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Organizational structuring and project team structuring in integrated product development project

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ABSTRACT

For a superior project result, integrated product development (IPD) project need to have stage-specific management approaches where the front-end structuring supports and strengthens the management of the project and the team during the execution stages. In the current study we focus on relationships on the organizational level variable during the front-end stage of the project, *organizational structuring*, with a project execution level variable, *project team structuring* to study the impact on product design glitches and project performance in the concurrent project environment. We hypothesize that managing the overall product development projects with integrated organizational structuring at the front stage and project team structuring during the development and project implementation stages can lead to reduced product glitches which can enhance the overall IPD project performance. We test our hypothetical model using data collected from the US automotive industry. Our data supports all the three proposed hypotheses. Discussion and implication of the empirical results, limitations of the current study, and recommendations for future studies are also provided.

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1. Introduction

Compared to the sequential approach, concurrent engineering has become a popular method to speed up new product development projects and help manufacturing firms seek competitive advantages (Hayes et al., 1988; Meyer, 1993; Patterson, 1993). In such projects various stages and activities are executed simultaneously and are generally facilitated by cross-functional teams (Jayaram and Malhotra, 2010; Koufteros et al., 2010). To find creative and innovative solutions to the engineering design problems in such cross-functional environments, experts from various disciplines work together in concurrent or parallel stages (Olson et al., 1995). Many researchers have theorized such dynamic, and complex, project environments as *integrated product development or IPD* (Krishnan and Ulrich, 2001; Gerwin and Barrowman, 2002; Rauniar et al., 2008b).

The IPD project's initial stage, also referred to as the *front end* stage, include activities such as assessments of competition, market, and technology, idea generation, project justification, action plan, etc. which are generally strategic and conceptual in nature (Khurana and Rosenthal, 1998). According to the authors, the front end stage requires organizational level analysis, planning and initiatives. Once the organization validates the new product concept to be congruent with organizational strategic agenda, the project enters into subsequent stages of development and implementation. These stages involve executing concurrent activities of detailed functional and technical design of parts and components, prototype developments, internal and external testing of components, system testing, manufacturing process design and development, etc. (Bingham and Quigley, 1990).

Despite its advantages, managing IPD projects is proven to be very challenging (Wheelwright and Clark, 1992), especially for complex products such as automobiles, which involves thousands of engineers and non-engineers of the developmental firm, client, and suppliers who spend years of designing, testing, and integrating hundreds of thousands of parts (Gokpinkar et al., 2010). Several recommendations at the individual level, team level, and organizational levels have been provided in the extant literatures in regard to the effective management and critical drivers of such complex project. For example, Backhouse and Brookes (1996) have suggested that project implementation can be improved through a good fit of the development firm's process and structure along with management focus, change, and proficiency. Koufteros et al. (2010) stressed the need of systematic and structured integration of the cross-functional team with suppliers and customers for superior project performance. Hart (1995) grouped the determinants of new product development performance into strategic and

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project level variables. Strategic level determinants included organizational culture, organizational strategy, organizational structure, and top management involvement and orientation. Project level determinants included uniqueness of the project, overall product development process, project structure, cooperation between departments, and the involvement of suppliers in new product development process. The meta-analysis of Henard and Szymanski (2001) identified four main groups of antecedents of new product development performance: firm strategy characteristics, firm process characteristics, product characteristics, and marketplace characteristics. Similarly, other important considerations in existing literature include attention to organizational issues (Bailey, 1999), team member selection (Gerwin and Moffat, 1997); individual member's characteristics (King and Majchrzak, 1996), information sharing and decision making (Rauniar et al., 2008b). Overall, past literatures have separately identified and addressed these critical issues at an individual level, team level, and organizational level, while little research work has been conducted to examine the integrated impact of these various levels on product development project performance, such as glitches in product development.

