Maximilian Palmié, Marco Zeschky, Stephan Winterhalter, Philipp Walter Sauter, Naomi Haefner, Oliver Gassmann (2015)

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The final version of this manuscript was published online in Small Business Economics on October 23, 2015.

The final publication is available at <http://link.springer.com/journal/11187>:

<http://link.springer.com/article/10.1007/s11187-015-9683-8>

DOI: 10.1007/s11187-015-9683-8

<http://dx.doi.org/10.1007/s11187-015-9683-8>

Please note that differences between this manuscript and the final publication may exist.

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Coordination Mechanisms for International Innovation in SMEs:
Effects on Time-To-Market and R&D Task Complexity as Moderator

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Abstract

As SMEs increasingly internationalize their innovation activities, our study strives to improve our understanding of the coordination mechanisms that SMEs can adopt to orchestrate these activities. Building on the evolutionary theory of organizations, we link three established coordination mechanisms (centralization, formalization, and socialization) to the time-to-market of SMEs' product innovations. We also argue that the complexity of the internationalized R&D tasks moderates the relationship between the three coordination mechanisms and time-to-market. Survey data from 103 SMEs with international innovation activities broadly support our theoretical account. With respect to the main effects, our findings suggest that a high degree of centralization tends to prolong the time-to-market, whereas formalization tends to shorten it. The moderation results further indicate that centralization can become more beneficial when a firm internationalizes highly complex R&D tasks, while formalization tends to become less beneficial with increasing task complexity. Main and moderation effects with respect to socialization are inconclusive. We discuss the implications of these findings for the academic literature and management practice.

1 Introduction

In many countries, small and medium-sized enterprises (SMEs) build the backbone of the economy (Ayyagari et al. 2007; Ling et al. 2008). Many high tech SMEs are niche players and aim for a worldwide market and technology leadership to achieve critical economies of scale (Qian and Li 2003). Due to global markets, international competition, and increasingly dispersed knowledge (Teece 2007; von Zedtwitz and Gassmann 2002), SMEs can benefit from tapping foreign knowledge (Sui and Baum 2014) and from staying proximate to key markets and following key customers around the globe (Lu and Beamish 2006; Naldi and Davidsson 2014). Many SMEs, like other firms, have therefore started to internationalize R&D activities to adapt their products to local customer requirements and to source local knowledge for global leverage (Kuemmerle 1997; Mudambi 2008; Narula 2004). Innovation fostered by international R&D activities is important for the prosperity of SMEs (Acs and Audretsch 1990; Mudambi and Zahra 2007). As coordination mechanisms facilitate international innovation activities, such mechanisms play an increasingly important role for firms (e.g., Ambos and Schlegelmilch 2007; Martínez and Jarillo 1991). This is particularly true for SMEs, which, due to their resource limitations (Lu and Beamish 2001), have even more stringent requirements for the successful and efficient coordination of international activities. SMEs typically have limited managerial cognition and may thus suffer from paying excessive attention to individual issues because this can limit their ability to pursue other activities (McDermott et al. 2009; Palmié et al. 2015). This limited cognition in conjunction with the often limited absorptive capacity brought about by constrained resources, might also impede learning in SMEs and their international subsidiaries (Corredoira and McDermott 2014; McDermott and Corredoira 2010). Due to these circumstances, their learning efforts—

which are important in innovation processes—are likely to benefit substantially from purposeful coordination.

With few notable exceptions (e.g., Caruana et al. 1998), existing research on coordination mechanisms for international activities has almost exclusively focused on very large multinational enterprises (MNEs). However, previous research has illustrated that SMEs and large firms differ in the challenges they face abroad (Vachani 2005) and, at least in some instances, in the organizational structures they adopt and find effective (Acs and Audretsch 1990; Qian and Li 2003; Terziovski 2010). Since key coordination mechanisms such as centralization, formalization, and socialization are anchored in firms' organizational structures (Gulati et al. 2009; Persaud 2005), the effects of international coordination mechanisms may differ between SMEs and large established firms. Thus, results from existing research on large MNEs are not necessarily transferable to SMEs, and specific research on coordination in SMEs is required. Additionally, the literature on the effects of coordination mechanisms has mostly addressed issues such as the extent of intraMNE knowledge flows (Björkman et al. 2004; Ghoshal et al. 1994; Noorderhaven and Harzing 2009; Yang et al. 2008), while paying rather little attention to more direct innovation measures (Persaud 2005). Overall, there is little understanding regarding the effects of specific coordination mechanisms on innovation performance, particularly not in the context of SMEs.

The purpose of this article is to improve our understanding of this pivotal topic. Building on the evolutionary theory of organizations (Dosi and Marengo 2007; Nelson and Winter 1982), we analyze the effect of the three established coordination mechanisms centralization, formalization, and socialization (Ambos and Schlegelmilch 2007; Manolopoulos et al. 2011; Muethel et al. 2012; Nobel and Birkinshaw 1998; Reger 1999) on an important aspect of SMEs' innovation performance, viz. the time-to-market of their

product innovations. Time-related innovation measures are very important as delays in market entry can massively reduce returns from innovations (Vesey 1991). As a consequence, innovation speed is one of the most important ways to assess a firm's innovation performance (Kerssens-van Drongelen and Bilderbeek 1999; Keupp et al. 2012). Time-based measures of innovation performance are particularly appealing for our purposes as the time it takes a firm to complete a task in need of coordination reflects the success of the firm's coordination efforts. Faster task completion typically indicates more successful coordination (Kownatzki et al. 2013). We therefore develop six hypotheses that link the three aforementioned coordination mechanisms as well as their interaction effect with R&D task complexity to the time-to-market of SMEs' product innovations. Studying the moderating role of R&D task complexity is particularly crucial in the context of SMEs as the resource scarcity that frequently characterizes them (Acs and Preston 1997; Lu and Beamish 2001) usually allows them to devote less resources to planning and analysis endeavors than larger firms (Lejarraga and Martinez-Ros 2014). As a consequence, SMEs might find it especially difficult to absorb complexity (Corredoira and McDermott 2014; McDermott and Corredoira 2010). Unique survey data from 103 German and Swiss high-tech firms with less than 2500 employees (we discuss the reasoning for this sampling choice in Sect. 4.2) allows us to test our hypotheses empirically, providing support for four of the six. The results suggest that a high degree of centralization tends to prolong the time-to-market, whereas formalization tends to speed up the innovation process. The result regarding socialization is inconclusive. Moreover, we also found that the complexity of the internationalized R&D tasks significantly moderates these effects for centralization and formalization, but not for socialization. The moderation results suggest that centralization becomes more beneficial for a fast innovation process when a firm internationalizes highly complex R&D tasks. In

contrast, formalization tends to become less beneficial with increasing task complexity. All in all, the results provide broad support for our theoretical account. A supplementary analysis further examines whether the effects of the coordination mechanisms differ across smaller and larger firms in our sample. It reveals rather minor differences: On the one hand, insignificant results for formalization and socialization indicate that these mechanisms are neither more nor less effective vis-à-vis time-to-market in firms with up to 500 employees (“traditional” SMEs) than they are in firms with more than 500 employees. On the other hand, a high degree of centralization, which already displays a detrimental main effect, seems to be even more harmful for traditional SMEs than for larger firms. SMEs might thus resemble larger MNEs when it comes to the application of formalization and socialization to orchestrate internationally dispersed R&D activities, but should be even more cautious with regard to centralization.

