The Preliminary Insight of Internal-External NPD Practices Integration and Product Development Time in Geographically Distributed Environment

Amlus Ibrahim, Universiti Utara Malaysia
Geraldy Dadriyansyah, Universiti Utara Malaysia
T Ramayah, Universiti Sains Malaysia
Global competitiveness is one of the most important issues in manufacturing industry nowadays. Almost every company in this business industry is affected by it and they are looking for new ways to remain aligned and competitive. In recent years, the long term success of some manufacturing firms and organizations has been enhanced by their ability to bring new products onto the market at regular and shorter intervals. In order to achieve that, effective new product development requires a good integration and collaboration between internal and external participants. Moreover, in current circumstances, issues on how to effectively integrate NPD constituents in dispersed area are increasing. Therefore, this conceptual paper intends to explore ways in which internal and external new product development (NPD) practices might contribute to the acceleration of product development time in the context of geographically distributed environment. Concurrent engineering represents the internal NPD practices, while external NPD practices are reflected by supplier and customer involvement. Based on past literatures in the related field, some theoretical and practical implications of internal-external NPD practices integration in virtual environment are discussed.

Keywords: Product Development Time; NPD Integration; Concurrent Engineering; Virtual Team

INTRODUCTION

Current global environment competitiveness has forced manufacturing firms to redesign their strategy to gain competitive advantage. In the last two decades, fundamental changes in business environment have contributed to make the differentiated organization strategy of new product development obsolete.

On top of that, one of the sustain power to be competitive is by involving all constituents in new product development as early as possible (Koufteros, Vonderembse, & Doll, 2001). It means that effective new product development requires a good integration and collaboration between internal and external participants (Koufteros, Vonderembse, & Jayaram, 2005). In order to enhance strategic integration, manufacturing firms must be able to accurately choose the best NPD practices which can accommodate both internal and external necessitates. Thus, an internal NPD practice such as concurrent engineering is compulsory to improve company’s overall NPD performance. However, there is a main issue to both theoretical and practical aspects of internal and external integration of NPD practices. As physical collocated team may no longer be efficient, especially when it comes to the usage of resources (Rafii, 1995); product development team, which involves internal and external constituents in NPD, should be shifted into a virtual collocated team. However, it is difficult to collaborate team members which are geographically situated.

Therefore, this study tries to explore ways in which internal and external constituents are effectively integrated and whether virtual team effectiveness may contribute to the acceleration of NPD time. Concurrent engineering methodology represents the internal NPD practices,
while external NPD practices are represented by supplier and customer involvement. We organize this paper as follows. First, we present a brief theoretical rationale for this study. We then present, in the main body of the paper, literature reviews of related variables such as internal integration, external integration, virtual team effectiveness, and NPD time, as well as a theoretical model of internal-external integration of NPD practices in virtual environments. A brief research methodology which will be used for empirical study of this paper is also discussed. We conclude by identifying several factors which are expected to enhance virtual team effectiveness, which in turn enhance NPD time.

THORITICAL RATIONALE

Intense competition has forced manufacturing firms to explore the best practices that suite their needs. Successful firms must be able to cope with the competitive environments. One of the sustain power to be competitive is by involving all constituents in new product development as early as possible (Koufteros et al., 2001). This means that effective new product development requires a good integration and collaboration between internal and external participants (Koufteros et al., 2005).

Several empirical studies support the positive effect of strategic integration on new product development performance. Koufteros et al. (2005) conducted a study among discrete-part manufacturing firms and confirmed the importance of internal and external integration. Droge, Jayaram, and Vickery (2000) in their study of NPD in automotive supplier industry also affirmed the significant causal relationship of synergistic integration which includes cross-functional team, and new product development performance. Further in a more recent study (Droge, Jayaram, & Vickery, 2004), they found that both internal and external integration are related to time-based performance and in turn significantly result in higher financial performance.

In the context of time-based performance and innovativeness, adequate communication and collaboration between internal-external participants is among the primary importance. A well-structured information processing enables internal and external participants to share knowledge and interpretation (Daft & Lengel, 1986). In addition to that, knowledge management implementation and electronic communication technology assist the NPD team to engender creativity and innovation (Akgun, Dayan, & Di Benedetto, 2008).

The perceived need for integration in product development is explained in uncertainty reduction theory (Gupta, Raj, & Wilemon, 1986). Since the existence of uncertainty in new product development is unavoidable, the need of integration among product development practices is compulsory to support the NPD team in order to cope with the fuzziness of their task environment. Furthermore, organizational theory also propose the integration of internal and external parties as a structural mechanism that firms employ to deal with the information processing requirements for developing and launching new product. Recent study of integration in new product development by Koufteros et al. (2005) indicate that internal integration acts as an important predecessor of external integration. However, neither uncertainty reduction theory nor organizational theory discusses the internal-external integration of NPD practices where the constituents are geographically distributed.

