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THE ROLE OF INTERORGANIZATIONAL COORDINATION CAPABILITIES IN NEW PRODUCT DEVELOPMENT¹

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Abstract

Scope. *The purpose of this study is to examine how information flows in collaborative new product development (NPD) across enterprises can be effectively managed. Following the information processing view of the product development process, interorganizational collaboration implies that tasks and technological capabilities are aligned for maximum effectiveness. This study proposes the concept of interorganizational coordination capability, which is proposed as a critical antecedent of NPD performance, manifested as (i) faster time to market, (ii) improved product quality and innovation, (iii) efficiency, and (iv) collaborative advantage. Whereas there is a long-standing trade-off between innovation and efficiency in NPD, this dissertation study aims to show how the co-evolution of IT coordination capabilities and task interdependencies can concurrently achieve both innovation and efficiency. This study aims to theoretically develop and empirically validate the complex interrelationship between interorganizational coordination capability and task interdependence, in addition to goal congruence, organizational interdependence, interorganizational trust, relationship specific investments, and complementary capabilities.*

Research Method. *The relevant context is the joint product development process in complex-product industries, such as the automotive industry. This study differs from prior research that focused on coordination structures at the firm level. I argue that the work unit level is also critical, because the work unit in the product development process is where most tasks occur. I will use a combination of case study and survey methodology. First, I will conduct several interviews with NPD and engineering managers, which aim to enrich the research model, provide qualitative support, and assist the development of measurement items. These interviews aim to uncover best business practices and explore how coordination capabilities are built. Second, an empirical study using a large-scale survey methodology will test the resulting hypotheses and provide quantitative support.*

Contribution. *This research has implications for the coordination of complex information flows in NPD, the utilization of coordination capabilities in interfirm NPD teams, and NPD performance. First, the study intends to shed light on how IT resources can transform into viable strategic options (coordination capabilities) that influence NPD performance and collaborative advantage. Second, it will prescribe how enterprises can effectively utilize coordination capabilities to co-evolve with the increasing information flows of NPD. Third, it will lay down how NPD groups can align their coordination capabilities with their information processing needs to concurrently achieve innovation and efficiency. From a research perspective, this study contributes to the theoretical development and operationalization of interorganizational coordination capability, a proposed key component in managing NPD processes. Finally, from a practical standpoint, the study will propose a set of critical antecedent factors that influence coordination, interdependence, and alignment and help identify ideal coordination configurations that positively influence NPD performance.*

¹The dissertation study is partially funded by the SAP America Doctoral Grant Competition Award administered by the e-Business Research Center at Pennsylvania State University. The author would like to thank his dissertation advisor Omar El Sawy and his dissertation committee members for their help and guidance.

Introduction

It is widely accepted that collaborative interfirm relationships are key for creating innovation, improving product development, and gaining a strategic competitive advantage (Dyer 2000, Dyer and Singh 1998). Despite the potential benefits of intensive collaboration, interorganizational dependencies are hard to manage (Rockart and Short 1989). Since managing interdependence within organizational boundaries has long been considered a major managerial problem (March and Simon 1958), achieving interorganizational coordination is a geometrically increasing challenge. However, information technology (IT) provides the resources to manage these interdependencies and facilitate productive collaboration. This study examines how organizations can leverage IT resources to build interorganizational IT-related capabilities to manage task interdependencies in new product development (NPD) for superior interorganizational NPD performance.

Product development requires complex information to be shared beyond organizational boundaries. Johnston and Vitale (1988) have referred to 'Inter-organizational Information Systems', which have the capacity to span across organizational boundaries and allow information flows across the supply chain (Konsynski 1993). Coordination is primarily an information-processing function, and therefore, a good candidate for support from IT (Crowston 1997). This study proposes the concept of interorganizational coordination capability as a critical factor in influencing relational value, both directly and also indirectly by matching with task interdependencies.

Interdependence has traditionally led to significant transaction risks; hence, organizations have traditionally avoided this increased risk by reduced outsourcing and vertical integration. Coordination was typically accomplished through physical and human resources that were costly and relationship-specific. Given these limitations, the extant literature has predominantly focused on contractual or governance structures at the firm level, aiming to reduce the transaction costs and risks of interfirm exchanges (Williamson 1985). Despite the focus on efficient contractual modes, organizations are now turning their traditional governance logic upside down by focusing on teams, tasks, and informal processes as the primary vehicles through which interfirm relationships are orchestrated (Moss-Kanter 1994, Sambamurthy and Zmud 2000). This study differs from prior research that focused predominantly on contractual or governance structures at the firm level. I argue that the work unit level is also critical, because the work unit is where the majority of instrumental tasks are performed, and coordination capabilities are needed toward managing tasks within interorganizational work units.