Our study contributes to academic research and management practice in several ways. First, it sheds light on the burgeoning phenomenon of SMEs with international R&D activities. In particular, we help close the knowledge gap on the coordination mechanisms that allow SMEs to orchestrate their international R&D activities successfully. Second, we provide indications that the effects of the diverse coordination mechanisms are moderated by R&D task complexity. Besides Noorderhaven and Harzing (2009), our study is among the first to concern itself with factors moderating the effects of coordination mechanisms. In so doing, it can show that centralization and formalization are not uniformly “good” or “bad,” but that their effects depend on the nature of the task that has to be coordinated. Third, this study extends the SME literature and sheds light on medium-sized firms that usually “fall between the cracks” of the “traditional” international SME and the large-firm-centered international coordination literatures, even though these medium sized firms constitute a considerable share of all firms with

international activities (Simon 2009). Our findings suggest that these intermediate firms with up to 2500 employees basically resemble “traditional” SMEs (with 500 employees or less). Specifically, we do not observe significant differences in the effects exerted by coordination mechanisms across both types of firms, except that the detrimental effect of centralization is even more pronounced for smaller firms than for their bigger counterparts. Fourth, by using time-to-market as a measure for innovation performance, we respond to the call for more research on this important yet neglected construct (Keupp et al. 2012). Fifth, our research holds important management implications for SMEs since it focuses on coordination mechanisms, which represent “some of the most powerful strategic levers” the managers can pull to realize their intentions (Gulati et al. 2009, p. 575; Persaud 2005).

The article is organized as follows. In the next section, we review the literature on coordination mechanisms. Section 3 provides our theoretical frame work, i.e., the evolutionary theory of organizations, and develops our hypotheses, before Sect. 4 describes sample, data collection, as well as our methodological approach. Section 5 presents the results of this study. In Sect. 6, we discuss the results and conclude with theoretical and managerial implications.

2 Literature review

Coordination is defined as the alignment and integration of value-adding activities which are interdependent but performed by different entities (Martínez and Jarillo 1991; Srikanth and Puranam 2011; Thompson 1967). The literature traditionally emphasizes three mechanisms that firms apply to accomplish coordination. This “common threefold conceptualization” of coordination mechanisms comprises centralization, formalization, and socialization (Sundaram and Black 1992, p. 742; also see Ambos and Schlegelmilch

2007; Nobel and Birkinshaw 1998). Centralization refers to the distribution of decision rights between the parent firm and its subsidiaries. In highly centralized MNEs, decision-making power is retained at the parent firm, whereas subsidiaries are very autonomous in MNEs characterized by a low degree of centralization (Ambos and Schlegelmilch 2007; Nobel and Birkinshaw 1998). Formalization designates “the extent to which rules, procedures, instructions, and communications are written” (Pugh et al. 1968, p. 75). Organizational socialization is the process by which “an individual is taught what behaviors and perspectives are customary and desirable within the work setting” (Gupta et al. 1999, p. 210). Most research on coordination has tackled large MNEs. Studies focusing on large firms have analyzed the effects of centralization, formalization, and socialization on the extent of intra-firm knowledge exchange (Björkman et al. 2004; Daft and Lengel 1986; Galbraith 1973; Ghoshal et al. 1994; Gupta and Govindarajan 2000; Noorderhaven and Harzing 2009; Tsai 2002), on subsidiary initiative-taking and development (Birkinshaw and Hood 1998; Birkinshaw 1997; Birkinshaw et al. 1998; Paterson and Brock 2002), on innovation creation (Ghoshal and Bartlett 1988; Kleinschmidt et al. 2007; Persaud 2005; Zaltman et al. 1973), and on firm performance (Adler and Borys 1996; Adler 1999; Barczak and McDonough 2003; Kawakami et al. 2012). What is largely missing in this stream of research is an examination of time-based measures, even though time-based measures (e.g., speed of the innovation process; achievement of delivery-time goals) play a critical role in a firm’s competitiveness (Kerssens-van Drongelen and Bilderbeek 1999; Keupp et al. 2012; Vesey 1991) and can be especially appropriate to indicate the efficiency of coordination efforts. The faster an organization accomplishes a task in need of coordination, the more efficient the coordination among the involved parties tends to be (Kownatzki et al. 2013).

Further, even though work on the application of coordination mechanisms is extensive, comparatively little attention has been paid to the effects of coordination mechanisms in smaller firms. This one-sided allocation of attention is detrimental as it has been pointed out repeatedly that different coordination mechanisms might be appropriate for firms of different sizes to accomplish given activities (Acs and Audretsch 1990; Qian and Li 2003; Terziovski 2010). Thus, the effects observed in a sample of very large firms might not hold for small firms, and scholars should be cautious not to transfer insights prematurely from one size class to another. Exceptions that have analyzed coordination mechanisms in the small firm context include Terziovski (2010) and Kawakami et al. (2012) who observed that formalization can enhance SME performance. Caruana et al. (1998) found that increasing centralization limits the entrepreneurial orientation of exporting SMEs, while formalization may increase it. Moreover, Cosh et al. (2012) also find that formalization can enhance SMEs' innovation performance, whereas centralization produced a negative effect on innovation performance in their study. Our study joins these rare efforts. To the best of our knowledge, it is the first effort to investigate the mechanisms by which SMEs coordinate their international innovation activities.

Finally, previous coordination research has scarcely discussed factors that can moderate the effect of coordination mechanisms. Studies applying a typology of subsidiary roles and suggesting significant differences in the prevalence of centralization, formalization, or socialization across different subsidiary roles tend to implicitly acknowledge the existence of moderating factors (e.g., Ambos and Schlegelmilch 2007; Birkinshaw and Morrison 1995; Gupta and Govindarajan 1991; Nobel and Birkinshaw 1998). Noorderhaven and Harzing (2009) explicitly consider the interaction effect between centralization and intensive social exchange across MNE units on the extent of

knowledge sharing within MNEs. The general scarcity of research along these lines is detrimental as it impedes our understanding of the conditions under which specific coordination mechanisms are particularly useful.

By using the time-to-market of product innovations as its outcome variable, by examining SMEs, and by introducing R&D task complexity as a moderator of the relationships between coordination mechanisms and time-to-market, our study intends to help close the three identified gaps.

3 Theoretical framework and hypotheses

Multiple reasons suggest using an evolutionary perspective for our purposes. First, Kogut and Zander's (1993) article demonstrates the significance of the evolutionary perspective for studying cross-border activities of multinational corporations (Tallman 2003). Second, the activities with which this perspective is concerned explicitly include "the patterning of particular ways of attempting to innovate" (Nelson and Winter 1982, p. 133). Third, the evolutionary perspective acknowledges the importance of organizational structures—of which centralization, formalization, and socialization are parts (Gulati et al. 2009; Persaud 2005; Pugh et al. 1968)—for the performance of such activities and the resulting outcomes (Dosi and Marengo 2007; Gavetti and Levinthal 2004; Nelson and Winter 1982). Finally, the evolutionary perspective views the speed with which firms perform relevant activities as a critical factor for their competitiveness (Kogut and Zander 1993; Nelson and Winter 1982). We therefore build on the evolutionary theory of organizations to examine the effect of organizational structures (coordination mechanisms) by which SMEs govern their international innovation activities on the time-to-market of SMEs' product innovations.

The evolutionary theory of organizations emphasizes the emergent and path-dependent nature of organizational structures and activities (Dosi and Marengo 2007). Organizational structures emerge and evolve through the interplay of various factors such as deliberate action of boundedly rational agents, unintentional outcomes of their actions, and “random events” (Dosi and Marengo 2007; Nelson and Winter 1982, p. 4). Although organizational structures can in principle be modified, the structures present at any given time tend to be relatively fixed for the moment and constrain and shape the agents’ current actions (Dosi and Marengo 2007; Nelson and Winter 1982). Similarly, their actions are constrained by the existing organizational routines. An organizational routine is “a bundle of coordinated activities that evolves slowly through local learning and typically involves substantial elements of tacit knowledge and context dependence” (Gavetti and Levinthal 2004, p. 1313). Routines guide organizational members in performing their tasks. By performing his/her task, each organizational member generates a stream of messages that other members react to. By adhering to established routines in performing their tasks, organizational members help the recipients of their messages to react correctly and smoothly. By facilitating coordination among members, routines can thus contribute to superior organizational performance (Nelson and Winter 1982). When organizational members try to deviate from established routines—or try to create new routines where none existed before—they introduce “some hesitation and awkwardness” into the organization and do so “at an opportunity cost in terms of forgone uses of conscious attention” (Nelson and Winter 1982, p. 85). These remarks illustrate a central assumption of the evolutionary theory of organizations, namely that transmitting knowledge is not costless, but time consuming and expensive (Nelson and Winter 1982; Tallman 2003). The speed with which firms can transmit valuable knowledge internally is a key determinant of their competitiveness (Kogut and Zander 1993). And their ability to

do so substantially depends on the organizational structures which they have implemented (Nelson and Winter 1982; Verbeke 2003).

