we argue that headquarters' ability to control its overseas R&D units will be contingent on the relative resource power *as well as* the task context of the individual R&D unit. Thus, this study rests on the notion that headquarters–subsidiary relationships are a mixed-motive dyad, in which members have interdependent as well as independent interests (Ghoshal and Nohria, 1989). The third contribution is empirical and builds on an original dataset of 134 R&D units belonging to 49 large German MNCs that together account for roughly 66 percent of the country's privately funded R&D. The data are used to test the relative power of the two theoretical perspectives in predicting headquarters' choice of control mechanisms.

The paper is organized into four sections. The subsequent section starts with a review of the relevant literature. Building on this discussion, a set of hypotheses is developed that relate the modes of control to individual contingency variables. The second section describes the design, the data collection instrument, and the measurements employed in this study. The third section presents the results of the empirical investigation. The final section discusses these findings and their implications for further research.

THEORETICAL BACKGROUND

Management control

Control has been the focus of extensive research in several branches of social sciences. In the narrower context of international business, scholars have been eager to point out the pivotal role of headquarters' coordination and control in implementing global strategies (Doz and Prahalad, 1981; Bartlett and Ghoshal, 1989; Kogut, 1985; Andersson and Forsgren, 1996). Control in this sense has usually been defined as any process (mechanism, instrument) applied by the organization to assure the execution of organizational goals and plans (Tannenbaum, 1968; Child, 1973). The different control instruments available to headquarters

have been widely discussed (Martinez and Jarillo, 1989, 1991; Ghoshal and Nohria, 1989; Bartlett and Ghoshal, 1989; Nobel and Birkinshaw, 1998; Gupta and Govindarajan, 1991). Building on this tradition, we will distinguish three types of control: *centralization*, where decision-making power is retained at the headquarters; *formalization*, where decision-making power is routinized through rules and procedures; and *socialization*, whereby organizational members develop common expectations and shared values that promote like-minded decision making.

International management researchers have linked these modes of control to various internal and external contingencies. For instance, contingency theory argues that the control mechanisms used by headquarters must be adapted to the task context faced by the individual subsidiary (Gupta and Govindarajan, 1991; Bartlett and Ghoshal, 1989). In contrast, the literature on organizational power suggests that subsidiary control is not only about designing control mechanisms in accordance with the units' task characteristics, but also depends on the relative power of the unit (Ander-sson and Forsgren, 1996; Pfeffer and Salancik, 1978). In the following section, we will draw on both research streams to develop a set of hypotheses.

R&D units' task context and management control

The link between the task context and management control has been firmly established in contingency theory (Thompson, 1967; Lawrence and Lorsch, 1967; Rosenzweig and Singh, 1991; Ghoshal and Nohria, 1989; Ghoshal and Westney, 1993). Gupta and Govindarajan (1991), for example, argue that subsidiaries perform different tasks which require distinct behaviors by management. Further, given that different control mechanisms support different behaviors, organizations should strive for a fit among their coordination and control instruments. Building on this or similar lines of reasoning, several studies examined control in relation to the unit's task context. As far as the MNC is concerned, two factors appear to have a direct bearing on this control relationship: the R&D unit's strategic mission (Nobel and Birkinshaw, 1998; Ambos and Schlegelmilch, 2004; Hakanson and Nobel, 1993) and its interdependence (Gencturk and Aulakh, 1995; Ouchi and Maguire, 1975; De

Meyer, 1991). In the following we will look at each of them in turn.

Interdependence

The relationship between interdependence and control has been widely investigated in the extant organizational literature (Thompson, 1967; Lawrence and Lorsch, 1967; Gencturk and Aulakh, 1995; Baliga and Jaeger, 1984; Ghoshal and Nohria, 1989; Gupta and Govindarajan, 1991). In the MNC context, authors refer to international interdependence as the condition in which subsidiaries or units of the MNC rely on other units' activities or inputs in order to perform their role effectively. With increased international interdependencies, the actions and decisions taken at a particular R&D unit have a greater impact on activities throughout the organization. Thus, it is even more important to ensure that such decisions are favorable for the MNC as a whole (O'Donnell, 2000). Contingency theory usually postulates a positive link between interdependencies and control (Ouchi and Maguire, 1975; Gencturk and Aulakh, 1995; Baliga and Jaeger, 1984). Gencturk and Aulakh (1995), for example, argue that interdependencies lead to an increase in process control. What the authors term process control comes close to our two categories of centralization and formalization. Ghoshal and Nohria (1989) state that interdependencies correlate with high degrees of formalization and socialization, and Ouchi and Maguire (1975) found they correlate to all three types of control. Thus, the following relationships are hypothesized:

Hypothesis 1: Headquarters will respond to increasing interdependencies with (a) an increase in centralization, (b) an increase in formalization, and (c) an increase in socialization.

