



The combined effects of internal and external supply chain integration on product innovation



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ABSTRACT

This research examines the individual and combined effects of internal integration (II) and external integration (EI) on product innovation. Two combined effects—balanced integration and complementary integration—are examined. Based on ambidexterity theory, the combined effects of II and EI are theorised to facilitate exploration and exploitation of external and internal knowledge, and subsequently improve product innovation. Our analysis of survey data from the Thai automotive industry ascertains that EI and complementary integration are positively associated with product innovation, but II and balanced integration are not associated with product innovation. This research is the first to provide novel insights into how exploration and exploitation of external and internal knowledge can be facilitated by internal and external integrations, and their complementary effects on product innovation, which was previously less understood. Our findings provide managerial insights for firms involved in supply chain integration implementation.

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1. Introduction

Internal integration (II) and external integration (EI) are widely accepted as having the ability to improve operational performance outcomes, such as quality, cost, delivery and flexibility (e.g., Ragatz et al., 1997; Kim, 2009; Flynn et al., 2010; Wong et al., 2011a; Prajogo and Olhager, 2012; Dröge et al., 2012). However, their impacts on product innovation are less understood. Due to their potential in facilitating exploration and exploitation, II and EI are arguably able to facilitate product innovation within and across organisations. Moreover, II and EI may, together, improve product innovation because exploitative innovations have been shown to have a positive impact on explorative innovations (Azadegan and Wagner, 2011). Even though there is already some empirical evidence which supports these arguments (e.g., Ettlie and Reza, 1992; Tassarolo, 2007; Parker et al., 2008; Lau et al., 2010), the literature is still being confronted by a lack of theoretical explanation and empirical evidence regarding the combined effects of II and EI on product innovation.

This research tests a theoretical model which explains how II and EI individually and together affect product innovation. The individual effects of II and EI are largely explained by information processing theory and relational view theory. For the combined

effects of II and EI, we refer to the ambidexterity theory from the field of organisational studies because ambidextrous firms are found to benefit from both exploitation of existing resources and exploration of new resources (March, 1991; Cao et al., 2009), and they are known to be relatively more innovative (Gibson and Birkinshaw, 2004; Jansen et al., 2006). This research offers three main contributions. The first contribution is to provide novel theoretical explanations to the individual and combined effects of II and EI on product innovation. Recent studies discover that the effects of II and EI on major operational performance outcomes are not universal. EI is distinguished as being more effective in affecting time-based performance, such as delivery and flexibility, while II is superior in affecting quality and cost, which are less dependent on time factors (Wong et al., 2011a; Schoenherr and Swink, 2012). However, it is unclear if the effects of II and EI on product innovation are indifferent, or if they follow the above logics. This research thus advances the previous studies by adding new insights into the individual and combined effects of II and EI on product innovation.

The second contribution comes from the novel approach we used to conceptualise the combined effects of II and EI on product innovation. Unlike most prior studies which tended to focus on the influence of II and EI separately (Ragatz et al., 1997; Tassarolo, 2007; Lau et al., 2010; Dröge et al., 2012), this research recognises the importance of coupling both II and EI to coordinate new product development processes within and across organisations (Hillebrand and Biemans, 2004; Koufteros et al., 2005). Based on

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ambidexterity theory, our theoretical model includes two possible methods in which II and EI work together to enhance product innovation. The first method is to allow II and EI to be balanced (called balanced integration), which is defined as achieving similar levels of II and EI to enable internal exploitation and external exploration processes to be linked without facing bottlenecks. The second method is to make II and EI complement each other (called complementary integration), which is defined as organisational efforts in complementing intra- and inter-organisational business processes to leverage the combined strengths of the pools of internal and external resources (Cao et al., 2009) or assets (Ragatz et al., 1997). According to our best understanding, these are novel conceptualisations in production and supply chain literature.

The third contribution rests on the operationalisation of the concepts of complementary and balanced integration. We adapted the method for measuring complementary and balance between exploration and exploitation by He and Wong (2004). Complementary integration is modelled as an interactional term (IIxEI) between II and EI. The interaction between II and EI has been examined by recent studies in operations and production literature (Dröge et al., 2004; Schoenherr and Swink, 2012) but no comparison with balanced integration has been made. Balanced integration is modelled as the difference between II and EI. The smaller the difference, the more balanced II and EI are. Such an approach to measure balance between exploitation and exploration has been used in organisational studies (He and Wong, 2004), but it is new to production and supply chain literature. In this research, these concepts are tested by survey data collected from first-tier automotive suppliers and automakers in Thailand, who are involved in combining II and EI efforts to facilitate new product innovation. This rigorous approach to operationalising balanced and complementary effects can be used to investigate the combined effects of II and EI on other performance outcomes.