Following the “common threefold conceptualization” of coordination mechanisms anchored in organizational structures (Sundaram and Black 1992, p. 742; also see, e.g., Ambos and Schlegelmilch 2007; Nobel and Birkinshaw 1998), we subsequently focus on centralization, formalization, and socialization to depict the coordination mechanisms by which SMEs with internationally dispersed R&D activities orchestrate these activities. We develop three hypotheses to study the effects of the three specific coordination mechanisms on the time-to-market of an SME’s product innovations. Afterward, our analysis goes beyond examining main effects since the seminal work on evolutionary theory already suggests that the “importance and efficacy of [... organizational structures] may be expected to vary among tasks” (Nelson and Winter 1982, p. 110). We therefore develop three additional hypotheses that study the interaction effects between the aforementioned elements and the task complexity of the internationalized R&D activities.

3.1 Hypothesis 1: The main effect of *Centralization*

Centralization refers to the distribution of decision rights between the parent firm and its subsidiaries. In highly centralized MNEs, decision-making power is retained at the parent firm, whereas subsidiaries are very autonomous in MNEs characterized by a low degree of centralization (Ambos and Schlegelmilch 2007; Nobel and Birkinshaw 1998). We expect that a multinational SME, which has highly centralized decision-making for its international innovation activities needs a lot of time to introduce product innovations to the market.

A major advantage of internationalizing R&D activities is that foreign subsidiaries can typically interact more extensively and closely with local actors than can their sister

units situated elsewhere (Mu et al. 2007). As a consequence, they can usually assimilate more knowledge from their local environment (Andersson et al. 2001, 2005; Mudambi and Zahra 2007), which allows them to create capabilities that might be unique within the MNE (Cantwell and Mudambi 2005) and to recognize opportunities in their local market (Ambos et al. 2010; Birkinshaw et al. 2005). If decision-making power is decentralized, they can devise responses to these opportunities on their own and, e.g., modify existing products to meet local needs. A high degree of centralization, in contrast, is likely to impede such responses. In a highly centralized MNE, a subsidiary that becomes aware of a promising opportunity in its local market has to communicate its observation—and potentially any ideas on how it would like to react—to its parent firm so that the latter can decide on these issues. Evolutionary theory suggests that these processes take time. First, it acknowledges that communication is rarely perfect (e.g., Nelson and Winter 1982, p. 67). Information that the recipient finds essential might be left out, misunderstood, or get lost, causing a need for clarification and delay (Ross and Staw 1993; Shimizu 2007). Second, the information the foreign subsidiary needs to transmit to the parent firm is easily ambiguous to the latter as it contains elements that are specific to the subsidiary's environment and to its capabilities (cf. Nelson and Winter 1982, pp. 73, 91). In order for the parent firm to base appropriate decisions on this information, ambiguity should be reduced. While reducing ambiguity is possible, it is time-consuming, costly, and not totally effective (Nelson and Winter 1982, p. 89). Third, parent firm managers must generally deal with numerous issues and do not have the capacity to attend to each of them immediately (Nelson and Winter 1982, p. 67). These reasons especially apply to SMEs. For one thing, SMEs tend to rely heavily on knowledge that emerges in their environment, e.g., on spillovers from R&D centers of larger firms, local universities (Acs et al. 1994, 2008), and other non market institutions (Corredoira and McDermott 2014).

For another, managerial capacity is a particularly scarce and highly stressed resource in smaller firms (Acs and Preston 1997; Lu and Beamish 2001). Therefore,

Hypothesis 1: The more an SME has centralized decision-making for its international innovation activities, the more time it will need to introduce product innovations to the market.

3.2 Hypothesis 2: The main effect of *Formalization*

Formalization designates “the extent to which rules, procedures, instructions, and communications are written” (Pugh et al. 1968, p. 75). We expect that a high degree of formalization of its international innovation activities will shorten the time that a multinational SME needs to introduce product innovations to the market.

In evolutionary theory, successful communication among organizational members is crucial for a smooth functioning of the firm (Nelson and Winter 1982, p. 104). A firm runs smoothly when its members perform appropriate jobs at any given time (Nelson and Winter 1982, p. 100). Information about which job is appropriate in a specific situation is contained in messages they receive from other organizational members. To actually select the appropriate one from the repertoire of possible jobs, members have to interpret incoming messages correctly (Nelson and Winter 1982, pp. 100, 104). A lapse in doing so tends to have “disruptive effects on organizational performance” (Nelson and Winter 1982, p. 107). Formalization can help firms avoid such disruptions as it typically reduces the ambiguity that occurs in communication, especially if the involved parties are spread internationally and do not share the same background (Ghoshal et al. 1994; Kogut and Zander 1993). By reducing such disruptions, formalization contributes to a shorter time-to-market of product innovations.

Moreover, formalization contributes to the routinization of decision-making (Nobel and Birkinshaw 1998). It is a core assumption of evolutionary theory that the routinization of activities contributes to the smooth functioning of a firm by facilitating the interpretation of incoming messages and by suppressing deliberate choice and hesitation (e.g., Nelson and Winter 1982, pp. 85, 104). Eliminating hesitation should also speed up the innovation process.

Insights into previous research suggest that the positive effect of formalization on the time-to-market of a firm's new products is particularly likely to materialize in small firms. While the overall findings on the impact of formalization on innovation-related outcomes are mixed (Cardinal 2001; Salomo et al. 2007; Tatikonda and Montoya-Weiss 2001), several scholars have pointed out that high levels of formalization can have a positive effect if firms refrain from adopting an undifferentiated approach to formalization, but choose its content and scope wisely (Baum and Wally 2003; Cardinal 2001; Persaud 2005). As SMEs tend to experience less pressure to formalize activities than large firms (Lejarraga and Martinez-Ros 2014; Rothwell and Dodgson 1994), we expect that SMEs are in a particularly good position to apply formalization in a refined manner and make the best of it. Further, SMEs frequently rely on "off-the-shelf technologies from other fields" for their innovative activities rather than inventing the technology underlying their products from scratch (Mascarenhas 1999, p. 262).

Using known technologies in product development facilitates the codification of the involved knowledge (Kogut and Zander 1993). Improved codification, in turn, can lead to a faster transfer of knowledge (Zander and Kogut 1995) and should hence further contribute to the positive effect of formalization on the speed with which firms can introduce product innovations. Therefore,

Hypothesis 2: The higher the degree of formalization of its international innovation activities, the less time an SME will need to introduce product innovations to the market.

3.3 Hypothesis 3: The main effect of *Socialization*

Through socialization, organizational members develop common expectations and shared values that promote likeminded decision-making (Nobel and Birkinshaw 1998, p. 483). Evolutionary theory suggests that a high degree of socialization in international innovation activities will shorten the time that a multinational SME needs to introduce product innovations to the market.