R&D mandate

Researchers have emphasized the importance of the subsidiaries' mandate as a factor shaping control (Bartlett and Ghoshal, 1989; Gupta and Govindarajan, 1991, 1994; Martinez and Jarillo 1991; Pearce and Singh, 1992; Ghoshal and Nohria, 1989). Nobel and Birkinshaw's (1998) study suggests that differing technology mandates also lead to different modes of control. R&D units have been categorized along a number of different criteria

(see, for example, Ronstadt, 1978; Behrman and Fischer, 1980; Pearce, 1990; Håkanson and Nobel, 1993; Chiesa, 1996, 2000; Kuemmerle, 1999). However, there seems to be an emergent consensus that it might be useful to distinguish R&D units into (1) adaptors of products to local market needs, (2) units that exploit the firms' technology competences on a global basis, and (3) R&D units established to augment or create new technological competences abroad. We will subsequently refer to these units as (1) local adaptors, (2) international adaptors, and (3) international creators, respectively.

A task-related perspective on control suggests that headquarters' use of control depends on the task context these different units face. Nobel and Birkinshaw (1998) argue that local adaptors will require only moderate control levels. With large parts of their work being devoted to local product adaptations, little central interference will be necessary. Thus, given the cost implied by socialization, the authors propose that formalization will be the preferred mode, followed by centralization. The global mandate of international adaptors, in turn, increases the level of coordination, and centralization becomes feasible. Relative to local adapters we would thus expect to see significantly higher levels of centralization, formalization, and socialization. Among all three mandates, international creators have the most complex mandate. The creation of new knowledge and competencies requires operational freedom, while the centrality of these resources implies a strong need for coordination. Considering the complexity and low programmability of tasks performed by these units, headquarters' attempts to control this type of technology unit via formalization are likely to fail. For these units, centralization and socialization will be the preferred modes of control. In line with Nobel and Birkinshaw's (1998) predictions, we hypothesize the following relationships:

Hypothesis 2: Relative to local adaptors, both, international adaptors and international creators will experience higher levels of centralization. The relationship should be strongest for international adaptors.

Hypothesis 3: Relative to local adaptors, international adaptors will experience higher levels of formalization; international creators will experience lower levels of formalization.

Hypothesis 4: Relative to local adaptors, both international adaptors and international creators will experience higher levels of socialization. The relationship should be strongest for international creators.

From a task perspective, both the R&D units' strategic mandates as well as the level interdependence have a bearing on the use of headquarters' control. While this logic rests on the predominance of the laboratory's task characteristics, an important stream of research within the international management literature has questioned this assumption. According to these authors, the ability to control foreign subsidiaries depends on the relative power the headquarters is able to exert over its overseas units (cf. Medcof, 2003; Andersson and Forsgren, 1996). In the next section, an alternative perspective of R&D unit control will be presented. This perspective draws on the literature on organizational power to predict the use of different types of control mechanisms.

Organizational power and management control

While the literature on organizational power and resource dependence is well established, it has been only sporadically applied within an MNC context (Harpaz and Meshoulman, 1997; Ghoshal and Nohria, 1989; Prahalad and Doz, 1981; Mudambi and Navarra, 2004; Medcof, 2001). Based on this literature, subunits acquire structural power from various sources, such as different resource endowments, capabilities, and dependencies of other network actors (Astley and Sachdeva, 1984; Astley and Zajac, 1990). Within the MNC, power dynamics among geographically dispersed subunits can be complex. Structural power enables subunits to exercise or resist influence over other units. Moreover, structural power may challenge the supremacy of headquarters' control and influence within the network. Thus, the questions 'How do subunits gain power?' and 'Through which means can the headquarters (re-)establish control?' become paramount.

With regard to the first question, literature has generally emphasized two main sources of subsidiary power: its relative resource endowments and its network centrality (Astley and Sachdeva, 1984; Astley and Zajac, 1990; O'Donnell, 2000; Medcof, 2001, 2003). The resource endowment

argument is grounded in resource dependency theory (Pfeffer, 1992; Medcof, 2001) and is consistent with the predictions of the resource-based view (Barney, 1991; Medcof, 2001). Formally put, the power of a subunit A over another unit B will depend on B's dependence on A's resources. Thus, following Medcof (2001), the relative power of a unit can be expressed as a function of the *importance* of the resources, the number of *alternatives* headquarters has to source them, and how much *discretion* the unit has in the development of the resource. Units controlling strategically important resources with few options for alternative sourcing should command a high power within the network.

