



Coordination in global R&D organizations: An examination of the role of subsidiary mandate and modular product architectures in dispersed R&D organizations



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ABSTRACT

International research and development (R&D) operations require a significant amount of coordination between the headquarters and the subsidiaries in order to integrate the dispersed activities in one final product. This article explores what mechanisms multinational companies (MNCs) use to coordinate their overseas R&D units. Based on a multiple case study involving nine MNCs with overseas R&D subsidiaries of varying mandates, we find that R&D sites with high technology and/or market orientation tend to be coordinated by informal mechanisms while sites with little technology and/or market orientation tend to be coordinated by formal mechanisms. Furthermore, it appears that this relationship is strongly affected by the product's architecture: while rather complex R&D activities are conducted at the systems level and at sites with high technology orientation, less complex R&D activities are conducted at the component level at sites with low technology and market orientation. Finally, the findings suggest that modular product architectures have a coordinating effect in global R&D activities which have the power to lower firms' overall coordination effort. The findings bear important implications for the effective coordination of MNCs' international R&D subsidiaries.

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1. Introduction

An enduring challenge for the contemporary multinational company is to be globally effective while being able to respond to local market requirements (De Meyer and Mizushima, 1989; Martinez and Jarillo, 1991; Nobel and Birkinshaw, 1998). This challenge materializes in the question which products should be developed for the global market and which products necessitate an adaptation to the specific needs of a local market. More recently, the increasing internationalization of R&D has compounded this challenge as competencies and resources have become globally dispersed (Birkinshaw, 1996; Gassmann and von Zedtwitz, 1999). Especially R&D typically involves a high amount of uncertainty and tacit knowledge which corroborates the firm's activities to managing the international R&D organization (Reger, 2004). This is particularly true for large, diversified firms with a far-flung international R&D network where the different R&D sites

contribute to the firm's technology and product portfolio. MNCs in this situation are forced to coordinate their dispersed R&D activities to achieve "integration among different units within an organization" (Martinez and Jarillo, 1989).

With the strong emergence of multinational firms in the 60s and 70s, research on coordination in globally active firms has gained increasing attention. Extant research on coordination in MNCs has predominantly focused on the mechanisms used to coordinate the activities of the firms' subsidiaries in the light of the subsidiary's mandate (Ambos and Schlegelmilch, 2007; Cray, 1984; Martinez and Jarillo, 1991). While it is commonly agreed that coordination mechanisms must be adapted to the specific context in which they are used, there is little understanding about how R&D activities are coordinated within the MNC, apart from a few exceptions (e.g., Asakawa, 2001; Manolopoulos et al., 2011). Due to the different types of innovation activities ranging from simple re-design to complex technology development, the coordination of R&D activities is presumably more encompassing than the general subsidiary coordination. This article uses the subsidiary's technology and market orientation as indicators of the subsidiary's R&D mandate to investigate how coordination mechanisms vary across these different degrees of orientation. Hence, the research question we address is: *what are the*

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mechanisms that MNCs use to coordinate their international R&D subsidiaries and how do they relate to the subsidiary's mandate as determined by their technology and market orientation? This article contributes to extant literature on coordination in multinational firms in at least two ways: first, by explicitly considering the context of R&D, we show what mechanisms global R&D organizations use to coordinate their dispersed R&D activities ranging from simple engineering and adaptation activities to complex technology, systems, and architecture development. Second, the article extends coordination literature by highlighting the coordinating power of modular product architectures which may lower the need for formal and informal coordination.

The paper is structured as follows. In the next section we review relevant literature on coordination and the different types of R&D subsidiaries which exist in multinational firms. Following the research methodology section, we present and discuss the findings of nine case studies of single subsidiaries of MNCs regarding the headquarters' coordination of their different subsidiaries. The article concludes with implications for theory and management practice regarding the effective coordination of international R&D activities.