During concurrent detail design and developmental stages of the IPD project, team leaders and members are involved in intensive problem solving and decision making process. These design, development, and tradeoff decisions made across the various stages by different teams and at different point of time needs to be consistent and coherent with the needs of organization, the project purpose and its targeted customers' needs. However, past studies (Rauniar et al., 2008a, 2008b) have pointed out that maintaining and managing consistent and integrated cross-functional decisions across the project is a daunting task. Conflicting and inconsistent decisions to the engineering design solutions at different concurrent stages of the IPD project can lead to design and development of product plagued with problems, or *glitches* that can have substantial impact on project performance, such as re-work, scrap, poor resource utilization, cost-overruns, poor quality of design, poor quality of conformance, etc. Importance of quality issues of a product and firm performance has long been recognized in management literatures. Studies in quality management have identified design and conformance quality (Garvin, 1987; Cusumano and Nobeoka, 1992) as critical quality related issues during design and development of a new product. The extent of product design glitches from the knowledge management perspective in IPD projects have been reported by Rauniar et al. (2008b). Similarly the study of Koufteros et al. (2010) on product glitches highlights the importance of supplier and customer integration with the project team.

To drive superior project performance, an IPD project, from early on, needs to have a well structured management approach that aligns and promotes the downstream design and development effort with the upstream strategic planning stage. In Borenstein (2008), Associated Press writer Seth Bornestein reported that a nine month delay in project selection process among the two proposals submitted to NASA cost the agency an additional $10 million and 2 year delay for the Mars mission. This report further stated that the conflict of interest created by these project proposals also led NASA to disband its original board formed to pick the project, and had to create a new panel to select the project that would avoid any conflict of interest. Such conflict of interest and alignment issues between organizational objectives and project objectives can tax both the project and organizations in terms of money, time, and customer satisfaction. In their meta-study, Henard and Szymanski's (2001) points that product development literature has generally directed attention at capturing the effect of project process characteristics, and thereby, ignoring the organizational level variables. Our current study is directed toward improving IPD project performance by simultaneously addressing management issues of an IPD project at the organizational level during the front end stage and the project team level characteristics at the project's development and implementation stages.

The scope of our current study is conceptually outlined in Fig. 1. There are primarily two objectives of our current paper in the area of IPD projects. First, it integrates the impact of organizational-level management decisions at the front stage of a project to the project level variables of the project execution stages. In the current study we focus on the organizational level variable of front end stage of a project, *organizational structuring*, with the IPD project execution level variable, *project team structuring*. We hypothesize that managing IPD projects with organizational structuring and project team structuring can lead to reduced product glitches which, in turn, can enhance the overall IPD project performance in terms of project cost, time, and customer satisfaction. We define organizational structuring of the IPD project to the extent to which the IPD project has strategic alignment and the upfront appointment of the heavyweight product manager to lead the project. Similarly, we define project team structuring of IPD projects to the extent to which the cross-functional teams of IPD projects have a shared project mission, are integrated, and have clarity of key project target tradeoffs. As illustrated in Fig. 1, we focus organizational structuring at the front end stage of the project, while we focus project team structuring issues at the development and implementations stages.

The second contribution is that we study the extent of project team structuring on product glitches from the perspective of work integration internal to a project. Product glitches are the design related problems and bugs in the new product development process because of poor team structuring. According to Petersen et al. (2005), the mechanisms that coordinate product designs with manufacturing are inherently complex issues that deserve further study. A past study has identified that knowledge integration of product development teams can minimize product design glitches (Rauniar et al., 2008b). In the current study we analyze the cause and effect of product design glitches from a work integration perspective that involves a cross-functional team led by a heavyweight manager. In studying the IPD project performance, we focus on the negative consequence of product design glitches on overall IPD project performance.

2. Literature review

In order to achieve competitive performance, proper fit between an organization's strategy and structure is essential (Chandler, 1962). This classical theory in strategic management regarding strategy–structure–performance has also been extended in the areas of innovation and development (Teece, 1998) which are tied to long term performance of an organization. Our current study extends this thinking of strategic alignment with structure to explain superior management and performance of an IPD project. We identify two separate structural issues surrounding the IPD project based on the hierarchical distinction between the organizational and IPD project level factors. To develop our theory, we divide the IPD project process into two distinct phases. The first is located upstream, which is the front end stage where organizational level decisions are made in regard to a specific project. The second is the detailed development and implementation stages where, we posit, team and project level factors are more important.

2.1. Organizational structuring at front end stage

The initial, front end stage of IPD projects includes all activities from the time the opportunity for a new product idea is identified,

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