Network centrality has been identified as a second major source of structural power (Astley and Zajac, 1990). Founded in the 'strategic contingencies perspective' on subunit power (Hickson *et al.*, 1971) and consistent with the predictions of social network theory (Freeman, 1979; Medcof, 2003), subunits have been said to acquire power when occupying pivotal roles in the intra-organizational network. The premise is that an organization's division of labor makes subunits collectively interdependent in the sense that the functioning of the system as a whole would be impaired if any of its component subunits ceases to perform their activities. In other words, those units that are centrally immersed in the organization's system of interdependent activities become essential to system functioning and, therefore, powerful. It has been argued that the two aspects, namely resource dependence and network centrality, are conceptually different (cf. Astley and Sachdeva, 1984). The ability of central network actors to access and potentially control resources, such as knowledge and information (Medcof, 2003), allows for some alignment of both facets in a more widely interpreted resource dependency perspective. As we will point out below, both facets lead to the same consequences with regard to management control, thus making the conceptual distinction somewhat less relevant in the context of our study.

Turning to the second question: How, then, do headquarters maintain control in the light of above-mentioned power dynamics? The literature on organizational power makes few predictions on how shifts in subunit power will affect the control modes available to headquarters. Astley and Sachdeva (1984) note that increases in power stemming from network centrality and resource power will reduce the headquarters' ability to

exercise control via 'hierarchical authority,' a concept that is close to our notion of direct control. However, the authors omit to discuss alternative ways to maintain control in these settings. Medcof (2001) addresses this shortcoming by suggesting that power shifts to the overseas technology units should be countered by inclusive management styles and goes on to suggest that socialization (organizational culture) constitutes an adequate control mode in such settings. Building on empirical data, Prahalad and Doz (1981) and O'Donnell (2000) come to similar conclusions. Prahalad and Doz (1981), for example, note that firms in their sample addressed the resulting control gap by what they call 'conflict resolution systems' (socialization). Similarly, O'Donnell (2000: 531) argues, 'the cooperative behaviors needed in conditions of high international interdependence are best facilitated through social control methods.' Thus, the general assessment here is that increasing power of subunits will lower headquarters' ability to exercise direct control, which will ultimately lead to a shift towards indirect forms of control.

The two power sources identified above relate nicely to two contingency factors previously discussed. In essence, both of the aforementioned contingencies can be, and have been, interpreted as sources of resource power, and thus fitted into an intra-organizational power perspective of headquarters control. While we acknowledge that there may be many other potential sources of power (e.g., size, access to local knowledge, management talent), in this paper we will restrict our arguments to these two sources and enter the other factors as control variables.

Interdependence and power

Astley and Zajac (1990) demonstrated that a subunit's power within an organization is greater when the subunit is highly interdependent with other subunits, or as the authors put it, possesses a central position in the network. Similarly, Ghoshal and Nohria (1989) argued that high interdependence is negatively related to centralization, since it causes decisions to reflect the competencies and perspectives of the headquarters only and constrains reciprocity in exchange relations. O'Donnell (2000) provides similar arguments. The conclusions drawn from these arguments is that high interdependencies should lead to a shift of control emphasis away from centralization

towards formalization and socialization. Thus, while both a political and a task-oriented perspective come to similar conclusions regarding the use of formalization and socialization, both perspectives run counter with respect to centralization. Hypothesis 5 formally reflects this counter-argument, i.e., when Hypothesis 5a is right, Hypothesis 1a must be wrong. Similarly, if Hypothesis 1a is supported, Hypothesis 5a cannot hold. As both perspectives are grounded in theory, it is ultimately an empirical question which of the two propositions hold. We will leave it to the empirical part of the paper to investigate which arguments will be supported.

Hypothesis 5: Headquarters will respond to increasing interdependence with (a) a decreasing use of centralization, (b) an increasing use of formalization, and (c) an increasing use of socialization.