The idea of the firm as a social community is “central” to evolutionary theory (Kogut and Zander 2003, p. 511). Socialization facilitates coordination as it contributes to the emergence of joint goals and a common understanding of how tasks may be performed (Nelson and Winter 1982, p. 120; Tallman 2003). It fosters the routinization of individual behavior (Kogut and Zander 2003). Thus, organizational members can better assess what their colleagues expect from them, what they need, and how they will behave. Shared goals can increase the willingness of knowledge-holding subsidiaries to share their knowledge with other units—subsidiaries that only pursue their own ends might refrain from transferring valuable knowledge to other units fearing that losing control over a valuable resource weakens their position of power within the MNC (Björkman et al. 2004; Mudambi and Navarra 2004). Shared goals further reduce remaining ambiguities (Brown and Eisenhardt 1995). These effects ease internal knowledge exchange (Tallman 2003) and add to the routine functioning of the firm (Nelson and Winter 1982, p. 120). We expect socialization mechanisms to be particularly powerful in SMEs (Di Gregorio et al. 2009; Yetim and Yetim 2006). Due to their smaller headcount

compared with larger firms, every employee who is exposed to socialization represents a larger share of the workforce in smaller than in larger firms. This, in turn, increases the odds that further employees interact with someone who has been exposed, which fosters the diffusion of joint goals and a common understanding. Their continuing interaction will subsequently further strengthen joint goals and common understanding. Hence,

Hypothesis 3: The higher the degree of socialization of its international R&D staff, the less time a multinational SME will need to introduce product innovations to the market.

3.4 Hypothesis 4: The interaction effect of *Centralization* and *Task Complexity*

While Hypothesis 1 highlighted why centralization tends to slow down the innovation process, we do not expect that centralization is equally bad for the time-to-market across diverse conditions. Rather, centralization may be more advantageous when the multinational SME has internationalized very complex R&D tasks. Complex tasks are characterized by considerable interdependencies (Gupta and Govindarajan 1991). When they are dispersed internationally, various units of the multinational SME will become dependent upon each other's actions. Such interdependencies, in turn, yield a substantial need for coordination among units (Ambos and Schlegelmilch 2007). If coordination is decentralized, the involved units will have to interact extensively with each other. These interactions are subject to the problems outlined above, viz. imperfection of communication, ambiguity caused by differences in units' environments and capabilities, and limited capacity to attend to incoming messages immediately. If coordination fails and a unit does something other units did not expect, "amplified disruptive effects on organizational performance" (Nelson and Winter 1982, p. 107) can occur as every attempt to cope with such a deviation may result in further departures from existing routines.

Therefore, Nelson and Winter (1982, p. 116) conclude: “In functioning complex systems [...], it is highly unlikely that undirected change in a single part will have beneficial effects on the system.” Such “undirected change in a single part” is less likely to occur when decision-making is retained at the parent firm. Moreover, even though the above problems might also impede communication between the parent firm and a foreign R&D unit, they are probably much more pronounced when the coordination of complex tasks has to be attained by decentralized efforts: When diverse interdependent units have to interact with each other and coordinate themselves, the amount of communication typically exceeds the amount of communication that is necessary when decision-making is centralized (Ghoshal et al. 1994). With complex tasks, centralization hence reduces the likelihood that the above problems manifest themselves and delay the innovation process. We therefore expect SMEs to benefit from centralization when coordinating complex tasks. It might well be that these positive effects of centralization are less pronounced in large firms as the latter tend to offer a broader product portfolio and serve more markets than smaller firms (Terziovski 2010; Vossen 1998). The diversity of their product portfolio and the multitude of markets served may restrict the extent to which decision-making can be efficiently centralized at headquarters in large firms (Birkinshaw and Morrison 1995; Rugman and Verbeke 1992). Rather, a large product portfolio and a huge variety of markets served stimulate the emergence of geographically dispersed centers of excellence within the firm that assume international responsibility for specific products or markets within the multinational corporation (Frost et al. 2002; Holm and Pedersen 2000). Yet, as our focus is on small firms,

Hypothesis 4: There is an interaction effect between centralization and R&D task complexity such that the more complex the internationalized R&D tasks are, the more beneficial centralization becomes for the time-to-market.

3.5 Hypothesis 5: The interaction effect of *Formalization* and *Task Complexity*

Hypothesis 2 explains why formalization tends to contribute to a short time-to-market. However, we also expect the benefits of formalization to diminish as task complexity increases.

First, when a task is highly complex, it becomes extremely cumbersome to identify, specify, and explicate all relevant alternatives ex ante in order to encode them in rules and documents (Noorderhaven and Harzing 2009). A firm which still aims to do so will probably have to devote considerable resources to this endeavor and spend a lot of time on it. These effects may prolong the time-to-market. Second, a high degree of formalization can impede the adaptation of routines, even if the routines do not work very well and adapting them would be appropriate (Crozier 1964; Kieser and Walgenbach 2003). This is because employees might be afraid of being held accountable for the poor performance and therefore look for ways to exculpate themselves. Following existing rules word-for-word is one possible way for them to demonstrate that they have done exactly what was expected of them. This leads to the paradoxical result that rules and routines are frequently reinforced when they should rather be changed (Kieser and Walgenbach 2003). The more formalized the underlying rules are, the more likely this paradoxical situation is to emerge because formalization tends to increase the specificity and reduce the vagueness of rules (Manolopoulos et al. 2011; Pugh et al. 1968). As high levels of complexity aggravate identifying, specifying, and encoding all relevant alternatives in formal rules ex ante (Noorderhaven and Harzing 2009), complexity increases the likelihood that formal rules turn out to be inappropriate, yet are closely followed by employees for reasons of exculpation.

As SMEs are typically characterized by resource scarcity (Acs and Preston 1997; Lu and Beamish 2001), they can usually devote fewer resources to their planning

endeavors than larger firms (Lejarraga and Martinez-Ros 2014). As a consequence, the difficulties to absorb complexity and formulate appropriate rules in complex situations ex ante are likely to be pronounced for SMEs. Therefore,

Hypothesis 5: There is an interaction effect between formalization and R&D task complexity such that the more complex the internationalized R&D tasks are, the less beneficial formalization becomes for the time-to-market.

3.6 Hypothesis 6: The interaction effect of *Socialization* and *Task Complexity*

Hypothesis 3 argues that a high degree of socialization tends to be associated with a short time-to-market. We expect that this beneficial effect becomes even stronger when a firm internationalizes highly complex R&D tasks.

Socialization fosters the emergence of shared values, beliefs, interests, and understanding among organizational members (Ouchi 1980; Turner and Makhija 2006). As highly socialized organizational members tend to accept the organization's goals as their own, socialization reduces differences between individual and organizational goals and hence promotes goal congruence among members and reduces their inclination to behave opportunistically (Perrone et al. 2003). For instance, this effect could increase subsidiaries' willingness to share valuable knowledge with other units, even though they relinquish control over a potential source of power by doing so (Björkman et al. 2004; Mudambi and Navarra 2004). Sharing the same values and beliefs typically makes people interact more intensely and exchange knowledge more extensively (Bresman et al. 1999; Zander and Zander 2010). Such increases in knowledge exchange should be particularly useful when a group of individuals strives to accomplish a complex task, in which individuals depend heavily on one another and in which higher needs for coordination and adjustments arise (Turner and Makhija 2006). Moreover, sharing the same beliefs and

understanding, they “could leave many things unsaid and could start from a point of substantial agreement,” resulting in a fast and consensual exchange (Wilkins and Ouchi 1983, p. 476). Highly socialized employees should also be more likely to help their colleagues resolve any problem that might emerge because cooperative behavior is encouraged by their tendency to accept “short-term imbalances in rewards” (Perrone et al. 2003, p. 427). Such cooperativeness seems to be particularly valuable in complex tasks, in which problems are more likely to occur. These arguments can be expected to apply especially to SMEs. As outlined in Hypothesis 3, the smaller headcount of SMEs and the higher exposure of SME employees to socialized colleagues are likely to increase the effectiveness of socialization mechanisms (Di Gregorio et al. 2009; Yetim and Yetim 2006). Therefore,

Hypothesis 6: There is an interaction effect between socialization and R&D task complexity such that the more complex the internationalized R&D tasks are, the more beneficial socialization becomes for the time-to-market.