2. Literature review

2.1. Types of coordination

2.1.1. Formal coordination

Coordination entails the alignment and integration of value-adding activities which are interdependent but performed by different entities (Child, 1973; Malone and Crowston, 1994; Martinez and Jarillo, 1991; Srikanth and Puranam, 2011; Thompson, 1967). Research on coordination has traditionally distinguished two basic mechanisms, i.e., formal and informal coordination mechanisms (Martinez and Jarillo, 1989; Reger, 1999). Formal mechanisms are embodied in organizational structures and procedures and involve the departmentalization, centralization, formalization, planning, as well as output and behavioral control of dispersed tasks (Martinez and Jarillo, 1989). Typical examples of formal coordination between two departments include routine meetings, routine processes, conference calls, or the exchange of standard documents. As such, formal coordination builds the structural approach to the interrelation between two organizational units. A concept which is often synonymously used for coordination is the concept of control, which can be distinguished in behavioral and output control (Ouchi and Maguire, 1975). Control can be readily exerted when common goals are agreed upon and when means-end relations between the different organizational units are completely understood. The concept of control therefore exhibits strong elements of formal coordination and is henceforth considered a formal mechanism.

2.1.2. Informal coordination

Informal coordination entails activities where two or more partners make substantial contributions of resources and know-how to agreed aims (Archibugi and Iammarino, 1999; Bergek and Bruzelius, 2010). Informal coordination targets at personal attitudes and relations between employees and therefore involves the socialization of employees, the establishment of cross-departmental relations, and informal communication between people and departments (Manolopoulos et al., 2011; Martinez and Jarillo, 1991). Informal communication can be achieved through personal contacts between R&D people, conferences and seminars or the exchange of scientists (Reger, 2004). Informal coordination through socialization includes, for example, the development of joint goals and strategies, common values and

norms, or education and personal development programs (Reger, 2004). Informal coordination is also often achieved through direct collaboration between two or more different entities. This is the case when collaboration is characterized by unstructured, affective relationships and when it is predicated on mutual understanding and a common vision, shared resources, and a joint effort at reaching a common goal (Kahn, 1996). As informal coordination is an intangible approach that cannot always be readily installed in an organization, its success depends on continuous relationships between two different entities and not just formal transactions as in the case of formal coordination. It has been found that with an increasing amount of uncertainty and tacit knowledge in R&D projects, informal approaches become more important to compensate for the lack of explicit knowledge that typically enables the use of formal approaches (Lawrence and Lorsch, 1967; Reger, 1999).

2.1.3. Hybrid coordination

More recently, Reger (1999, 2004) has proposed the concept of hybrid coordination mechanisms. These mechanisms “include some elements of structured self-coordination and trans-departmental relations [...] and cannot be unequivocally classified as structural or informal mechanisms because many of their sub-instruments are either not, or only to some extent, a part of the organizational structure” (Reger, 2004, p. 58). These mechanisms include task forces, interdisciplinary project groups, core programs and core projects as well as technology platforms and promoters. The common nature of these mechanisms is that they are often temporary in nature to achieve a specified goal and cut across the formal organization in that people affected by these mechanisms often come from different organizational parts. A type of hybrid coordination mechanisms can also be modular product architectures. A product architecture is defined as the “scheme by which a product's functions are allocated to its components” (Ulrich, 1995, p. 419). Modular product architectures are characterized by a high degree of decomposability of the product into different components with clearly defined interfaces (Baldwin and Clark, 2000; Chen and Liu, 2005; Gershenson et al., 2003; Ulrich, 1995). In the most extreme case, modular product architectures have a one-to-one mapping from functional elements to the physical components that execute these functions (Ulrich, 1995). Because of that, changes in one component do not affect the functionality of other modules, enabling the independent development of modules. In addition, product modularity entails that interfaces between modules are clearly defined (Baldwin and Clark, 1997; Cabigiosu et al., 2013). Modular product architectures therefore provide a form of embedded coordination which may reduce the overall coordination efforts in product development projects (Cabigiosu et al., 2013; Sanchez and Mahoney, 1996). Product architectures as a means of coordination are ultimately hybrid as their design requires strategic planning and the precise definition of technical interfaces by an interdisciplinary team (e.g., people from R&D, manufacturing, and sales), before physical product development activities can actually take place (Zirpoli and Camuffo, 2009). Finally, product architectures often mirror organization architectures so that they are, at least for some time, part of the organizational structure (Sanchez and Mahoney, 1996). Due to the increased complexity of dispersed R&D activities of multinational firms, it has been argued that hybrid mechanisms are of increasing importance for the coordination of R&D (Reger, 2004).

2.2. Types and mandates of R&D units

Existing literature has typically determined the type and role of a single R&D subsidiary based on the nature of its tasks (Birkinshaw and Hood, 1998; Kuemmerle, 1997; Nobel and

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