R&D mandate and power

As recently demonstrated by Medcof (2001), the R&D unit's strategic mandate can also be fitted into an organizational power perspective. According to Medcof (2001), the relocation of critical technological resources into overseas technology units implies an equal shift in resource power. In the formal language of resource dependency theory, we would expect those units that control valuable, inimitable resources and that have a high discretion to possess the highest relative power. Given the three strategic mandates investigated in this study, we would thus assume to find relatively little power with local adaptors. International creators would possess high power, and international adaptors fall somewhere in between. The unfavorable power balance between headquarters and its arguably most important technology centers puts the MNC into a dilemma. Following our arguments above, we predict that headquarters' desire to fill this 'control gap' will lead to a shift from direct forms of control to more indirect and subtle modes. In other words, with increasing levels of resource power, as represented in the strategic mandate, headquarters will apply less direct control and more social control. A similar argument can be made for formalization. The establishment of firm-wide standards and procedures increases the procedural justice and thus the acceptance of leadership within the MNC (Kim and Mauborgne,

1993). However, by introducing formal decision rules and by specifying standards, headquarters arguably apply a more stringent and less participative control regime than is the case with socialization. In sum, while we would still expect a positive relationship to prevail, theoretical predictions are less clear-cut and the effect of subunit power on formalization should be less strong as compared to socialization. Thus, in line with Medcof (2001), Prahalad and Doz (1981), and Ghoshal and Nohria (1989), and building on the arguments of the previous section, we propose the following:

Hypothesis 6: Relative to local adaptors, both international adaptors and international creators will experience lower levels of centralization. The relationship should be strongest for international creators.

Hypothesis 7: Relative to local adaptors, both international adaptors and international creators will experience higher levels of formalization. The relationship should be strongest for international creators.

Hypothesis 8: Relative to local adaptors, both international adaptors and international creators will experience higher levels of socialization. The relationship should be strongest for international creators.

Control variables

Size of the R&D unit

It is well accepted in the literature that the size of an R&D unit can constitute an important source of power (Prahalad and Doz, 1981; Ghoshal and Nohria, 1989). The impact of size on headquarters' control has been investigated in a series of studies (Schmaul, 1995; Hedlund, 1981; Picard, 1979; Garnier, 1982; Gates and Egelhoff, 1986; Egelhoff, 1988). In accordance with the literature on organizational power, we assume that R&D unit size is negatively related to centralization and positively related to formalization and socialization. Accordingly, in testing our hypotheses, we deemed it important that we control for the potential effects of R&D unit size.

External embeddedness

As discussed earlier, R&D units may also draw power from the network of external relationships in

which they are embedded (Emerson, 1962; Cook, 1977; Andersson and Forsgren, 1996; Ghoshal and Bartlett, 1990; Asakawa, 1996). Andersson and Forsgren (1996) suggest that higher degrees of embeddedness result in lower perceived control on the subsidiary's side. Quite similarly, Asakawa (1996) found high tensions in headquarters–subsidiary relationships for R&D units with high network embeddedness. Hence, high embeddedness may shield the subsidiary from headquarters' control. Accordingly, all our hypotheses are tested after controlling for the potential effects of the units' external embeddedness.

Cultural distance

There already exists a large body of both theoretical and empirical literature dealing with the fact that cultural distance has a major impact on the MNC's choice of entry mode, knowledge transfers, as well as control systems (Asakawa, 1996; Ambos and Schlegelmilch, 2004; Kogut and Singh, 1988; Baliga and Jaeger 1984; Rosenzweig and Singh, 1991; Garnier, 1992; Harzing, 1999; Gomez-Mejia and Palich, 1997; Hamilton and Kashlak, 1999). Consequently, we test our hypotheses controlling for cultural distance among the headquarters and the local R&D laboratory.

METHODOLOGY

Sample and data collection

The German top 500 listing, as published by 'Die Welt,' was used to determine the number of German firms with overseas R&D investments. Telephone pre-contacts with all 500 enterprises revealed a total number of 106 firms that indicated to operate overseas R&D sites. These firms form the population under investigation. Data collection took place in fall 2000. In all cases, respondents were senior R&D managers at headquarters, who were generally believed to be most knowledgeable about the topics surveyed. Using a standardized mail survey, detailed responses on the type of R&D investment, integration, and links to the local research community were determined. The final instrument was pretested in nine firms using cognitive interviews, and was judged suitable. Only with respect to laboratory budget were minor modifications deemed necessary to accommodate the various industries under investigation. All managers

were contacted by phone before the questionnaire was mailed out. Two telephone reminders, the offer of an executive summary, and the invitation to participate in a workshop on the topic at the authors' home university ensured a high response rate. These efforts led to a response of 46 percent (49 firms) providing data on a total of 134 overseas R&D units. To assess nonresponse bias, we tested whether responding firms differed from nonresponding firms with respect to size (personnel, sales) and consolidated profits in the reporting year. The test indicated that firms in the sample and population did not differ significantly.

