

Virtual Integration as an Approach to Engender Product Innovation and Accelerate Product Development Time: A Literature Analysis

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Abstract- Global competitiveness has forced manufacturing firm, as an internal constituents, to work closer with their suppliers and customers in order to produce highly innovative product in shorter time interval. However as the business trends in manufacturing industry have evolved, centralized integration has become obsolete and no longer be efficient. Concurrent engineering methodology allows manufacturing firms to adopt a new collaboration approach called virtual integration. With the aid of computer-mediated communication, virtual integration is believed to be a promising solution to NPD collaboration issues. Therefore, this conceptual paper is aimed to seek for a new approach to engender product innovation which at the same time accelerates product development time in geographical dispersed setting through literature analysis. Some prepositions are developed to provide a preliminary understanding on this issue that would be beneficial for future research in this field.

Keywords: Virtual integration, product innovation, product development time

I. INTRODUCTION

Internationalization as an extent of globalization has forced manufacturing firms to seek for new ways to sustain their competitive advantages in the context of new product development (NPD). It would be extremely difficult for them to just rely on quality, cost, service, and product differentiation in order to remain competitive. They must be able to compete on the basis of new technological feature and product innovation. On top of that, the ability of a manufacturing firm to bring new product to market faster through reducing the number of defects and more concern on manufacturability aspect has become an increasingly important factor to market success [1]. Acceleration in product development time and product innovation are among the main concern for manufacturing firms to sustain their market share as well as strengthen their competitive advantage.

Due to more complex processes and structures involved in NPD, the increase of issues related to project management, people management, and structural management is inevitable. These issues are among the main obstacles for manufacturing firms to develop new product

on time and produce innovative product since these issues commonly relate to continuous effective operation, technical matters, and efficiency in managing NPD activities [2]. Operational efficacy, technical issues, and innovativeness can be accommodated should the structural and strategic integration within an organization is well-executed [3,4,5]. Concurrent engineering, a product development methodology, has promoted the utilization of cross-functional team as a solution to the above issues. Cross-functional team is one of the best approaches to integrate all of the constituents in NPD to collaborate and achieve the best outcome. In order to collaborate actively with internal and external constituents and drawing on resources that are often geographically distributed, virtual integration has emerged to be an effective collaboration instrument. With the aid of computer-mediated communication, virtual integration facilitates new ways of communication and collaboration.

Therefore, this conceptual paper is aimed to seek for a new approach to engender product innovation which at the same time accelerates product development time in geographical dispersed setting through literature analysis. As this paper primarily focuses on geographically dispersed environment, we develop some prepositions which relate to virtual integration, product innovation, and product development time to provide a preliminary understanding on this issue that would be beneficial for future research in this field.

II. LITERATURE REVIEW

A. Theoretical 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 [6]. It means that effective new product development requires a good integration and collaboration between internal and external participants [5].

Several empirical studies support the positive effect of strategic integration on new product development

performance. Reference [5] conducted a study among discrete-part manufacturing firms and confirmed the importance of internal and external integration. [4] 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 [3], 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 innovation, 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 [7]. In addition to that, knowledge management implementation and electronic communication technology assist the NPD team to engender creativity and innovation [8].

The perceived need for integration in product development is explained in uncertainty reduction theory [9]. 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 [5] 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 [10]. 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 integration to mediate the correlation of cross-functional team and product development time and innovation. The conceptual framework is presented in figure 1.

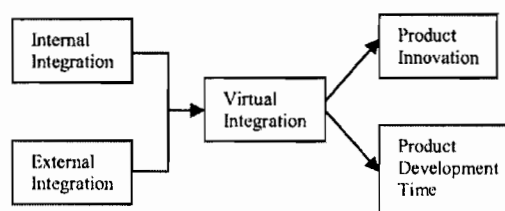


Fig. 1. Conceptual Framework

B. Virtual Collocated Team

Centralized integration product development is no longer efficient in globalized manufacturing and trade world [11]. Centralized integration 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. According to [12] there are four main drivers of virtual integration, such as organizational trends, business requirements, new and emerging technology application, and level of expertise that the team members have. Paradigm shift forced by current global competitiveness has promoted virtual integration become a solution to product development. Reference [13] 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 [14, 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.

III. DISCUSSION: PREPOSITIONS DEVELOPMENT AND EXPECTED RESULTS

A. Internal Integration

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. One of the most influential enablers for perceived benefits of concurrent engineering is integration of cross-functional teams and deployment of collocation teams [15].