Many unused resources reside outside organizational boundaries, which can only be exploited through joint effort. The relational view (Dyer and Singh 1998), derived from the strategic management literature, offers critical insights regarding interorganizational resources and capabilities. The IS literature (e.g. Bharadwaj 2000, Sambamurthy and Zmud 2000) also adds to our understanding on the role of IT management in influencing IT-related capabilities. The basic premise of the information processing view of organizations (Galbraith 1977) and of the product development process (Clark and Fujimoto 1991) suggests a need for alignment between the information processing needs (task interdependencies) and the information processing (coordination) capabilities. This dissertation study mainly draws upon (a) the relational view, (b) IT management literature, and (c) the information processing view to theoretically develop and empirically validate the performance implications created by the alignment between interorganizational coordination capability and task interdependence in NPD. This study examines how organizations can leverage their joint efforts to create relational value, manifested through time and cost improvements, innovation and better product quality, and collaborative advantage.

Following Krishnan and Ulrich (2001), product development is viewed as a business process involving multiple information flows that can be usefully supported by knowledge and tools. NPD is a highly information-intensive activity, whose outcome is determined by the combination of complementary resources and the role of information sharing; hence, projects typically vary in terms of their overall task interdependence. According to Gulati and Singh (1998), coordination is likely to be of utmost concern in joint product development. Successful product development relies on the partner ability to leverage IT across their work units and build IT-related capabilities (Bharadwaj, Sambamurthy and Zmud 2002). Hence, the research context of the study of complex task interdependencies among enterprises is the new product development process.

This study examines the phenomenon of collaborative new product development across enterprises that leverages coordination capabilities to facilitate NPD performance through effective management of interdependent activities. To my knowledge, no studies have been reported in the alignment and co-evolution between task interdependence and coordination capabilities for superior NPD performance. Hence, this proposal aims to shed light on the following research questions:

1. How can task interdependence in the supply chain be effectively coordinated to improve NPD performance?
2. What is the nature and role of the construct of interorganizational coordination capability?

3. Does alignment between task interdependence and coordination capability influence NPD performance?
4. What is the relationship between task interdependence and coordination capabilities?
5. What other antecedent factors contribute to task interdependence and coordination capabilities?

Conceptual Development

The conceptual basis of this proposal is rooted in the organization's information processing view (e.g. March and Simon 1958, Galbraith 1977), as applied to an interorganizational level of analysis (Bensaou and Venkatraman 1995) in the product development process (Clark and Fujimoto 1991). Alignment suggests that the information processing needs (task interdependencies) are matched with the information processing (coordination) capabilities. Following the relational view of interorganizational relationships (Dyer and Singh 1998), the emphasis is on the pursuit of joint NPD performance outcomes (collaborative advantage, time to market, product quality, innovation, and efficiency) by aligning task interdependencies with interorganizational coordination capabilities. The proposed conceptual model is shown in Figure 1.