Measures

Management control

The measures of control were based on questions originally developed by Martinez and Jarillo (1991). Individual items were slightly adjusted in wording to fit the R&D context of this study. *Centralization* was measured on a four-item scale asking managers to indicate the degree of local autonomy, the degree of direct supervision, the existence of integrated planning systems, and the utilization of reporting systems. *Formalization* was measured on a two-item scale assessing the emphasis placed on standardized processes and procedures and the degree to which formalized rules and policies were enforced. *Socialization* was a five-item scale measuring the degree of shared values, the use of expatriates, the frequency of R&D personnel exchange between units, the degree to which local managers participated in international trainings, and local management's involvement in joint teams and taskforces. All items were subjected to a principal component factor analysis with oblimin rotation to assess convergence within and divergence between scales. This analysis produced three stable factors representing centralization, formalization, and socialization. Table 1 displays the results of the factor analysis. In the case of socialization, two items measuring international trainings and participation in task forces did not consistently discriminate between the three factors and were dropped from further analysis. The remaining three items were used for socialization.

Mandates of R&D units

Studies have utilized a series of different approaches to derive typologies of subsidiaries and

Table 1. Oblimin rotated factor matrix for multi-item control scales

Items	Principal components		
	1	2	3
Direct supervision	0.744	0.212	-0.218
Centralization	0.743	0.246	-0.07
Planning	0.742	-0.184	0.204
Output control	0.701	-0.186	0.220
Expatriate control	-0.04	0.815	0.04
Socialization	-0.01	0.792	0.09
Job rotation	0.09	0.649	0.03
Formalization	0.01	0.155	0.853
Standardization	0.02	0.04	0.798
Eigenvalue	2.89	1.60	1.21
Percent of variance	32.13	17.72	13.46

R&D units. Hakanson and Nobel (1993), for example, relied on factor analysis of multiple motives to derive a typology of five different strategic mandates. Although empirically sophisticated, motives are not always a good proxy to determine management behavior, which constitutes the prime focus of this paper. Other prominent studies, for example Pearce (1990), relied on self-typing measures. While easy to administer, the high risk of inflated role assessment led us to abstain from this procedure. In light of these drawbacks, we decided to follow Nobel and Birkinshaw (1998) and apply a rather simple heuristic: those units who direct their effort exclusively to the local market are classified as *local adaptors*. The remaining units were divided in two groups depending on the primary nature of their work. Technically this was achieved by assessing the percentage of work devoted to capability exploiting vs. capability augmenting activities.² The conceptualization of this variable was adopted from Kuemmerle (1997) and proved to be a reliable indicator of the strategic mandate. As in Kuemmerle's study, all R&D units clearly subscribe to one or the other task. Thus, the remaining two mandates were derived by a split at the 50 percent mark. Where more than 50 percent of the work is devoted to capability augmenting

² In the survey, respondents were provided with a definition of these concepts. Capability-augmenting activities were defined as 'experimental or theoretical work undertaken to create and acquire new knowledge that your firm considers important for future products.' Capability-exploiting activities were defined as 'systematic work, drawing on existing knowledge within the firm and directed toward producing products in the near future or adapting existing products.'

we called the R&D units *international creators*; where more than 50 percent fall into the other category we termed them *international adaptors*. This procedure resulted in 13 local adaptors, 82 international adaptors, and 39 international creators.

Interdependence

Following Harzing (1999) and Conger (1992), constructs were operationalized on a three-item scale asking for the percentage of work that was received from other units, the percentage of work that was passed forward to other units, and the percentage of projects developed jointly. A Chronbach's alpha of 0.72 was obtained for this measure.

Size of the R&D unit

Unit size was measured as the number of employees.

External embeddedness

Following Boehmer (1995) and Ambos and Reitsperger (2004), we used a graphical scale and employed a two-step procedure to assess the external embeddedness of an R&D unit. Managers were first asked to identify collaborators from a range of possible partners (e.g., competitors, suppliers, customers, other firms, private research institutions, universities, local governments, or other institutions). In a second step, they were asked to rate the importance of the existing cooperation. Multiplying network ties by tie strength, we calculated the network density of the given R&D unit. Following Ghoshal and Bartlett (1990), we derived the final measure by dividing the actual network density by the total possible network density.

