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International R&D partnerships and intrafirm R&D–marketing–production integration of manufacturing firms in emerging economies

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ABSTRACT

Although cross-functional integration is important for research and development (R&D), research about implications of cross-functional integration has been rather sparse. In new product development (NPD), no study to date has examined intrafirm as well as interfirm integration of key functions such as intrafirm R&D–marketing–production together with interfirm integration of host R&D–partner R&D. Such marketing and operations interface contributes to a better understanding of how operational and marketing activities impact on competitiveness and firm performance. This study collected data from 202 electronics manufacturing firms operating in an emerging economy, mainland China and Hong Kong with international R&D partnerships. The findings indicate that a high level of R&D integration between firms improved NPD performance when cross-functional integration is based on existing rather than new product configurations and key technologies. Interestingly, in high distance situations, cross-functional integration in the production validation stage generated NPD success. The findings show that high environmental uncertainties lead to a high level of host and partner firms R&D integration. However, product newness has no significant effects on R&D integration in any of the NPD stages.

1. Introduction

In today's globalized markets, one of the ways firms respond to competitive pressures is by developing international research and development (R&D) partnerships, and strengthening cross-functional integration (Song, Thieme, & Xie, 1998; Van Dierdonck & Miller, 1980). In particular, firms in emerging markets increasingly form R&D partnerships with foreign firms to compete with established global firms and gain new knowledge such as new technologies and digitized product development processes. With rapid proliferation of new product offerings, fast changing environments and shortened product life cycles, knowledge of how integration of key functions and stages of new product development (NPD) in intra and interfirm integration affect successful operations will determine a firm's long-term competitiveness (Holland, Gaston, & Gomes, 2000; Koufteros, Vonderembse, & Doll, 2002; Verona, 1999). Operations research shows the importance of cross-functional integration among organizational functions in determining new product performance (e.g., Ernst, Hoyer, & Rübsaamen, 2010; Harryson, 1997). As global competition intensifies, it is imperative for firms operating in emerging economies (China, Brazil and India) to improve operational efficiency of functional interdependence in intra and interfirm R&D partnerships. Cross-functional integration can help firms not only generate innovation but also reduce inefficiency of information asymmetry as a result of resource and/or activity duplications among functions and between firms. Yet, no research has examined the impact of both intra and interfirm integration activities on NPD performance.

Previous studies mainly examined intra-firm interaction and collaboration among functions, e.g., marketing, logistics, R&D, finance and manufacturing (e.g., Joshi, 2010; Kahn & Mentzer, 1994; Maltz & Kohli, 2000). However, it is important to examine intrafirm integration across functions such as R&D–marketing–production together with interfirm integration of host R&D–partner R&D′ (hereafter R&D–R&D′) because interfirm NPD collaboration can be affected by intrafirm cross-functional integration (e.g., marketing–manufacturing, R&D–marketing). Consideration of both intra and interfirm integration can provide new insights into functional interdependence and new product performance success from operational as well as industrial marketing perspectives. For instance, operational demands of cross-functional activities combined with marketing's emphases such as environmental situations or situational dimensions would provide a more complete picture than separate treatment of either field of study or intra and interfirm functional integration. In NPD literature, situational dimensions include product newness, physical distance, R&D experience and environmental uncertainty (Griffin & Hauser, 1996; Jin, 2001; Lu & Yang, 2004; Olson, Walker, Ruekert, & Bonner, 2001; Song & Parry, 1997; Song et al., 1998). Since differing situational dimensions would have different degrees of impact on different types of cross-functional integration and NPD stages, it is important to understand appropriate levels of functional integration especially for an interfirm NPD collaboration spanning diverse geographical

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boundaries and market environments. Despite the increasing dominance of major emerging economies in global manufacturing, no research has yet examined the above gaps. Thus, in the context of China, the present study examines: (1) whether more host R&D–partner R&D′ integration during the NPD process result in better NPD performance; (2) how R&D integration across firms generate NPD success under different situational dimensions; and (3) how R&D–marketing–production integration within firm generates NPD success under different situational dimensions.

2. Theory and hypotheses

Cross-functional integration can be defined as operational collaboration among intra and/or interfirm functions such as NPD collaboration in terms of information sharing and cooperation involving resources across functions (e.g., Gupta, Raj, & Wilemon, 1985a & b, 1986; Song & Parry, 1992, 1993; Song et al., 1998). Functional integration has been mainly examined through resource dependency theory (Pfeffer & Salancik, 1978) and contingency theory (Lenz, 1980, 1981; Miller, 1988; Venkatraman, 1989). In terms of resource dependency theory, interdependency exists among coalitions for critical resources, in this case between functions. For example, a cross-functional team comprises individuals from different functions to apply different skills to achieve common organizational objectives such as common goals in collaborative NPD (Holland et al., 2000). Resource dependency theory posits that interdependency of resources and capabilities through integration enables firms to better cope with their environment (Ettlie, 1995; Swink, 1999). Put simply, each firm in NPD partnerships or each function in collaborative NPD shares and integrates critical resources to successfully achieve common NPD objectives. However, the extent of interdependence particularly at different NPD stages may differ in terms of internal and external resource differences and demands. For example, R&D, marketing, and production functions in an organization have different priorities and educational backgrounds, which may influence the outcome of their integration. Individual functions develop distinct skills, resources, and professional capabilities which are interdependent across organizational functions (O'Leary-Kelly & Flores, 2002; Ruekert & Walker, 1987; Sherman, Berkowitz, & Souder, 2005; Song & Swink, 2002; Verona, 1999). Thus, firms that integrate intra and/or interfirm functions would have a better control over external jolts in the environment through shared and integrated resources (Pfeffer & Salancik, 1978).