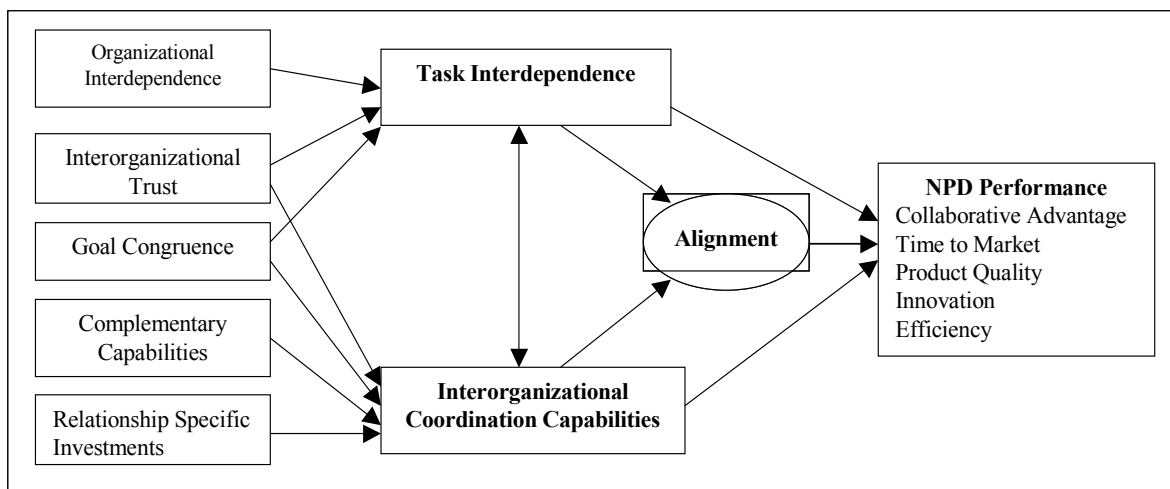


Figure 1. The Proposed Research Model

Task Interdependence

Following Scott (1981) and Andres and Zmud (2002), task interdependence refers to the extent to which a task requires work units to engage in workflow exchanges of product, information, skills, or resources, so that changes in the state of one activity affect the state of the other. Task interdependence corresponds to the workflow or internal interdependence proposed by Thompson (1967). When there is a higher volume of information flow that needs to be exchanged for task completion, task interdependencies increase. While there are multiple sources of information processing needs (Bensaou and Venkatraman 1995), this study focuses on the needs arising from task interdependencies. Thompson (1967) describes three types of task interdependence. Van de Ven et al. (1976) added another type of interdependence – team interdependence – to account for added complexities. Following these researchers, I propose four types of task interdependence – pooled, sequential, reciprocal, and team.

According to Moss-Kanter (1994), interdependence is a key factor in building successful interfirm relationships. Exploitation of co-specialized capabilities, which is an important source of relational value (Dyer 2000), is greater when task interdependencies are higher. By creating different types of interdependencies, it is possible to effectively coordinate interorganizational tasks to create relationship value (Blankenburg Holm et al. 1999). Task interdependence can be used to reduce development time and increase quality and performance (Joglekar et al. 2001). Krishnan et al. (1997) shows that overlapping sequential activities, hence increasing their interdependence, reduces development lead time. Helper and MacDuffie (2001) argue that highly interdependent activities are key sources of performance improvement. Interdependencies in supply chain problem-solving routines also affect innovative and learning processes (Sobrero and Roberts 2001). Zajac and Olsen (1993, p. 135) argue that value can be created by (a) knowing the partner's preferences and concerns as a basis for mutual gain, and (b) discovering ways in which similarities

of shared interests can be exploited to maximize cooperative joint gains that accrue to both parties. Hence, a higher level of task interdependence is positively associated with NPD performance.

Interorganizational Coordination Capabilities

Coordination refers to the mode of linking together different work units to collectively accomplish a set of tasks (Andres and Zmud 2002). Following Mintzberg (1993), I define coordination as the management of distinct interorganizational tasks, activities, and work that are shared among new product development work units. Coordination refers to the notion of workflow coordination discussed by Tan and Harker (1999). In the context of new product development, coordination is the means to overcome the difficulties of sharing information. Coordination mechanisms differ on their complexity and the burden they impose on communication and decision-making (Thompson 1967, p. 56). Following March and Simon (1958), there are two types of coordination to manage task interdependence, (a) by programming and (b) by feedback. These types of coordination correspond respectively to the centralized and decentralized control of interdependence proposed by Sikora and Shaw (1998), and organic and mechanistic coordination strategies proposed by Andres and Zmud (2002). Coordination by programming typically involves planning, rules, and programs. Coordination by feedback requires intense information flow, which Thompson (1967, p. 56) defines as mutual adjustments based upon new information.

IT capabilities are combinations of IT-based assets and routines that support business tasks in value-adding ways (Bharadwaj et al. 1999, Ross et al. 1996, Sambamurthy and Zmud 2000), and the IS literature has recently begun to view IT management as a capability. For example, Bharadwaj (2000) integrated the resource-based view with IT to propose organizational IT-related capabilities. IT has long been viewed as an enabler of interorganizational capabilities (Johnston and Vitale 1988, Cash and Konsynski 1985). Coordination is a critical interorganizational IT-related capability, described as the information processing capacity of interorganizational work units to leverage IT resources to effectively manage information flows.

Bensaou and Venkatraman (1995) indicate two distinct uses of IT: (a) IT used for better control of information flows, and (b) IT for better coordination of non-structured tasks. Nevertheless, this study describes coordination capabilities as the interorganizational capacity to coordinate information flows through both standardization and plan, and through mutual adaptation and communication. Following Crowston (1991, 1997) and Malone and Crowston (1994), coordination capability is described as the ability to accurately identify task interdependencies and employ the appropriate coordination mechanism to manage the interdependency. This conceptualization suggests that coordination capability is the capacity of work groups to create the right things at the right time and give it to the right people.