4. Data and methods

4.1 Data sample and data collection

In order to test our hypotheses, we collected data through a survey among Swiss and German small and medium-sized enterprises. Several reasons speak in favor of this country focus: Switzerland and Germany feature a relatively large number of small and medium-sized companies, and Swiss and German firms exhibit a high degree of internationalization, also with respect to R&D (Hollenstein 2005; von Zedtwitz and Gassmann 2002). For data collection, we contacted different industry associations (SwissMEM; ICTSwitzerland; Medtech Switzerland; the German Chamber of Commerce & Industry; Switzerland Global Enterprise). We specifically asked for companies that

established at least one R&D subsidiary in a foreign country at least 5 years prior to the survey. In order to gain a more comprehensive picture of relatively small multinational enterprises, we focused on high-tech, small and mid-sized companies with a company size of up to 2500 employees (see the subsequent paragraph for more details on this sampling choice). This resulted in a list of 660 companies with direct contact to top management. We contacted the top management of each company by mail to ask for participation in this survey. The survey was conducted from July 2013 to February 2014 and yielded 107 completed responses of individual companies. We excluded responses of four companies because of too much missing data. The final sample hence comprises 103 companies with no or only few missing data, giving a response rate of 15.6 %. These companies represent more than 200 international R&D subsidiaries. To a large extent, these companies are active in the manufacturing industry. Most of them operate in niche markets; the average R&D intensity amounts to 8.3 % of firm sales and average firm size to 879 employees.

4.2 Firm size as a sampling criterion

As per definition, a multinational enterprise is a firm that operates across borders—i.e., maintains at least one subsidiary in another location than its home country—regardless of the amount of people it employs (Bartlett and Ghoshal 1998). However, international management research often adopts a focus on very large firms with multibillion revenues, sites in dozens of countries, and several ten-thousand employees (e.g., Bartlett and Ghoshal 1998; Birkinshaw 1997; Birkinshaw et al. 1998; Ghoshal and Bartlett 1988; Gupta and Govindarajan 2000; Rugman and Verbeke 2004; Tsai 2002). In contrast, the SME literature typically studies companies with less than 500 employees (Mazzucato and Parris 2014; OECD 2005). Firms of an intermediate size with up to 2500 employees are caught between these extremes, but constitute highly relevant objects of research since

they represent a considerable share of all companies with international activities (Simon 2009).

Previous research has occasionally argued that overall firms that slightly exceed the 500 employee threshold are more likely to resemble SMEs with international activities than the very big MNEs frequently emphasized in the international management literature and included them in studies on SME internationalization (e.g., Karagozoglu and Lindell 1998). We followed this example and focus on firms with up to 2500 employees, especially as doing so allows us to examine whether the coordination mechanisms exert substantially different effects across “traditional” SMEs with 500 employees or less and somewhat larger firms (see the supplementary analysis in Sect. 5.1).

4.3 Measures

The measures applied in this survey are based on existing, validated scales when possible. Most measures consist of multi-item constructs where each item was measured on a seven-point Likert-scale anchored at “strongly agree” (1) and “strongly disagree” (7), unless stated otherwise. We calculated a composite score for each multi-item construct that equals the mean of its corresponding items (Kellermanns et al. 2012; Keupp et al. 2011).

4.3.1 Dependent variable

Following previous research (e.g., Baker and Sinkula 2007; Perols et al. 2013; Tatikonda and Montoya-Weiss 2001), a seven-point scale was used to depict the time-to-market of a firm’s product innovations relative to industry standards. A value of “1” indicates that a firm needs much more time to develop the products in its portfolio than its nearest

competitors in the industry do. In contrast, a value of “4” means that its development speed equals industry standards, and a value of “7” indicates that the firm develops its products much faster than comparable firms.

4.3.2 Independent variables and moderator

The constructs for the coordination mechanisms centralization, formalization, and socialization are based on previous studies utilizing these mechanisms within the context of global R&D (Ambos and Schlegelmilch 2007; Manolopoulos et al. 2011; Martínez and Jarillo 1989; Nobel and Birkinshaw 1998). Centralization of decision-making for international innovation activities was measured as the degree to which a decision is taken by the headquarters versus the subsidiary regarding the direction of subsidiaries' innovation activities and definition of subsidiaries' documentation standards and innovation project norms ($\alpha = 0.746$). Formalization of international innovation activities measures the degree to which a company applies formalized procedures for technical documentation and communication standards ($\alpha = 0.697$). The construct socialization of international R&D staff is based on the degree to which a company uses expatriates or international training programs in foreign subsidiaries with innovation activities ($\alpha = 0.694$). Dispersed tasks vary in their degree of complexity (Mudambi 2008), and thus the moderator variable degree of R&D task complexity measures how complex the innovation tasks handled by the subsidiaries are. We weighted different activities based on their complexity with pure maintenance being the least complex (rated 1 point), followed by engineering with little complexity (2 points), product development being moderately complex (3 points), and research being the most complex one (4 points). We included activities in our calculations if they made up at least 5 % of a respondent's total activities. To determine the overall degree of R&D task complexity, we summed up the

points given for the R&D tasks affected by international coordination, yielding scores for task complexity ranging from 1 (i.e., low task complexity) to 10 (i.e., very high task complexity). All independent variables and the moderator were standardized prior to calculating interaction terms and conducting regressions (Aiken and West 1991).

4.3.3 Control variables

We included common control variables for studies in the field of international R&D. In particular, we control for firm size (logged) measured by the logged number of fulltime employees, for R&D intensity measured as R&D expenditures relative to sales, for firm age (logged) measured in logged years and for industry affiliation (even though most respondents are active in the machinery industry).

4.4 Common method variance, reliability, and validity of measures

Following the recommendations by Chang et al. (2010) and Podsakoff et al. (2003), we employed multiple procedural (ex ante) and statistical (ex post) approaches to rule out single respondent bias and common method variance (CMV). The procedural approaches included: different question for mats and scale anchors for our constructs; a cover story to create a psychological separation between independent and dependent variables; counterbalancing the question order; assuring respondents of the anonymity and confidentiality of our study and that there are no right or wrong answers, and to answer as honestly as possible (Podsakoff et al. 2003). In terms of statistical remedies to counter CMV, we employed Harman's one-factor test which indicated no bias caused by CMV (three factors emerged, the first only explaining 27.28 % of the variance; see Podsakoff and Organ 1986). We also ran a factor analytic model in which all items of our key constructs (independent and dependent variables) were forced to load on only one factor.

The poor-fit indices displayed by this model (CFI = 0.501; AGFI = 0.576; TLI = 0.252) suggest that common method bias is not a problem in this study (Menon et al. 1996). Overall, the various approaches unanimously suggest that our results are unlikely to be biased substantially by CMV.

The reliability and validity of our scales were tested using diverse approaches. All of these methods consistently indicate high levels of reliability and validity. Their reliability was examined by calculating Cronbach's alpha (Nunnally and Bernstein 1994). Convergent validity was assessed by applying principal component factor analysis with oblique rotation.¹ Our items formed three scales.² Table 1 details loadings, cross-loadings, and communalities for these items. High direct factor loadings and low cross-loadings indicate a high degree of convergent validity (Hair et al. 1998).

Finally, discriminant validity was examined by calculating average variance extracted and comparing its square root to the correlation coefficients among the scales (Staples et al. 1998). This analysis indicates high levels of discriminant validity (see Table 1).

5 Results

Table 2 gives descriptive statistics and correlations for the key variables. The table suggests that multi collinearity among variables is not an issue as all correlation coefficients are well below the value of 0.9 (Hair et al. 1998). Moreover, computing variance inflation factor (VIF) indices further alleviated multicollinearity concerns (maximum VIF = 1.71; mean VIF = 1.51; see Chatterjee et al. (2000)).