As cited in [6], there are several advantages of involving people with different expertise in NPD practice. High functional diversity within a cross-functional team engenders transfer of knowledge and ideas. Moreover, reference [3] and [8] confirmed that the greater the functional areas being represented in an NPD team, the higher the ability to acquire, process, and utilize knowledge, which at the end enhance the degree of team's innovativeness and creativity.

The involvement of internal constituents such as R&D, manufacturing, and marketing personnel during the initial stage of new product development is critical. As stated in the theory of organizational information processing, early planning and collaboration between design and manufacturing personnel is important to reduce uncertainty.

Early exchange of information and shared of visions, missions, and values should eliminate information gaps among constituents and further less design and manufacturing problems are generated. Thus, integrating internal constituents as early as possible would accelerate product development speed. The study of product development in the context of internationalization suggests that organizational and technology integration is achieved should constituents are involved early during the initial stage of new product development [4]. Based on the above, the following prepositions are offered:

P1. The level of internal integration within cross-functional team will be positively related to product innovation.

P2. The level of internal integration within cross-functional team will be positively related to acceleration of product development time.

B. External Integration

Along side internal integration, customer integration is also one of the critical elements in new product development. It is a valuable way to achieve new product success [16, 17]. The presence of customers at every stage of new product development would benefit companies in many ways [17, 16]. New product ideas, enhanced product development effectiveness, market uncertainty reduction, and reduced time to market are among the benefits arising from close customer partnership. On top of that, customer integration also positively effect product innovation, especially in high equivocality environment [5].

In line with customer integration, supplier integration plays an important role in better execution of product development activity. The effects of supplier involvement in product development are expected to enhance both strategic and operational outcomes. The strategic impact includes increased efficiency and effectiveness as well as better

access to technological resources and knowledge; while the operational impact relates to lead time reduction, cost reduction, provides alternative solutions on materials, and development of better products. In addition, supplier closeness would also result in boundary-spanning synergetic integration which accommodates manufacturing firms to generate its own knowledge capital [18]. This knowledge capital is important to minimize time involved in new product development. Thus, external constituents such as customer and supplier play a pivotal role in cross-functional team, especially when it comes to idea generation and product concept. Hence the following prepositions are offered:

P3. The level of external integration involved will be positively related to product innovation.

P4. The level of external integration involved will be positively related to acceleration of product development time.

C. Virtual Integration

Virtual integration which is symbolized by virtual team, a relative recent phenomenon, is becoming increasingly attractive to organizations due to developments in communication technologies. Due to the recent trend towards corporate restructuring, change in business requirements such as cross organizational product development, and intense competition in manufacturing industry, firms are forced to work with others which are often dispersed across space, time, and organizational boundaries. In specific, shift in organizational trends affect manufacturing firms to start applying virtual integration. According to [14], mergers, acquisitions, downsizing, and outsourcing are the examples of organizational trends which contribute to the rapidly growing trend in implementing virtual integration. Another important aspect in making virtual integration applicable is rapid development of technologies. Advanced technology and communication tools allow the virtual integration to perform effectively and efficiently. They also facilitate the development of virtual integration and allow higher return on investment due to decrease in cost of bandwidth. 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 [13, 18].

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 dispersed 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. On top of that, virtual integration of internal constituents and customers improve the output of knowledge creation as well as knowledge distribution. Reference [19] stated that virtual integration supports the implementation of knowledge acquisition and knowledge creation. Advanced communication technologies enable internal constituents and customer to interact and collaborate intensively which trigger innovative and creative ideas. Virtual integration effectiveness is expected to significantly mediate the relationship of internal-external integration and NPD time.

P5. The level of virtual integration will positively mediate the relationship between internal-external integration and product innovation.

P6. The level of virtual integration will positively mediate the relationship between internal-external integration and acceleration of product development time.

IV. CONCLUSION

In conclusion, this study tries to provide a theoretical and practical highlight on internal-external integration and its

relation toward product innovation and product development time. To be specific, this study emphasizes on the effectiveness of virtual team to mediate the effect of internal-external practices integration on product innovation and product development time acceleration. Furthermore, the result of this study in the form of propositions is expected to generate answers to ambiguous and contradict outcomes from previous studies about NPD practices, especially to those which relate to geographically dispersed environment.

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