Technological Forecasting & Social Change 99 (2015) 156–167

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

Towards understanding integration of heavyweight-product managers and collaboration software in collaborative product development: An empirical study in Taiwan

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ARTICLE INFO

Article history:
Received 5 January 2015
Received in revised form 18 June 2015
Accepted 25 June 2015
Available online xxxx

Keywords:
Heavyweight-product managers (HPM)
Collaborative product design
Computer utilization
Task–technology fit (TTF)
Collaboration design performance

ABSTRACT

With rapid proliferation of new product offerings, fast changing environments and shortened product life cycles, firms are being compelled to adopt a collaborative product development (CPD) approach to integrate key functions and stages of new product development in intrafirm and interfirm. An efficient CPD must rely on collaborative information systems (IS) to facilitate and support collaboration processes. Successful implementation of IS to fit the task must be recognized. Heavyweight-product managers (HPMs) who have sufficient authority to make significant decisions affecting the operation of the collaborative IS features and has gained significant importance Based on the task–technology fit model and by using CPD data collected from a survey of 205 companies, hypotheses regarding the role of HPMs and collaborative IS in enhancing collaborative product development were empirically tested. The results indicate that HPMs have a significant impact on the fitness of IS-to-task and computer utilization, and ultimately significant positive effect on product quality, as well as a reduction in design changes, cycle time and cost. The HPM seems to be an important exogenous construct affecting the relationships among the fitness of IS-to-task, computer utilization and product development performance. Firms implementing CPD operating in a changing and competitive environment appear to adopt HPMs to integrate collaborative product development task and system features for encouraging IS practices and improving CPD performance.

1. Introduction

New product development (NPD) is a key to sustainable competitive advantage and prosperity for firms in changing environments (Verona, 1999; Craig and Hart, 1992), even if it is neither critical nor a requirement for a few firms. Firms currently face an environment characterized by rapid proliferation of new product offerings, rigorous global market competition, rapid economic and technological change as well as shortened product life cycles. Therefore, they have been compelled to develop new high-quality products at an increased speed and a reduced cost to enhance customer satisfaction. To achieve this objective, firms must move from stand-alone organizations to multi-firms network organizations to collaboratively innovation with partners, suppliers and customers (Eng and Ozdemir, 2014; Stein et al., 2014). This mechanism is generally known as collaborative product development (CPD) (Nieto and Santamaría, 2007; Mishra and Shah, 2009; Andersen and Drejer, 2009; Snow et al., 2011). A flurry of collaborative new product development has been initiated, especially when the stakes are high, projects are costly, and the prerequisite technology is no longer in the domain of a single firm (Talay et al., 2009). In practice, CPD refers to various firms working together to develop a product via an intensive communication, coordination, and integration among cross-firm design teams across corporate boundaries. This collaboration occurs among participants possessing various expertises, coming from different skill areas in both internal groups and external partners.

Intensive communication, information sharing, integration, and coordination conflicts among product development teams are crucial elements for a successful product development process (Nambisan, 2002; Banker et al., 2006), especially true in CPD. Such cross-team tasks entail a greater number of interfaces and handoffs necessary to synchronize information and product design data transferring boundaries that cannot be efficiently fulfilled without information systems. Thus, an effective CPD usually relies on collaboration software (Barczak et al., 2006; Chen et al., 2008; Smith and McKeen, 2011; Ozcan and Islam, 2014), called collaborative product commerce (CPC). CPC software improves information integrity and streamlines product design and development

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http://dx.doi.org/10.1016/j.techfore.2015.06.030
0040-1625/© 2015 Published by Elsevier Inc.

processes that are not well structured or require significant manual intervention. It also enables product design teams to collaborate by facilitating the sharing of data used in the design, development and management of products. On the other hand, from a socio-technical perspective, the implementation of information systems is not just a technical system investment (Smith and McKeen, 2011; Laudon and Laudon, 2007; Orlikowski and Barley, 2001). Goodhue and Thompson (1995) proposed that the fit between task and IS must be recognized for the successful implementation of IS. This means that the IS must be designed and modified in a manner that fits organizational and task needs. Furthermore, organizations and individuals must also be encouraged to change to allow the IS operate and prosper.

Research in organizational behavior has recognized the importance of leaders in initiating changes, reducing conflict, coordinating resources, building group synergy and enhancing team performance (Yukl, 1998). In a CPD project, the impact of inter-organizational collaborative design teams on the product development process is strongly influenced by their leaders (Jassawalla and Sashittal, 2000), especially the heavyweight-product manager (HPM). The HPM has substantial formal and informal influence or authority and can serve as a changes initiator, disturbance handler, resource allocator, organization integrator and coordinator in managing, guiding, and motivating diverse team members toward the common goals and objectives of a CPD project. However, empirical research that examining the relationship between collaborative design team leadership, especially the role of the HPM in facilitating the fitness of CPD task and collaborative IS, computer usage and CPD performance has been surprisingly limited (Gerwin and Barrowman, 2002; Koufteros et al., 2002; Koufteros and Marcoulides, 2006).