In order to investigate the existing gap of those theories, this study generates a model which is adapted from product concept to economic value chain (Syamil, Doll, & Apigian, 2004) which is presented in Figure 1. Product concept to economic value chain is a causal chain of product development, starting from product concept and ending with economic value. This chain of categories of variables reflects the importance of process performance, i.e. teamwork, team productivity, and engineering change time, to intervene the relationship of product development
process and overall project performance. Hence, this study emphasizes on the effectiveness of virtual team to mediate the correlation of internal-external practices integration and NPD performance. However, product concept to economic value chain does not particularly focus on the strategic integration among parties involved in the project. Therefore, this study also would like to emphasize on the limitation of this model and concentrate on the internal-external integration of NPD practices. The theoretical model for this study is presented in Figure 2.

**Figure 1.** Product concept to economic value chain diagram (Syamil et al., 2004)

**Figure 2.** Theoretical model of internal-external NPD integration in virtual environment.

**LITERATURE REVIEWS**

**Internal Integration: Concurrent Engineering**

Increasing pressure in the market, especially in manufacturing industry, demands organizations to shift their approach for product development into a more systematic and integrated approach. In order to stay ahead of the competitors, concurrent engineering provides the necessities for manufacturing firms to improve their competitiveness and achieve the desired expectation.

Concurrent engineering allows integration of several functions as well as breaking the organizational boundaries, which is impossible to be practiced using the traditional engineering method. Experts from various functional disciplines are integrated during the actual design phase and tradeoffs related to producibility, testability, and serviceability are made in real time (Turino, 1992).

Concurrent engineering has been a notably internal integration process in NPD practices. Droge et al. (2004) expose concurrent engineering as one of the “design process integration” along side design for manufacturability, standardization, and computer aided design/ computer aided manufacturing. In a more recent study, Koufteros et al. (2005) also put concurrent engineering as the internal integration which acts as an antecedent to external integration.

**Product Development Team**

The primary process in adopting concurrent engineering philosophy is teeming, which involves the assemblage of people with different skills, experiences and perspectives on the product
development process. Each of the team members in concurrent engineering team represents the relevant departments and functions.

Concurrent engineering team is composed of experts from various functional areas such as engineering, production, marketing, and R&D which has a vested interest in the development project. The team is formed to work on a specific project, and stays together throughout the development of the product. The continuity in team membership underscores the need to establish long-term relationships with the core team members and also with both customers and suppliers or subcontractors.

In order to ensure the effectiveness and continuity of product development team, members contributing to the design and development of new product should be located close to each other. Collocation of team has been considered as one of the main tools for enabling concurrent engineering (Bergring & Andersin, 1994). According to Kim and Kim (2009) and Boyle, Kumar, and Kumar (2006), in current virtualized coordination era, physical collocation is still relevant since it is complicated to manage the communication process for geographically separated team and it may inhibit the process of NPD. However these studies are more on product quality as NPD success determinant, while the impact of virtual collocated team on product development time and innovation is still abstract and need further investigation.

External Integration: Supplier Involvement

The impact of supplier integration has been widely investigated by scholars. There are many advantages of bringing suppliers early into the new product development (Hartley, Meredith, & McCutcheon, 1997). According to Monczka and Trent (1997) in their study of US manufacturers, it was found that suppliers need to be early integrated into the NPD team since 50% of the cost of good sold is generated from purchase of materials.

In the supplier integration, there are two kinds of approach that lead to supplier strategic collaboration, which are supplier development and supplier partnership (Droge et al., 2000; Droge et al., 2004; Koufteros et al., 2005). Both of this approach is important predictors to NPD time minimization. Supplier development relates to the practice of assessing and evaluating the supplier’s performance as well as providing facility for the supplier personnel to improve their capability (Droge et al., 2000; Droge et al., 2004). On the other hand, supplier partnership is closely related to early involvement of suppliers into the NPD process to provide useful thoughts and ideas to product design and access to technology capabilities (Droge et al., 2000; Droge et al., 2004).

External Integration: Customer Involvement

Customer integration is critical in today’s business, especially those that closely related to high degree of innovativeness. The presence of customers in new product development team provides a good understanding of current customers’ requirements out there in the market. Moreover, customer involvement gives extra knowledge for the internal constituents to produce product that customers really demanding. It is believed that close collaboration and relationship with customers would enhance timely responsivenes. According to Koufteros et al. (2005), customer integration positively effect product innovation, especially in high equivocality environment. Further, the information and market knowledge generated by customers would contribute to higher quality and cycle time reduction (Sherman, Souder, & Jenssen, 2000).

Virtual Team Effectiveness

Centralized collocated product development is no longer efficient in globalized manufacturing and trade world (Rafii, 1995). Centralized collocated team such as physical collocation team should be switched to a more widespread group of people, thus virtual collocation team becomes the preference to manufacturing firms nowadays. Globalization is one of the main drivers of virtual collocation team. Paradigm shift forced by current global competitiveness has promoted virtual collocation team becoming a solution to product development. Duarte and
Snyder (1999) stated that virtual collocation team is formed as a result to new ways of working, being introduced as a reaction to current business requirements.