A contingency theory suggests that cross-functional integration among different departments represents an important aspect of organizational structure in terms of the types of lateral relationships, and the degree of collaboration and participation that exists between the different functions (Galbraith, 1973; Khandwalla, 1973). This is because empirical evidence shows that the relationship between functional integration and organizational performance is moderated by a firm's strategy and environment (O'Leary-Kelly & Flores, 2002). As such, the relevant contingency effects can lead to different levels of integration that affect NPD performance. Many firms are examining their product development practices and are implementing approaches such as cross-functional integration that enable them to cope with increasing uncertainty and equivocality (Koufteros et al., 2002). A contingency perspective contends that improvement in NPD performance is not simply achieved by increasing the level of integration under all circumstances, but could be contingent upon different situations (Sherman et al., 2005; Song et al., 1998; Yap & Souder, 1994). For example, new products are susceptible to a high environmental uncertainty (Huber, O'Connell, & Cummings, 1975) and increased integration may not always be beneficial to overall performance (Adler, 1995). Previous studies have shown that the relationship between cross-functional integration and NPD performance is moderated by certain situational dimensions, e.g., product newness (Jin, 2001; Song & Swink, 2002), company characteristics (Lu & Yang, 2004; Thieme, Song, & Shin, 2003), and environmental uncertainties (Lu & Yang, 2004; Song & Montoya-Weiss, 2001); and in further specific relationships between cross-functional integration in each NPD stage and NPD performance (e.g. Lu & Yang, 2004; Olson et al., 2001; Song & Swink, 2002; Song et al., 1998). Thus, emerging economy contexts such as international R&D partnerships in China may influence situational dimensions and their effects on the specific cross-functional integration and NPD performance.

It is possible to delineate four distinct NPD stages in China's high-tech industries: the initial stage, the engineering validation test (EVT), the design validation test (DVT) stage, and the production validation test (PVT) (see Table 1). Although NPD process of manufacturing industries in industrialized countries has been divided into five stages with development, test and pilot run as a separate stage (e.g., Lu, 2003; Lu & Yang, 2004), intense competition and lack of long-term R&D projects in emerging countries necessitate rapid production test to capture market demands early as opposed to implementing pilot run.

In a review of past studies on the integration of production and marketing/sales decisions, O'Leary-Kelly and Flores (2002) note that few empirical studies focused on the integration of decision areas involving the production–marketing interface. Although prior research examined functional integration of R&D–marketing, and production–marketing (e.g., Song & Swink, 2002; Van Dierdonck & Miller, 1980), research on the interface of host R&D–partner R&D′ (R&D–R&D′) in NPD under different situational dimensions has been rather sparse (see Table 2). As the relative importance of each functional specialist's role such as R&D can be interdependent and different between firms (Jin, 2001; Olson et al., 2001; Verma & Sinha, 2002), R&D partnerships and integration with other specialist functions such as marketing and production may affect NPD performance. Empirical evidence shows that integration between partners in NPD collaboration can affect NPD performance (e.g. Ettlie & Pavlou, 2006; Lichtenthaler & Lichtenthaler, 2004; Sivadas & Dwyer, 2000).

In the R&D–marketing interface, different R&D projects (situational dimensions) require different actions being taken (structural/process dimensions), which in turn affect firm performance (e.g., Ruekert & Walker, 1987). Prior research on the types and levels of cross-functional integration in each NPD stage produced inconclusive results in terms of variation of the influence of situational dimensions on the stages of NPD process. Brettel et al. (2011), Swink and Song (2007), Gomes et al. (2003), Song and Swink (2002), Olson et al. (2001) and Song et al. (1998) have found both the same as well as conflicting results for the integration of NPD stages across functions. In a survey of 236 managers from a variety of industries against five stages of NPD process, Song et al. (1998) have shown the impact of joint involvement between divisions on NPD performance may be positive, not significant, or even negative depending each NPD stage. Olson et al. (2001) have arrived at relatively similar conclusions from their survey of 34 projects in a diverse array of industries, and examined the impact of the level of cooperation between functions on NPD performance in two NPD stages—the early stage for product conceptualization and the later stage for physical production. Brettel et al.'s (2011) survey of 118 NPD projects shows varying performance implications of diverse types of cross-functional integration in two NPD stages—the development and commercialization stages. Similar results were also observed in Swink and Song (2007) and Song and Swink's (2002) studies which examined the effect of cross-functional integration across four NPD stages, and Gomes et al.'s (2003) research which examined the integration based on five NPD stages.

Some studies support early NPD involvement in marketing–production, R&D–production in later NPD stages and R&D–marketing in all NPD stages. In contrast, there is little consensus about the integration of marketing–production in later NPD stages and R&D–production in early NPD stages. Various studies have found different patterns and effects of R&D–marketing, R&D–production, or marketing–production integration under different situational dimensions (e.g. Koufteros et al., 2002; Lu & Yang, 2004; O'Leary-Kelly & Flores, 2002; Olson et al., 2001; Souder et al., 1998; Thieme et al., 2003). One possible explanation for