To bridge the existing research gap, we extended the task–technology fit (TTF) model (Goodhue and Thompson, 1995) by incorporating the role of HPMs into the model to study the fits between CPD task and collaborative IS, computer usage and the performance of CPD. This method is named as collaborative integrated product development (CIPD) approach. This study analyzes a survey of 205 companies of Taiwanese, they have implemented CPD project, to test the effects of the activities of HPMs on the fitness between CPD task and CPC software, CPC software use and performance in CPD.

In the CIPD approach, we found that the HPM has a significant effect on the fitness between CPC software and CPD task, which in turn leads to improve in the frequency and intensity of collaboration among product design teams. They also have a significant direct impact on computer utilization, and ultimately significant positive effect on product quality, as well as a reduction in design changes, cycle time and cost. Our primary contribution to the current literature on CPD and organization management is to develop a better understanding of the effects of HPMs and CPC software on product collaboration development and IT implementation. We aim to initiate a new theoretical perspective for research in the field of collaboration technology and management, and to empirically identify and validate the role of organizational mechanisms for the TTF model with data from CPD projects.

2. Literature review

In this section, the role of IT and HPM in CPD is described and prior literature on the TTF model is drawn upon to develop our research framework.

2.1. CPD and collaborative information systems

CPD implies that a group of collaborators work together to achieve a common product development goal. In an extensive review of organization theory, strategy, and operations management literatures, we found that the term "collaboration" is widely used in the new product development context but defined diversely. Referring to the definitions used by Mishra and Shah (2009) and Barki and Pinsoneeault (2005), we define CPD task features to be interchangeable with integration and coordination among diverse product development teams, with a lesser extent of cooperation and communication. CPD tasks involve rich forms of communication, coordination and integration that may be initiated by parties inside or outside the core development team. Design information is both "pulled" and "pushed" among partners, all of whom have equal access to a common design database. Collaboration at the highest level can be viewed as a framework to connect people, processes and data (information) for communication, coordination and integration. From managerial viewpoint, collaboration in product development can be managed as a highly unstructured integration and coordination which no-uniform solution or pattern, and a highly structured communication process (Swink, 2006). Unstructured collaboration focuses on promoting integration, coordination and creativity among engineering teams and allows engineers to exchange ideas in an unrestricted way. Collaboration may involve impromptu meetings or brainstorming sessions (in-person or virtual). Conversely, the structured type involves procedures that require collaboration to execute design plans. A structured approach sets guidelines for how documents are shared, which parts are searched, and how designs are revised. In structured collaboration, the focus is primarily on defining how engineers search for data, how design information is shared between partners, and how information is managed across the supply network from the design engineer to the manufacturing floor.

It is widely recognized that CPC is used to assist an enterprise in achieving CPD. From the process viewpoint, CPC is the process of designing a product through collaboration among multidisciplinary developers associated with the entire lifecycle of the product; from the information systems viewpoint, CPC comprises a class of software that facilitates management and communication generated during design and development. An important objective of CPC is to address the insufficient or even absent manufacturability checks concurrently by detecting and considering conflicts and constraints at earlier design stages. Thus CPC must provide a multitude of capabilities, including communication, visualization, calculation, and simulation tools that enable the creation of new product knowledge (Yassine et al., 2004). Moreover, CPC should enable design teams to collaborate across inter-organizational boundaries to gather and share requirements, conduct design iterations, verify and test product designs, as well as to provide the final design handoffs to other departments (Adler, 1995; McGrath and Iansiti, 1998). To support collaborative design, information and communication technologies are used to augment the capabilities of individual specialists and enhance the ability of collaborators to interact with each other and with computational resources.

Furthermore, with the globalization of product design, the members of collaborative teams often work in tandem and independently by using different engineering tools distributed at separate locations, even across enterprise boundaries and various time zones worldwide (Shen et al., 2008). Thus, CPC is implemented not only among multidisciplinary product development teams within the same company but also across corporate boundaries and time zones. It supports a broad range of system-to-system collaborative capabilities for processing both structured and unstructured design data (Nambisan, 2003), with increasing numbers of suppliers involved in the process.

2.2. Task–technology fit (TTF)

The linkage between information technology and performance has been an ongoing concern for firms seeking to adopt effective technologies. The task–technology fit (TTF) model (as shown in Fig. 1), proposed by Goodhue and Thompson (1995), concentrates on the appropriateness of the technology to the task. It is one recent model gaining popularity and acceptance among information systems researchers. The TTF model originated from the cognitive fit theory of Vessey (1991) who proposed the cognitive fit model from a cost perspective. This model postulates that a cognitive fit between problem-solving aids and a problem-solving task reduces the complexity of that task, thereby improving the