Cultural distance

To assess the cultural distance among the headquarters and the overseas R&D units, we followed the procedure advocated by Kogut and Singh (1988). Using the host country as a proxy for national culture, we assigned cultural value scores to each R&D unit (Hofstede, 1980). Index values were calculated by summing up mean differences over four cultural dimensions after dividing the difference of *i*th home and host country scores, by

the variance of the i th dimension (see Kogut and Singh for details).

Analysis

To test the combined influence of the proposed contingency factors on the mode of control used for internationally dispersed R&D units, multiple regression analysis was applied. Specifically, six models were constructed, using the three control types (centralization, formalization, and socialization) as the dependent and the six contingency variables as the independent variables. The complete set of equations to be tested is as follows:

$$\begin{aligned} \text{Centralization} &= \alpha + \beta_1 \text{CD} + \beta_2 \text{SIZE} \\ &\quad + \beta_3 \text{EMBED} + \beta_4 \text{INTERD} \\ &\quad + \beta_5 \text{ADAPT} + \beta_6 \text{CREAT} \\ \text{Formalization} &= \alpha + \beta_1 \text{CD} + \beta_2 \text{SIZE} \\ &\quad + \beta_3 \text{EMBED} + \beta_4 \text{INTERD} \\ &\quad + \beta_5 \text{ADAPT} + \beta_6 \text{CREAT} \\ \text{Sozialization} &= \alpha + \beta_1 \text{CD} + \beta_2 \text{SIZE} \\ &\quad + \beta_3 \text{EMBED} + \beta_4 \text{INTERD} \\ &\quad + \beta_5 \text{ADAPT} + \beta_6 \text{CREAT} \end{aligned}$$

with CD = cultural distance, SIZE = R&D unit size, EMBED = external embeddedness, INTERD = interdependence, ADAPT = international adaptors, and CREAT = international creators. Because multiple observations from the same MNC might not be independent, we used robust standard errors that corrected for firm-specific clustering and used the robust clustering procedure as implemented in the statistical software package STATA 9.1 (Moulton, 1986; Rogers, 1993). Data were examined to comply with the requirements of regression analysis, i.e. linearity, equality of variance, and normality. Plotting standardized residuals against standardized predicted values showed no major violations. We examined the variance inflation factors (VIF) and all of the scores were below 2.7. A coefficient variance decomposition analysis with condition indices (cf. Hair *et al.*, 1998) confirmed that multicollinearity was not a serious problem. Finally, a Cook–Weisberg test using fitted values for our dependent measures equally confirmed that heteroskedasticity was not an issue. Collectively these results ensured us that multiple regression

was appropriate. Consequently, a two-step hierarchical regression was applied to analyze the impact of the independent variables on the three forms of control. First, we entered the three variables pertaining to cultural distance, R&D unit size, and external embeddedness (Models 1, 3, and 5); in the second step (Models 2, 4, and 6) we entered our two predictor variables, R&D units' mission (two dummies), and interdependence.

RESULTS

There is significant variance given the sample size. R&D units range in age from 1 year to over 60 years. Thirty-four percent employed fewer than 20 employees, 14.6 percent more than 200. Thirty-four percent had an annual budget of less than €2 million, while 22.2 percent spent more than €20 million. Table 2 contains a summary of the descriptive statistics and correlations for all variables in this study. No variable exhibits distribution or correlation problems.

The results of the regression analysis are summarized in Table 3. Our first set of models (1, 3 and 5) informs on the impact of cultural distance, R&D unit size, and external embeddedness on our three control modes. Well in line with prior empirical findings, our cultural distance measure significantly and positively relates to the degree of centralization. Similarly, as predicted by prior studies, R&D unit size correlates significantly and positively with formalization and socialization. However, a negative relationship among R&D unit size and centralization could not be confirmed. Looking at the embeddedness measure, all three coefficients show the expected sign but never reach significance.

Our second set of models (2, 4, and 6) presents the full analysis, including the interdependence measure and the two mission dummies. In all three models R^2 increases significantly. Specifically, we observe a twofold increase in R^2 for formalization and socialization and a threefold increase in the case of centralization. We take these findings as an indication that our predictor variables add considerable explanatory power to the models.