Coordination efforts are ongoing attempts to exploit existing synergies and unique opportunities (Anderson and Narus 1990). Sambamurthy and Zmud (2000) describe coordination as the realization of business value through the orchestration of complementary capabilities. Through coordination of activities in a way that creates an efficient joint workflow system, enterprises can raise the value of the relationship (Blankenburg Holm et al. 1999). For example, human asset co-specialization results in complementary utilization enabled by superior coordination and information sharing (Dyer 1997). Interorganizational coordination capabilities enable organizations to share information to facilitate the achievement of NPD performance outcomes and competitive advantages (Jap 2001). Hence, superior interorganizational coordination capabilities are positively associated with superior NPD performance.

Alignment of Task Interdependence and Coordination Capabilities

At the heart of the organization theory perspective of NPD is organizational alignment as a critical success factor (Krishnan and Ulrich 2001). Information processing theory asserts that increased information exchange is essential to manage task interdependence, which forms the conceptual basis of the alignment between task interdependence and coordination capabilities (Galbraith 1977). This perspective maintains that performance is determined by the alignment between the interdependence of the work unit's tasks and the ability of the structure to coordinate the information needed to deal with the uncertainty that interdependence essentially creates. Whereas alignment had traditionally focused on efficiency (cost-minimization) considerations (Thompson 1967), this study follows Zajac and Olsen's (1993) emphasis on joint value maximization. Alignment addresses both the issue of (a) *doing the right things* (effectiveness), and also (b) *doing things right* (efficiency).

Task interdependence gives rise to information processing needs that supply chain partners need to match with appropriate information processing capabilities for greater performance (Bensaou 1997). This argument is validated by the notion that

interdependence creates uncertainty (Bensaou and Venkatraman 1995); hence, coordination mechanisms are introduced to alleviate this uncertainty by properly coordinating information flows. Reduction in uncertainty is often associated with increased performance. Williamson (1991) argues that a coordinated adaptation enjoys advantages as the condition of interdependence increases. Therefore, NPD performance stems from matching information processing capabilities with information processing needs. In sum, alignment between task interdependence and interorganizational coordination capabilities is positively associated with NPD performance.

Co-Evolution of Task Interdependence and Coordination Capabilities

Co-evolution of task interdependence and coordination capabilities refers to the reciprocal, mutually-reinforcing integration of information processing needs with information processing capabilities. Eisenhardt and Galunic (2000) argue that co-evolution among partner organizations generates synergistic combinations. In fact, capability building refers to the interfirm ability to integrate joint resources for creating interfirm capabilities.

Eisenhardt and Brown (1999) and Eisenhardt and Galunic (2000) propose co-evolution as a strategic process where firms change their collaborative links, such as information exchanges and resources to capture collaborative advantages. Co-evolution implies an iterative loop among capabilities and tasks that allows exploitation of new opportunities (Helfat and Raubitschek 2000). For example, Srinivasan et al. (1997) argues that increasing IT capabilities make it optimal to pursue multiple concepts and select designs later in the process. In sum, co-evolution describes how firms improvise combinations of capabilities, knowledge, and resources to create value (Sambamurthy et al. 2002). In sum, there is a co-evolutionary, mutually reinforcing relationship between task interdependence and interorganizational coordination capabilities toward superior NPD performance over time.

Interorganizational Trust

The presence of interorganizational trust obliges partners to behave cooperatively. Trust allows task coordination and confidential information sharing (Dyer 1997), which further facilitates coordination. Therefore, trusting partners have easily manageable information exchange interfaces, which allow them to increase their interdependencies and work toward improving their coordination capabilities. Hence, interorganizational trust is positively related to (a) higher task interdependence and (b) superior interorganizational coordination capabilities.

Organizational Interdependence

Following Blankenburg et al. (1999), organizational interdependence is defined as the strength of motivational balanced dependence relationship between partners and the replaceability of the partner. According to Wilson (1995), there is well-defined process where organizational interdependence is transformed into task interdependence with mutual interest in coordinating activities for value creation. Hence, organizational interdependence is positively related to higher task interdependence.

