Interorganizational information processing and the contingency effects of buyer-incurred uncertainty in a supplier's component development project

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Shortened product life cycles, faster technology advances, and increasing global competition have forced buying firms increasingly invite their core suppliers in the early stages of new product development (NPD) to leverage the suppliers' knowledge and development capabilities for improving their development performance (e.g., cost, quality and time to market).

Boeing's experiences with the development for its 787 model give us lesson learned to this point. Boeing's 787 Dreamliner, which was jointly developed and manufactured by the company and its global suppliers, had initially been hailed as a successful "posterchild" case of global supplier involvement in NPD (Nolan and Kotha, 2005). However, despite these promising beginnings, Boeing suffered from a series of part shortages, delivery delays, and quality problems (engine failures, fuel leaks, battery fires), both while the planes were being produced and later on while they were in service. This eventually led the Federal Aviation Administration (FAA) to ground all 787s temporarily in 2013 (Koh et al., 2013). The total cost of the 787 development project amounted to over $40 billion, even more than twice the original budget (Shenhar et al., 2016).

In the comprehensive review of Boeing's 787 design and manufacturing system, the FAA and Boeing uncovered that many of the reported problems resulted from "basic communication and coordination issues" between Boeing and its suppliers (FAA, 2014, p. 12). Specifically, Boeing overestimated suppliers' design and manufacturing abilities and falsely assumed that suppliers knew how to run their businesses. As such, Boeing initially failed to transfer its tacit knowledge accumulated over decades of development experience to its supplier partners (Lunsford, 2007). Thus, Boeing's design requirements were not clearly communicated to its primary suppliers, and sometimes design responsibilities about "who does what" were not clearly delineated (FAA, 2014). Hence it is not surprising that suppliers often misinterpreted the design requirements and sometimes did not even know who was responsible for them. In addition, in cases where Boeing did not establish specific design requirements or where suppliers were not familiar with these, suppliers did not attempt to adequately verify them with Boeing or resorted to industry design standards. In conclusion, Boeing's insufficient transfer of information and knowhow, the introduction of many radically innovative technologies, numerous and late engineering change orders, and the absence of face-to-face and timely communication and coordination efforts among Boeing and its suppliers eventually effectuated design deficiencies, variability in manufacturing, and abnormal part behavior or even failures.

This case of Boeing's 787 highlights that successful supplier involvement requires adequate and accurate information exchange between the buyer and the supplier. This is in line with extant research, which empirically validates that buyer firms' interorganizational information sharing facilitates joint problem-solving, coordinates work schedules, and improves NPD project performance However, while a majority of such past research has addressed the buyer's perspective, no research has yet examined what challenges a supplier may face, as well as how the supplier can overcome these challenges to achieve its own component development objectives. In this study, we answer this questions by focusing on the role of a supplier's interorganizational information processing capabilities in driving its component development performance by explicitly taking into account project uncertainties arising from the buyer's actions.

Drawing from organizational information processing theory (OIPT), we conceptualize a *supplier's interorganizational information processing capability* (IIPC) as the supplier's ability to collect, assimilate, and integrate information from a buyer firm, and position it as critical to the supplier's component development performance. Furthermore, taking a contingency perspective, we contend that the value of the supplier's IIPC is significantly amplified or dampened by buyer-incurred project

uncertainty. We consider two types of buyer-incurred project uncertainty: task uncertainty and relational uncertainty. Specifically, we consider two sources of task uncertainty, namely a *buyer's component novelty* and a *buyer's engineering change orders* (ECOs). In addition, we view a *buyer's knowledge protectiveness* as a source of relational uncertainty. A buyer's component novelty refers to the newness of technical requirements associated with the component for the supplier. A buyer's engineering change orders refers to the buyer's alteration of parts, drawings, or software that have already been released to its suppliers during the product design process. And lastly, a buyer's knowledge protectiveness is associated with how open and willing the buyer is in terms of sharing information with its supplier. We differentiate our investigation by offering a comprehensive look at all three sources of uncertainty from the supplier's perspective, and by hypothesizing the value of a supplier's IIPC in driving better project performance to be amplified when the supplier faces either higher component novelty or higher magnitudes of engineering change orders as initiated by the buyer. In contrast, the more protective a buyer is of its knowledge, the more this will dampen the effect of a supplier's IIPC on its performance.

The hypotheses are tested with data collected from 103 supplier component development projects in South Korea. As a result, this study empirically demonstrates the significant effects of a supplier's IIPC in enhancing the supplier's component development performance. In addition, we substantiate that the magnitude of a buyer's ECOs positively amplifies the benefits of the supplier's IIPC, while the buyer's knowledge protectiveness significantly hampers it.

Within this context, our research advances understanding of supplier involvement in NPD in the following ways. First, taking a supplier's perspective, we examine a supplier's ability to process information in a component development setting as a part of a buyer's NPD project, an aspect that has not been explored in prior studies. We thus complement the buyer-centric perspective of the extant supplier involvement literature by validating the criticality of interorganizational information processing from the supplier's viewpoint. And second, we empirically substantiate the contingency effects of buyer-incurred project uncertainty on the effectiveness of a supplier's IIPC for its component development performance. Although uncertainty has been studied in prior NPD research, scant attention has been paid to how buyer-incurred—yet unintended—project uncertainty influences a supplier's component development performance. By examining such contingency effects from the supplier's perspective, we shed new light on how a buyer's behavior can influence the supplier's new component development environment.

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