Of our two predictor variables, interdependence is significant and positively related to all three modes of control. These findings are well in line with our theoretical predictions, thus supporting Hypotheses 1a, 1b (5b), and 1c (5c), while simultaneously rejecting the counter-hypothesis 5a. The

Table 2. Mean, standard deviations, and correlations among study variables

	Mean	S.D.	1	2	3	4	5	6	7	8	9
1. Centralization	0.0	1.0	1								
2. Formalization	0.0	1.0	0.232	1							
3. Socialization	0.0	1.0	0.199	0.083	1						
4. Cultural distance	0.859	0.745	0.263	-0.007	0.073	1					
5. R&D unit size	74.09	69.19	0.032	0.193	0.146	-0.191	1				
6. Embeddedness	0.300	0.185	-0.074	-0.111	0.005	-0.093	0.282	1			
7. Interdependence	67.45	48.37	0.300	0.254	0.325	0.038	0.127	-0.220	1		
8. International adaptors	0.611	0.489	-0.153	0.184	-0.003	0.031	0.042	-0.139	0.097	1	
9. International creators	0.291	0.456	0.283	-0.187	-0.037	-0.140	-0.010	0.110	-0.093	-0.805	1

Correlations at or above $|.16|$ are significant at .05 level

Table 3. Linear regression models

	Centralization		Formalization		Socialization	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Cultural distance	0.3392***	0.3732***	0.0076	-0.0328	0.0882	0.0758
R&D unit size	0.0022	0.0009	0.0051***	0.0039*	0.0026*	0.0012
External embeddedness	-0.5602	-0.1717	-1.2074	-0.7125	-0.4334	0.0823
Interdependence		0.0048**		0.0043†		0.0061***
International adaptors		0.6156**		0.1981		0.1418
International creators		1.1818***		-0.3568		0.1069
Model statistics						
R^2	0.0843	0.2564	0.0797	0.1470	0.0335	0.1176
F-score	4.98	4.30	2.32	2.66	1.20	3.39
Significance	0.005	0.001	0.088	0.026	0.319	0.008

† $p < 0.15$; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

organizational power literature argues that high levels of centralization do not work well with centrally embedded network actors, as interdependence shifts the relative power to the focal unit. This unit might be able to resist decisions that reflect the perspectives of headquarters only. Given that the counter-argument (Hypothesis 1a) could be supported, we conclude that the task context serves as a better predictor.

The impact of our three R&D mandates was assessed via two dummy variables: one for international adaptors and one for international creators (with local adapters serving as the baseline). Our results confirm our Hypothesis 2, as both international creators and international adaptors, are significantly and positively related to centralization. However, they do not confirm a significantly higher use of centralization for international adaptors. Hypothesis 3 hypothesized a positive relationship between formalization and international

adaptors and a negative relationship between formalization and international creators. Model 4 confirms the direction of such a relationship, but both coefficients fail to reach acceptable significance levels; thus no statistical support can be established for these relationships. Similar results were obtained with regard to Hypothesis 4. While both dummies show the predicted sign, none of the coefficients reaches significance. Our hypotheses related to the organizational power perspective fare worse. Results clearly fail to support Hypotheses 6 and 8, while results regarding Hypothesis 7 are inconclusive at best.

DISCUSSION

In this section we will further discuss and conclude our findings. In particular, we will highlight the positive impact of interdependence, the counter-evidence regarding socialization, as well

as the relatively weak predictive power of an organizational power compared to a task-related perspective.

Our results confirm the positive impact of interdependence on all three modes of control. Both contingency theory and the organizational power perspective predicted that increasing levels of interdependence will lead to higher levels of socialization and formalization. The results of our study suggest such a relationship. Interdependence was also found to be positively related to centralization. While such a relationship was expected from a contingency theory perspective, the positive relationship among centralization and interdependence runs counter to what literature on organizational power would imply. Thus, if interdependencies indeed constitute a source of power, R&D units are obviously not able to build on that. On the one hand, this may indicate that headquarters' desire to control outweighs any discontent this could cause on parts of the local R&D management. On the other hand, the fact that interdependent units are equally controlled with high socialization may ease these tensions. In fact, further studies should consider treating these modes as complementary, not substitutes (Martinez and Jarillo, 1989; Harzing, 1999).

