



## Role change of design engineers in product development

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### Abstract

Product development is recognized as cross-functional, knowledge-intensive work that has become increasingly important in the fast-paced, globally competitive environment. Researchers and practicing managers contend that design engineers may play an important role in product development efforts. However, their effect on the product development process is not well understood and the extent of their impact on product development performance has not been adequately accessed. This research defines the changing role of design engineers, and it discusses their impact on setting clear project targets and sharing knowledge about customers. The study investigates the impact of these variables on product development productivity. Data collected from 205 manufacturing firms were used to create valid and reliable instruments to assess role change of design engineers, clarity of project targets, shared knowledge about customers and product development productivity. Results from structural equation modeling indicate that as the role of design engineers expands the clarity of project targets increase. This increase impacts the extent of shared knowledge about customers. Increases in the clarity of project targets and shared knowledge about customers appear to enhance product development productivity.

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### 1. Introduction

Product development is knowledge intensive work that creates successful new products by linking upstream activities such as research and development, marketing and product conceptualization with downstream activities such as manufacturing system design,

operations and supplier chain management (Brown and Eisenhardt, 1995; Clark and Fujimoto, 1991; Clark and Wheelwright, 1993; Ettl, 1995; Cooper, 1999; Peterson et al., 2003). Successful product development requires the integration of these activities to create a team-oriented environment that facilitates information exchange and shared decision-making (Davenport and Jarvenpaa, 1996; Khurana and Rosenthal, 1998; Koufteros et al., 2001, 2002).

Product development design engineers help the team transform the concepts generated by customer contact, market study and research and development

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into shapes, characteristics and functions that meet customer price and performance expectations (Ettlie and Stoll, 1990; Sandström and Toivanen, 2002). Positioned at this significant junction between abstract ideas and viable products, design engineers have the opportunity to coordinate important aspects of the product development process including concept development, planning, system level design, detail design, testing and refinement and ramp-up (Twigg, 1998; Ulrich and Eppinger, 1995). Design engineers also support the product development team to clarify targets and to receive, analyze and disseminate knowledge among team members. These activities are necessary for successful cross-functional product development. For design engineers to participate effectively in this new environment, they should possess an expanded set of capabilities. Beyond rigorous technical skills, they should be effective team players and communicators who can participate in cross-functional decision-making and problem solving (Jassawalla and Sashittal, 2000; Lam, 1996; Sandström and Toivanen, 2002).

As project targets are clarified, efforts of the design team should become more focused and efficient. Khurana and Rosenthal (1998) emphasize the importance of knowledge sharing in the fuzzy front-end of product development. Hoopes and Postrel (1999) and Paashuis (1998) indicate that more knowledge sharing may facilitate greater product development productivity. With shared knowledge about customer wants, it is easier for groups to reach consensus because they have a common understanding of product design issues and expected outcomes.

This study develops and discusses a conceptual framework that describes the relationships among the role change of design engineers, the clarity of project targets, shared knowledge about customers and product development productivity. The study develops valid and reliable measures for each variable using approximately half of the data collected from the Society of Automotive Engineers. The remainder of the sample is used to test the relationships among these variables.

## **2. Role changes in integrated product development**

An expanded role for design engineers is driven by the evolution of product development from a

sequential, functional and loosely linked process to a concurrent, cross-functional and integrated process (Brown and Eisenhardt, 1995; Koufteros et al., 2001). In the traditional approach, functional groups work independently to develop and evaluate a list of alternatives, and each functional area has a narrowly defined responsibility. This kind of specialized and limited communication is not conducive for coordination and collaboration, and it may hide critical problems. As these problems (e.g., design defects, cost and quality) surface late in process, the cost and time to resolve them may be excessive (Ettlie and Stoll, 1990).

Integrated product development is a cross-functional approach that seeks customer inputs, comprehends organizational capabilities, understands regulatory, technical and competitive threats and opportunities, and considers a broadly defined set of stakeholders. Product development teams seek senior management's guidance regarding a project's strategic fit (Wheelwright and Clark, 1992). They assess suppliers' capabilities (Clark and Wheelwright, 1993) and know regulatory requirements (Toffel, 2003). They recognize the impacts of a project on business results (i.e., stockholders) (Narver and Slater, 1990), but they understand that customer satisfaction is a primary consideration (Paashuis, 1998). The team guides work activities by identifying and pursuing specific project's targets that lead to product development. In this environment, the cross-functional team engages in interdependent and rich interactions in intra- and inter-organizational networks (Tidd, 1995; Sanchez, 1996; Harmsen et al., 2000).

As a firm shifts toward integrated product development, the functions (R&D, marketing, engineering and manufacturing) operate in a collaborative manner, barriers to communication are removed, knowledge is properly transferred and complex problems are resolved in a timely manner. As a consequence, product development teams move towards a globally optimized design with multiple performance measures (e.g., time, quality, cost and delivery) through a shared understanding of the product and process. They identify sets of project targets and communicate the extent of shared knowledge on customers, suppliers, products, competitors and capabilities (Hong et al., 2004b). Such upfront planning is essential in integrated

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