2. Theoretical model and hypotheses

The effects of internal integration (II) and external integration (EI) on production innovation have been largely studied separately. Through interaction, communication, information sharing, coordination and collaboration across functional departments, II is known to have a positive effect on the performance of new product development and innovation (Gupta et al., 1986; Griffin and Hauser, 1996; Olson et al., 1995; Griffin, 1997; Troy et al., 2010; Wong et al., 2009). Based on the similar arguments, EI involves similar efforts between customers and suppliers, which can support joint development of new products (Ettlie and Reza, 1992; Griffin and Hauser, 1996; Handfield et al., 1999; Verona, 1999; Ragatz et al., 1997, 2002; Monczka et al., 2000; Koufteros et al., 2005; Petersen et al., 2005; Tassarolo, 2007; Lau et al., 2010; Wong et al., 2012). Though not always clearly stated, the above studies loosely draw theoretical foundations from organisational information processing theory (Wong et al., 2011b; Schoenherr and Swink, 2012) and relational view theory (Dyer and Singh, 1998) to support their arguments. So far most empirical studies above found support for these theories, with just a few exceptions (e.g., Ragatz et al., 2002; Scannell et al., 2000). To our knowledge, no study so far compares the effects of II and EI on product innovation.

Furthermore, while the individual impacts of II and EI on some aspects of product innovation have been previously studied, their combined effects are currently less understood. This is partly due to the existence of conflicting perspectives and the lack of theory. The first perspective considers II and EI as a single construct (Ettlie and Reza, 1992; Scannell et al., 2000) such that the roles of II and EI and their interactions are not revealed. The second perspective hypothesises II as antecedent of EI which, subsequently, positively

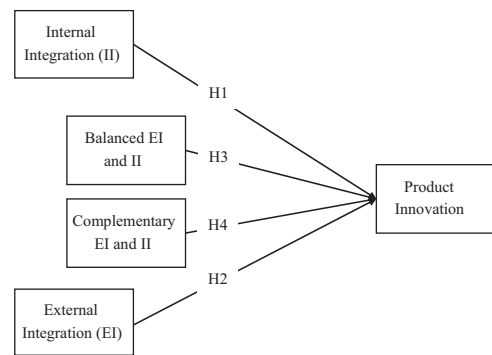


Fig. 1. The theoretical model.

affects product innovation; this perspective has so far received partial support from limited empirical results (Koufteros et al., 2005). The third perspective suggests that II and EI may affect each other (Flynn et al., 2010; Germain and Iyer, 2006; Stank et al., 2001). This perspective is further clarified by an empirical study which indicates that the complementarity between II and EI could have a positive impact on product development (Hillebrand and Biemans, 2004). Somehow, the lack of theoretical foundation hampers the above attempts to enhance the understanding of the combined effects of II and EI on product innovation.

Fig. 1 illustrates the theoretical model of this research. The first two hypotheses (H1 and H2) explain the individual effects of II and EI on product innovation. To advance the literature, we refer to organisational information processing theory (Wong et al., 2011b; Schoenherr and Swink, 2012) and relational view theory (Dyer and Singh, 1998) to explain the impacts of EI and II on product innovation. Organisational information processing theory suggests the need to gain access to market information and improve information process capability especially to remain competitive in uncertain business environments (Lawrence and Lorsch, 1967; Thompson, 1967). Relational view theory argues that a collaborative relationship instead of an adversarial relationship in a supply chain is often a better way to gain competitive advantage through complementary assets and competences (Dyer and Singh, 1998). We further relate these two theories to the concepts of exploration and exploitation (March, 1991) such that the market intelligence and new ideas owing to integrative efforts can be explored and exploited for effective product innovation. The last two hypotheses (H3 and H4) explain the combined effects of II and EI, including balanced and complementary effects, on product innovation. They are grounded on ambidexterity theory. This model is unique because it elucidates the individual effects of II and EI as well as their combined effects on product innovation. The hypothetical relationships illustrated in the model are further explained in the next sections.

2.1. External integration and product innovation

In general, EI involves the strategic alignment of business processes, information sharing and joint collaboration with suppliers and customers (Dröge et al., 2004; Koufteros et al., 2005; Flynn et al., 2010; Lai et al., 2008; Dröge et al., 2012). In the context of new product development, EI helps firms to establish mutual understanding (Petersen et al., 2005; Revilla and Villena, 2013) and gain information through network relationships (Tassarolo, 2007). Specifically, through market-directed integrative mechanisms (Ettlie and Reza, 1992), EI enables firms to acquire knowledge of customers' needs (Griffin and Hauser, 1996; Ragatz et al., 1997). Through upstream value-chain integration (Ettlie and Reza, 1992), EI shares this knowledge and product design requirements with suppliers (Clark and Fujimoto, 1991). In addition, EI supports early

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