¹ We used oblique rotation because we expected the emerging factors to be theoretically related (Hair et al. 1998).

² Both the Bartlett test of sphericity ($\chi^2 = 138.577$ with 15 *df*, $p = 0.000$) and the Kaiser–Meyer–Olkin measure of sampling adequacy (MSA = 0.658) indicated the data were eligible for factor analysis. A factor was retained prior to rotation if its eigenvalue exceeded unity (Kaiser–Guttman criterion).

Table 1. Final set of oblimin-rotated factors

Item (paraphrased)	Loading on oblimin-rotated factor			
	1 Centrali zation	2 Formali zation	3 Socializ ation	Commu nality
CENT1: HQ determines foreign site innovation activities	0.8650	0.0830	0.2057	0.7975
CENT2: HQ defines documentation standards and innovation project norms	0.8777	0.1964	0.0608	0.8126
FORM1: Defined technical standards	0.2673	0.8149	0.1176	0.7493
FORM2: Defined communication standards	0.0731	0.8846	0.1039	0.7987
SOC1: Expatriates at foreign sites	0.1212	0.0584	0.8786	0.7901
SOC2: International training	0.1628	0.1749	0.8245	0.7369
<i>Eigenvalue</i>	2.56	1.12	1.01	
<i>Proportion of variance explained</i>	27.28%	25.43%	25.37%	
<i>Cumulative variance explained</i>	27.28%	52.71%	78.08%	

Bold print designates direct (main) loadings.

We applied regression analysis to test our hypotheses. While it is common practice even in the most prominent journals of the management field to base causal claims on a regression analysis of cross sectional data (see, e.g., Garriga et al. 2013; Lenox et al. 2010; Shepherd et al. 2011; Tatikonda and Montoya-Weiss 2001), readers should bear in mind that a cross-sectional design, strictly speaking, only allows to infer association, not causality. Our findings might hence be considered tentative (also see, e.g., Garg et al. 2003; Margolis and Molinsky 2008; Sidhu et al. 2007). Since the dependent variable is conditioned on values between 1 and 7, we estimated Tobit regression models (Greene 2003). We specified these models to report robust (Huber White) standard errors to correct for potential heteroscedasticity. The models were constructed incrementally by first entering only the controls in a baseline model (Model 1 in Table 3), adding the covariates of the main effects subsequently (Model 2), and the interaction effects between our independent variables and the moderator in a final step (Model 3). As the statistical software performed list wise deletion on cases where information regarding one or more variables was missing, the models use less than 103 observations. Akaike information criteria (AIC) indicate that the full model which

includes all controls, independent variables, and interaction effects fits the data best.

Table 3 documents all models and their diagnostics.

Table 2. Descriptive statistics and correlations^{a, b, c}

Variable	1	2	3	4	5	6	7	8
1 Time-to-market	1.000							
2 Centralization	-0.019	1.000						
3 Formalization	0.200*	0.336***	1.000					
4 Socialization	0.221*	0.321**	0.223*	1.000				
5 Task complexity	0.063	-0.038	0.110	-0.077	1.000			
6 Size ^c	0.030	0.029	-0.017	0.055	-0.014	1.000		
7 R&D intensity	0.017	-0.033	0.072	0.078	-0.063	0.080	1.000	
8 Age ^c	0.012	-0.066	-0.132	0.002	0.153	0.243*	-0.133	1.000
<i>Mean</i>	4.182	5.399	5.292	4.292	7.260	6.296	8.300	3.238
<i>Std. dev.</i>	1.224	1.269	1.223	1.537	2.511	1.246	8.690	1.119
<i>Min</i>	1	1	2	1.5	1	2.303	0.5	0
<i>Max</i>	7	7	7	7	10	7.824	50	5.136

^a Correlations for industry dummies are not shown; they are available from the corresponding author.

^b Spearman correlations. †p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

^c Logged variable.

The full model (Model 3) provides (tentative) support for four of our six hypotheses: for H1, which posited a negative effect of centralization on the time-to-market (i.e., that centralization slows down the innovation process), at $p < 0.01$; for H2, which asserted a positive effect of formalization on the time-to-market (i.e., that formalization accelerates the innovation process) at $p < 0.001$; for H4, which asserted a positive interaction effect between centralization and task complexity (i.e., that centralization is more beneficial for innovation speed when highly complex tasks are internationalized) at $p < 0.05$; and for H5, which posited a negative interaction effect between formalization and task complexity (i.e., that formalization is less beneficial for innovation speed when highly complex tasks are internationalized) at $p < 0.10$. In contrast, H3, which predicted a positive effect of socialization on the time-to-market, and

H6, which predicted a positive interaction effect between socialization and task complexity, fail to gain support.³

5.1 Supplementary analysis of firm-size differences

The fact that our sample includes firms beyond the “traditional” SME size limit further allows us to explore the question whether “traditional” SMEs differ from somewhat larger firms in the effects that centralization, formalization, and socialization exert on the time-to-market of their product innovations. We therefore created a dummy variable called “traditional SME” which took on the value of “1” if the corresponding firm had 500 employees or less and “0” if it was larger. Three variables were generated that captured the interaction effects between this dummy and centralization, formalization, or socialization, respectively. Subsequently, we added these three interaction terms to a model that includes all of our independent and control variables (i.e., to Model 2 in Table 3). While the coefficients corresponding to the interaction terms with formalization and socialization, respectively, were both insignificant, the coefficient corresponding to the interaction term with centralization was significant at $p < 0.05$ and displayed a negative sign. These results indicate rather minor differences across “traditional” SMEs and somewhat larger firms: While the effects of formalization and socialization do not seem to differ significantly across the two types of firms, the detrimental effect of centralization—already exhibiting a negative main effect—is even more pronounced for “traditional” SMEs than it is for their larger counterparts. See Model 4 in Table 3 for the results.

³ The main effect of socialization (H3) is relatively close to the 10%-level and the effect actually becomes significant at $p \leq 0.10$ if the full model is specified with the absolute (rather than the log-transformed) values for the two control variables *firm size* and *firm age*.

Table 3. Robust Tobit estimates for the dependent variable *Time-to-market*^{a, b, c}

	Model 1 (baseline)	Model 2	Model 3 (full)	Model 4 (supplementary)
Centralization		-0.272** (0.102)	-0.318** (0.099)	-0.283** (0.099)
Formalization		0.500** (0.171)	0.566*** (0.150)	0.523** (0.181)
Socialization		0.175 (0.106)	0.160 (0.102)	0.179 (0.107)
Centralization x R&D task complexity			0.120* (0.052)	
Formalization x R&D task complexity			-0.089† (0.047)	
Socialization x R&D task complexity			0.055 (0.043)	
Centralization x traditional SME				-0.558* (0.224)
Formalization x traditional SME				0.089 (0.314)
Socialization x traditional SME				-0.066 (0.210)
R&D task complexity		0.041 (0.081)	-0.014 (0.068)	0.058 (0.079)
Size ^d	0.053 (0.134)	-0.005 (0.165)	0.095 (0.156)	-0.011 (0.157)
R&D intensity	-0.011 (0.016)	-0.033 (0.022)	-0.025 (0.020)	-0.031 (0.020)
Age ^d	-0.071 (0.139)	-0.151 (0.135)	-0.120 (0.127)	-0.086 (0.162)
Electronics	0.303 (0.389)	-0.254 (0.345)	-0.409 (0.346)	-0.229 (0.342)
Medtech	0.098 (0.478)	0.316 (0.447)	0.270 (0.458)	0.478 (0.414)
Other	0.298 (0.352)	0.649 (0.474)	0.618 (0.448)	0.597 (0.472)
Constant	4.013*** (0.830)	2.637* (1.126)	2.335* (1.037)	2.185† (1.140)
Log-pseudolikelihood	-141.30	-93.03	-89.40	-90.79
McFadden's Pseudo R ²	0.007	0.097	0.132	0.118
F statistic (d. f.)	0.39 (6, 79)	3.11** (10, 51)	3.86*** (13, 48)	3.28** (13, 48)
AIC	298.599	210.051	208.803	211.575

^a The dependent variable *time-to-market* is anchored at '1' meaning 'much slower' and '7' meaning 'much faster' than competitors. A positive effect means that *time-to-market* relative to competitors improves, whereas a negative effect implies that *time-to-market* slows down.