Second, our study found surprisingly little support for the impact of the R&D unit mandates on socialization. Building on Nobel and Birkinshaw (1998), we expected to see a much higher impact of international creators on social control than for international and local adaptors. Interestingly, our non-findings appear to be well in line with other prominent studies (Asakawa, 1996; Gupta and Govindarajan, 1994). Gupta and Govindarajan's (1994) explanation appears to be particularly interesting in the context of this study: faced with unexpected low levels of socialization for their 'international creators,' the authors suggest that units utilize their resource power not only to counteract centralization but also other 'invasive' forms of control like socialization. In this context, it is of interest that Asakawa (1996) could show that socialization leads to high tensions among Japanese firms. These findings are also in line with Ambos and Reitsperger (2004), who confirmed that socialization leads to significantly lower performance in what the authors call 'centers of excellence.' Future research in this field might find it beneficial to revisit the issue of socialization by taking a more detailed look at the specific

socialization patterns and their role in controlling international R&D units.

Finally, we emphasize that almost all of our propositions derived from the literature on organizational power fail to gain support. In our sample, neither the usually proposed negative relationships between the sizes of the R&D units, their external embeddedness, nor the negative relationship between control and interdependence, could be found. Notwithstanding the fact that this may be due to measurement error or, as Hedlund (1981) argues, countervailing forces, we tend to conclude that, in R&D units, power is not a major issue. Probably other, task-related, considerations motivate headquarters to use specific control instruments. A more detailed analysis of the potential sources of power would be useful to this end. The long time lags before R&D programs show measurable results on corporate balance sheets may help to explain why international creators cannot materialize the power stemming from their strategic resource position: the lack of immediacy may well override the holdup that resource endowments create. Thus, one crucial question for further studies would be to incorporate not only a larger variety of power sources but also to find ways to estimate their relative importance (Brockhoff, 1998). Such investigations may help to further explain why resource dependency theory works well in the general context of manufacturing and sales subsidiaries (cf. Doz and Prahalad, 1981), but fails to offer substantial explanatory power in the specific context of international R&D units.

Limitations

Several limitations of this study have to be noted that could lead to further research. First, this study is based on a population of German MNCs. Given that prior research was able to demonstrate a link between culture and control, limiting our study to the population of one large nation appears to be appropriate to reduce spurious effects stemming from cultural heterogeneity. On the other hand, this approach obviously puts limits towards the generalizability of our results to other national samples. We like to point out that the constructs and roles used here are entirely consistent with those developed by other scholars (e.g., Nobel and Birkinshaw, 1998; Ronstadt, 1978) in rather different settings. Thus bias, should it exist, will be mainly related to the level, not the kind, of our

findings. Still further studies should test whether similar relationships prevail in other national contexts.

Second, our decision to utilize key informants to measure theoretical constructs by means of perceptual measures introduces the risk of common method bias. To assess common method bias in our sample, we used Harman's one-factor test (Podsakoff and Organ, 1986). The factor analysis of the variables used in the regression modes revealed four factors with eigenvalues greater than 1, with no sign of a 'general' factor explaining a disproportional large share of the common variance. This result indicates that common method bias is not a serious problem. Although we took extra care to measure our constructs via objective, or at least multifaceted measures wherever feasible, further studies may benefit from separating independent and dependent measures in time or across multiple respondents.

Third, as previously indicated, we restricted our study to only a few, but commonly treated, sources of power. Further studies might gain additional insights by searching for additional variables. Research in sociology, for example, emphasizes, among others, legal power and expertise, both of which could be related to the subsidiaries mandate and status within the MNC. A related issue is that subsidiary power was not directly measured in this study. Instead, subunit power served as an abstract intervening concept that guided the development of testable hypotheses about manifest measures. Although such a treatment of a core concept is not unusual in organization science (e.g., the concept of information-processing theory explored in Egelhoff, 1991), this line of research could be significantly strengthened if future studies develop empirical measures of subunit power and explore the direct effects on headquarter control. One way forward could be the utilization of experimental designs (cf. Brockhoff, 1998), which would allow researchers not only to access the level but also the relative weight of different power bases.

CONCLUSION

Given the pertinent need to advance our theoretical and empirical knowledge on management processes in international technology networks, this study applied and contrasted two theories in an international R&D setting. Building on arguments

of two established streams, i.e., contingency theory and the literature on organizational power, our study provided empirical evidence on control. Based on this evidence, the explanatory power of contingency theory was found to be considerably stronger than that of theories emphasizing organizational power. Finding the reasons behind the limited explanatory power of the latter in controlling international R&D units will provide a fertile ground for future research. Equally interesting would be a more detailed look into the organizational processes that are effective in controlling international R&D units. Together, both research avenues will shed additional light on where contingency theory contradicts the literature on organizational power and where both perspectives complement each other.

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