Shift in organizational trends also affect manufacturing firms to start applying virtual collocation team. According to Haywood (1998), mergers, acquisitions, downsizing, and outsourcing are the examples of organizational trends which contribute to the rapidly growing trend in implementing virtual team. Furthermore, cross organizational product development and significant changes in products and services are also the main drivers for virtual team.

Other factors contribute to the success of virtual team that have been identified, are those which closely related to the common characteristics of virtual teams. As concluded from several studies from the past, there are at least five key factors contributing to the effectiveness and failure of virtual team. The key factors include: (1) Clarifying objectives (Earnhardt, 2009); (2) the use of communication technology (Duarte & Snyder, 1999; Earnhardt, 2009); (3) team forming (Earnhardt, 2009); (4) trust (Earnhardt, 2009); and (5) leadership (Duarte & Snyder, 1999).

Another important aspect in making virtual collocation team applicable is the rapid development of technologies. Advanced electronic communication media allows the virtual team to perform effectively and efficiently. It also facilitates the development of virtual team. On top of that, the use of virtual collocation team allowing higher return on investment due to decrease in cost of bandwidth (Haywood, 1998).

**New Product Development Time**

NPD time is among the NPD success determinants that receive a great attention from practitioners in this industry since its criticality in product development. NPD time can be divided into two phases; the pre-launch phase and the production and market launch phase (Droge et al., 2000). The pre-launch phase is the early stage of NPD where product concepts, idea generation, technical and financial assessments, marketing plan development, and testing are accomplished. Whereby, the production and market launch phase is a more time consuming stage where the production ramp-up and commercialization of product are occurred. The ability of firm to accelerate these two phases should improve profitability by allowing development and manufacturing cost advantages (Gonzalez & Palacios, 2002).

Faster product development and early introduction of product provide a great advantage for manufacturing firms, particularly in term of competitiveness. Internal integration, such as concurrent engineering, and external integration such as supplier and customer integration positively correlate to product development time. Droge et al. (2004) suggest the importance of early involvement of both internal and external parties through extensive communication during idea generation and conceptual stage. This early involvement helps to accelerate the overall process of product development time.

Another study conducted by Carbonell and Rodriguez (2006) indicates staff-related and structural-related factors such as team proximity or collocation and functional diversity, which usually engage in internal-external integration, also explain the variance of product development time. Team proximity or collocation is positive and significant in explaining innovation speed particularly in technologically complex project. While for functional diversity, an increase of functional diversity accelerates innovation speed only at low level of functional diversity.
RESEARCH METHODOLOGY

This study will use a quantitative approach among the automotive industry, in order to conduct, collect, and followed by data analysis. Hypothesis testing will be undertaken in order to explain the variance of dependent variable. The variables involved in this study are presented in the theoretical model diagram as shown in Figure 2. Moreover, structured questionnaire will be used to measure the variables whereby the items are adopted from past literatures.

DISCUSSION AND EXPECTED RESULTS

Virtual teaming, a relative recent phenomenon, is becoming increasingly attractive to organizations due to developments in communication technologies. The implications of a remote distributed working environment, though, are not illustrated or experienced extensively.

In a broader scope, issue on inadequacy of collaboration and communication should effect the effectiveness of internal-external practices integration. There have been so many queries on how to effectively integrate third parties into the NPD and how to properly link the firm’s problem solving effects with the third parties, moreover when the suppliers or customers are geographically distributed. Hence, based on the past literatures, there are five key predictors in effectively integrating internal and external NPD constituents into a virtual team. The five factors include clarity of objectives, communication technology usage, team forming, mutual trust, and proper leadership (Duarte & Snyder, 1999; Earnhardt, 2009).

Leader of the virtual team must be able to clearly communicate the objectives of the NPD project. Roles, expected contributions, and boundaries must also be well-specified, otherwise miscommunication would occur in the latter stage of product development, which in turn would prolong the product development time. Moreover, communication among internal and external constituents is more difficult to organize in geographically separated team. Thus, technology for communication and collaboration across distance becomes an important facet of managing and studying virtual teams. Virtual teams need to have the ability to adapt and shape communication technologies to their specific purposes to be success. Because of the nature of virtual teams that does not allow frequent informal face-to-face interaction, highly structured communication among team members become inevitable. The communication among participants should be clear and in constant manner to ensure the information is well-received by everyone. Rapid development of communication technologies nowadays, such as internet and other sophisticated tools, provides the ease to make virtual teams become possible. Those advanced communication technologies include internet, electronic mail, video conferencing, bulletin boards, and groupware.

Virtual teams could be formed from infinite pool within the organization and from external organizations. The involvement of suppliers and customers in the team would increase the challenge of virtual team formation. However, if all of the factors mentioned above is properly executed and implemented, integration of internal and external constituents into a virtual team should accelerate NPD time as well as enhance product innovation. Virtual team effectiveness is expected to significantly mediate the relationship of internal-external integration and NPD time.
REFERENCE