Goal Congruency

Goal congruency is defined as the extent to which supply chain partners perceive the possibility of common goal accomplishment (Jap 2001). Compatibility in goals and priorities reduces the uncertainty about the partner's motives and alleviates fears of opportunistic behavior, inviting greater interdependence and coordination effort. Hence, goal congruency is positively related both to (a) higher task interdependence, and also to (b) superior interorganizational coordination capabilities.

Complementary Capabilities

Complementary capabilities in interorganizational work units are described as the paired contributions toward a joint outcome. Following Jap (1999), complementary capabilities are likely to increase the effort required to coordinate these complementary resources, resulting in superior interorganizational coordination capabilities.

Relationship-Specific Investments

Relationship-specific investments are non-fungible investments that uniquely support a supply chain relationship and cannot be readily used in other relationships (Williamson 1985). These investments promote efficiencies in coordination (Dyer 1997) and facilitate interaction patterns and coordination efforts between partners (Jap 2001). Hence, the extent of relationship-specific investments is positively related to superior interorganizational coordination capabilities.

Research Methodology

This study uses a combination of field interviews and survey methodology, allowing qualitative and quantitative materials to be used in this research design. First, the exploratory interviews with NPD and engineering managers will help refine the study's hypotheses and provide support for the chain of causality in the proposed relationships. These interviews aim to uncover best business practices and explore how coordination capabilities are built from IT resources. Hence, a primary goal of the data collection effort is to uncover ideal configurations between task interdependence and coordination capabilities. It will also aim to validate the proposed construct of interorganizational coordination capability, following the procedure of Bharadwaj et al. (2002). Second, a set of empirical studies using survey methodology will provide statistical support for the proposed set of testable hypotheses using a sample of interorganizational new product development relationships. Two empirical studies using a large-scale survey methodology will test the resulting hypotheses and provide quantitative support. The first exploratory survey will be conducted with members of the Society of Automotive Engineers, targeting NPD engineering and R&D managers. The second confirmatory study will follow the procedure of Song and Parry (1996), targeting NPD managers from both buyer and supplier firms (matched pairs) since the unit of analysis is the interorganizational work unit. A survey instrument will be created on the basis of the extant literature and scales, and also on the language of the informants, their experience to elicit responses, and pretests.

Research Context. The empirical validation of the proposed research model will be tested in the context of the product development process in the automotive industry. The automotive industry is expected to follow the trend of the PC industry, short product development, build-to-order business, and heavy reliance on IT capabilities.

Expected Contribution

The primary purpose of this study is to show that the effective management of task interdependencies in the product development process results in multiple valued outcomes for all participating enterprises. An important driver of effective coordination lies in the power interorganizational work units to exploit critical IT resources. These coordination capabilities have a co-evolutionary relationship with task interdependencies in the sense that greater task interdependence requires greater coordination, and superior coordination capabilities call for more intensive information flows. In addition, this study proposes a set of antecedent factors that influence coordination capabilities and task interdependence.

This study aims to inform research and practice about how interorganizational units can improve NPD performance by utilizing coordination capabilities. Hence, it aims to contribute to the theoretical development and operationalization of the interorganizational capability construct, aiming to entice future research on increasing IT coordination capabilities by utilizing the power of IT-related resources (Bharadwaj et al. 2002).

A key contention of this study is that NPD performance depends on the alignment between interdependence and coordination. Misalignment among these contingencies can either insufficiently handle intensive information flows, or overload the decision process by consuming time and effort. A managerial contribution of this study is to prescribe ideal configurations that reduce misalignments. From a practical perspective, this study aims to identify best practices in employing web-based software functionality to effectively manage information flows and task interdependencies in interorganizational NPD processes. Finally, since coordination capabilities are flexible strategic options that can be deployed for strategic objectives, this study aims to prescribe how managers can take advantage of these capabilities to identify new synergistic opportunities and promote beneficial organizational change.

Whereas Thompson (1967) proposed that rational organizations should coordinate task interdependence to minimize coordination costs, this study proposes that IT coordination capabilities could help enterprises align their interdependencies to create relational value, manifested both through time and cost efficiencies, but also through innovation and product quality. Following Zajac and Olsen (1993), the aim of this study is to examine value realization from aligning task interdependence with coordination

capabilities. Alignment of interorganizational coordination capabilities with task interdependencies is posited as a critical opportunity for joint gains to be realized. This dissertation study aims to uncover how interorganizational capabilities emerge from IT resources, co-evolve with uncertainty, and result in interfirm NPD performance and buyer-supplier collaborative advantage over time.

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