^b †p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001 (two-tailed test). Robust standard errors in parentheses.

^c Machinery is the baseline category for the industry dummies.

^d Logged variables.

Additionally, we performed t-tests on the mean values of the coordination mechanisms centralization, formalization, and socialization as well as R&D task complexity to determine whether there were significant differences between “traditional SMEs” and larger firms. According to our results, reported in Table 4, the two groups of firms do not appear to differ significantly in the degree to which they apply the coordination mechanisms or in the complexity of the R&D tasks they internationalize. These results thus corroborate the conclusion that companies with up to 2500 employees tend to resemble “traditional” SMEs.

Table 4. Differences in means between ‘traditional SMEs’ and larger firms

	Mean (std. dev.) for ‘traditional SMEs’ in our sample (No. of employees ≤ 500)	Mean (std. dev.) for the larger firms in our sample ($500 < \text{No. of employees} \leq 2,500$)	Are the differences between ‘traditional SMEs’ and larger firms significant?
Centralization	5.335 (1.264)	5.415 (1.294)	Not significant
Formalization	5.346 (1.082)	5.212 (1.305)	Not significant
Socialization	4.096 (1.669)	4.392 (1.441)	Not significant
R&D task complexity	7.083 (2.535)	7.375 (2.540)	Not significant

Two-tailed t-tests were calculated.

6 Discussion and conclusion

Our study analyzed coordination mechanisms in the context of small and medium-sized enterprises which have internationalized their R&D activities. Specifically, we focus on the three “traditional” coordination mechanisms centralization, formalization, and socialization and examine their effects on the time-to-market of these firms’ product innovations. Building on the evolutionary theory of organizations (e.g., Dosi and Marengo 2007; Nelson and Winter 1982), we develop a theoretical account that not only covers the main effects of these coordination mechanisms, but also argues that the relationship between coordination mechanisms and time-to-market is moderated by the complexity of the R&D tasks which the firm has internationalized. Survey data from 103

SMEs provide broad, yet tentative support for our account, yielding significant results for four out of six hypotheses. We find that a high degree of centralization tends to prolong the time-to-market relative to industry standards, whereas a high degree of formalization makes for a rather short time-to-market. However, increasing levels of task complexity render centralization more and formalization less beneficial for the time-to-market. The result with respect to socialization is inconclusive—the significance of its main effect depends on the way two control variables are specified. These findings have several important implications for the academic literature and management practice.

6.1 Implications for the academic literature

Our study adds to our knowledge about coordination mechanisms that SMEs may apply to foster their internationalized innovation processes. While SMEs increasingly engage in international R&D activities, previous research has only rarely concerned itself with the question of how they might coordinate these activities. To begin with formalization, we add to the debate whether SMEs should mirror large firms and rely quite heavily on formalization as a coordination mechanism (Terziovski 2010) or whether they should avoid high degrees of formalization in order not to risk constraining their flexibility, which has been high-lighted as a key success factor for SMEs compared to large firms (Berends et al. 2013; Fiegenbaum and Karnani 1991; Qian and Li 2003). While their results are not unambiguously affirmative (Cardinal 2001; Salomo et al. 2007; Tatikonda and Montoya-Weiss 2001), most existing studies on the influence of formalization on innovationrelated outcomes in large firms still seem to point toward a positive effect (Adler and Borys 1996; Damanpour 1991; Kleinschmidt et al. 2007; Persaud 2005; Salomo et al. 2007). Compared to the large firm literature, the emerging literature on formalization in small firms draws an even clearer picture. Thus, the positive effect of

formalization on SME's time-to-market that we observe here is in line with previous efforts that see formalization as supportive for firm performance (Kawakami et al. 2012; Terziovski 2010), entrepreneurial orientation (Caruana et al. 1998), and innovation performance (Cosh et al. 2012). The overall findings may be less ambiguous for small than for large firms as SMEs face less pressure to formalize (Lejarraga and Martinez-Ros 2014; Rothwell and Dodgson 1994), so that SMEs may use formalization in a more nuanced manner that makes it particularly effective. That a high degree of formalization supports SMEs with international R&D activities in introducing product innovations more quickly (as our results indicate) is not only a worthwhile outcome in itself, but may also be considered a form of flexibility as it enables firms to react more swiftly to changing customer demands. Thus, formalization and flexibility are not per se mutually exclusive.

Centralization has likewise been related to flexibility. For instance, Bartlett and Ghoshal (1998) argue that centralization impacts the tradeoff between global synergy and local flexibility. Our result regarding the main effect of centralization indicates that centralization may prolong the time-to-market of a firm's product innovations. Centralization thus reduces the aforementioned flexibility of a firm to react swiftly to changing customer demands. Again, our finding is in line with existing SME research on the effect of centralization on innovation related outcomes (Caruana et al. 1998; Cosh et al. 2012). And again, the SME literature provides a clearer picture than its large firm counterpart: While the SME literature unanimously finds a negative effect of centralization on innovation-related outcomes, the large firm literature exhibits mixed results overall (Cardinal 2001; Palmié et al. 2014), even though negative effects might be dominating the large firm literature as well (e.g., Ambos and Birkinshaw 2010; Birkinshaw et al. 1998; Bresman et al. 1999; Damanpour 1991; Mudambi et al. 2007; Persaud 2005). The observation that the negative effect of centralization becomes clearer

in smaller firms is further refined by our supplementary analysis, which indicates that the negative effect of centralization is more pronounced for the “traditional” SMEs than for the somewhat larger firms in our sample. The negative effect of centralization hence seems to become more apparent, when the firms under investigation are smaller. This might be due to the fact that centralizing decision making at the firm’s headquarters efficiently and effectively requires substantial amounts of management capacity and attention, which are particularly scarce and highly stressed resources in smaller firms (Acs and Preston 1997; Lu and Beamish 2001).

Turning to the main effect of socialization, our findings are inconclusive. Depending on the way we specify two control variables, the positive effect of socialization on the time-to-market is either significant or not. The ambiguity of our finding contrasts with previous research which has quite consistently observed positive effects of socialization on innovation-related outcomes in large firms (e.g., Ghoshal and Bartlett 1988; Gupta and Govindarajan 2000; Noorderhaven and Harzing 2009; Persaud 2005; Tsai 2002). That the findings appear to be clearer for larger than for smaller firms seems surprising as we have argued in developing our hypotheses that SMEs provide a receptive context for socialization endeavors (also see Rothwell and Dodgson 1994; Vossen 1998). Unfortunately, we are not aware of any previous efforts that would link socialization to innovation related outcomes in small firms, and so we cannot assess conclusively whether the findings on socialization tend to be more ambiguous in smaller than in larger firms in general. A potential explanation for why they might be more ambiguous in SMEs is rooted in the operationalization of the socialization construct. Following many studies before us, we measure socialization as the degree to which an SME applies socialization mechanisms. However, as SMEs’ small headcount may amplify socialization forces (Di Gregorio et al. 2009; Yetim and Yetim 2006), a small

dose of socialization mechanisms might already be sufficient to set off socialization processes, which will subsequently be reinforced through a high exposure to and frequent interactions among socialized colleagues. We encourage future research to test this explanation by using more direct measures of the extent to which SME employees are socialized instead of the common measures on the degree to which firms apply socialization mechanisms.

The interaction effects between the coordination mechanisms and R&D task complexity have important implications for the literature as well. Introducing R&D task complexity as a moderator alleviates the main effects of formalization and centralization. At high levels of task complexity, formalization hence tends to become less beneficial for the time-to-market—and consequently the associated flexibility—whereas centralization becomes more beneficial. Given that previous research has reported mixed results for both centralization and formalization vis-à-vis innovation-related outcomes, identifying factors that moderate their effects provides a potential explanation for such inconsistencies and could contribute to their clarification: It shows that the effects of centralization and formalization, respectively, are not uniform across conditions, but context dependent. Thus, if two studies observe inconsistent results for centralization or formalization, it might be that their empirical settings differ in terms of this moderating factor. Future research could hence improve our understanding of centralization and formalization by paying more attention to the complexity of the tasks in need of coordination or to other moderators that it may identify. Our results regarding formalization are also very intriguing for another reason. While we find that formalization is basically beneficial for the time-to-market of product innovations, its positive effect diminishes with increasing task complexity, which suggests that SMEs might be well advised to use formalization to a greater extent when they internationalize relatively

simple R&D tasks than when they internationalize more complex R&D tasks. Before SMEs internationalize R&D tasks at all, they are typically characterized by relatively low degrees of formalization (Kawakami et al. 2012). Since firms typically internationalize simple tasks first and more complex tasks later (e.g., Vernon 1966), our findings suggest that a rather complex pattern of formalization over time might be most promising. Extending previous research which has highlighted the dynamic nature of centralization (Ambos et al. 2011), our paper points toward a potential dynamism in formalization. We would like to encourage future research to examine formalization from an explicitly dynamic perspective.

To the best of our knowledge, our study represents not only the first effort to shed light on the moderating role of R&D task complexity for the relationship between coordination mechanisms and innovation related outcomes in the small firm literature, but in the literature as a whole. Scholars should bear in mind that larger firms typically possess larger resource endowments which might allow them to better absorb complexity (Lejarraga and Martinez-Ros 2014). Therefore, complexity may affect large firms differently than small firms. We thus hope that our study inspires future research on the moderating role of complexity in large firms so that it will be possible to compare our results to those pertaining to large firms. Our paper examines firms with up to 2500 employees to improve our understanding of these medium-sized firms which are frequently neglected by previous research, even though they account for a considerable share of all companies with international activities (Simon 2009): While the “traditional” SME literature typically focuses on firms with 500 employees or less and has rarely studied the coordination of internationally dispersed activities (for a notable exception, see Caruana et al. 1998), the “traditional” MNE literature on coordination mechanisms usually draws on samples of very large firms (e.g., Bartlett and Ghoshal 1998;

Birkinshaw 1997; Gupta and Govindarajan 2000; Nobel and Birkinshaw 1998; Rugman and Verbeke 2004; Tsai 2002). The notion that coordination mechanisms might not always be equally effective across firms of different sizes (Acs and Audretsch 1990; Qian and Li 2003; Terziovski 2010) does therefore point not only toward a knowledge gap with respect to the effects that coordination mechanisms exert in small firms, but also toward the question whether the medium-sized firms with up to 2500 employees will resemble “traditional” SMEs or not. Our supplementary analysis suggests that these medium-sized firms basically resemble “traditional” SMEs when it comes to the effects of coordination mechanisms, at least as far as time-to-market is concerned. The only significant difference that we observed was that the effect of centralization is even more pronounced in the “traditional” SMEs. Future research could explore whether these findings also hold for other performance measures.

Finally, our study provides insights into the antecedents of the time-to-market of a firm’s product innovations. Time-to-market has substantial implications for the returns that a firm can reap from its innovation efforts (Vesey 1991) and is consequently one of the most important measures to assess a firm’s innovation performance in practice (Kerssens-van Drongelen and Bilderbeek 1999; Keupp et al. 2012). However, management research has rather rarely used it, resulting in calls for further research on it (Keupp et al. 2012). Responding to these calls, our findings not only show which coordination mechanisms allow a firm to shorten its time-to-market, but also underscore the potential of this performance measure for the academic literature. Time-to-market is a particularly well-suited measure to depict the effects of coordination mechanisms since succeeding coordination typically results in swift processes (Kownatzki et al. 2013). It is hence a more direct measure of coordination success as many widespread measures of innovation performance such as new product counts, the firm’s patent output, or the

market performance of new products. A reliance on more direct measures might help future research to resolve some of the inconsistencies that have been observed in the existing coordination literature.

6.2 Implications for management practice

Several features of our study are conducive to managerial implications. First, managers have so far been “left without much theory based guidance” on how they could coordinate knowledge intensive processes within multinational firms (Foss and Pedersen 2004, p. 341). This especially applies to managers of relatively small multinationals as the existing literature has primarily focused on very large MNEs. Our study adds to the theory based guidance we can offer to small and medium-sized companies with international innovation activities. In so doing, it addresses areas of high managerial relevance: First, centralization, formalization, and socialization are key elements of formal and informal organizational structures (Gulati et al. 2009; Persaud 2005) and hence represent “some of the most powerful strategic levers” available to managers (Gulati et al. 2009, p. 575). It is thus likely that managers will be able to coordinate their international R&D activities successfully if they set the degrees of centralization, formalization, and socialization appropriately. Our study provides them with insights into which degrees appear especially promising and on factors they might want to consider in setting the degrees. As more small firms internationalize their R&D activities (Narula 2004), our insights are of relevance for an increasing number of firms. Second, the time-to-market of product innovations is one of the most important measures of innovation performance used in practice (Kerssens-van Drongelen and Bilderbeek 1999). Our study illustrates what managers can do to achieve a comparatively fast time-to-market, namely to set the degrees of centralization, formalization, and socialization appropriately. As we found

rather minor differences in those mechanisms' effects across "traditional" SMEs and somewhat larger firms, our insights might still be of interest to firms that have more than 500 employees.

6.3 Limitations and paths for future research

Some paths for future research were already highlighted in the preceding discussion. Moreover, our study indicates that the evolutionary theory of organizations (Nelson and Winter 1982) can explain innovation-related phenomena in multinational firms quite well. The evolutionary theory of firms is an offshoot of the behavioral theory of firms (Cyert and March 1963) whose family comprises some further theories such as the attention-based view. The attention-based view has generated useful insights in both the MNE and the innovation literatures (Bouquet and Birkinshaw 2008; Palmié et al. 2015). We thus believe that future research can substantially advance our understanding of innovation-related phenomena, multinational organisations, and SME management by applying one of these theories. Besides pursuing these paths, future work could also address the limitations of our study. Empirically, we restricted ourselves to small multinationals from Switzerland and Germany, even though our theoretical arguments are not specific to these particular countries. Future research should therefore test the generalizability of our theoretical claims by examining different settings. Moreover, our study shares the common limitation that a cross-sectional design only allows to infer association, not causality. While the proposed direction of influence is supported by substantial theoretical reasons as well as anecdotal evidence (Foss and Pedersen 2004), future efforts should still deploy longitudinal research designs to address the question of causality more comprehensively. Until then, our results are best considered tentative (Garg et al. 2003; Margolis and Molinsky 2008; Sidhu et al. 2007). Further research could also complement

our supplementary analysis whether the coordination mechanisms exert substantially different effects in “traditional” SMEs and in firms employing up to 2500 people with an explicit comparison of SMEs and much larger MNEs. Finally, our study illustrates that the effects exerted by coordination mechanisms can depend on moderating factors. We therefore encourage future research to consider additional moderators. For instance, it has been pointed out that the innovations produced by SMEs frequently differ from the innovations produced by large firms, e.g., in terms of their radicalness (e.g., Acs et al. 1997; Audretsch 1995). Examining the effects of further moderators beyond R&D task complexity appears to be a particularly promising avenue to contribute to the comprehensiveness of our understanding regarding coordination mechanisms.

Acknowledgments: We thank SBE’s editor Gerald McDermott and two anonymous reviewers for their helpful comments.

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