A Conceptual Model of Virtual Product Development Process

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Abstract – **In today's dynamic marketplace, companies are under strong pressure to introduce new products for long-term survival with their competitors. Besides, every company cannot cope up progressively or immediately with the market requirements due to knowledge dynamics being experienced in competitive milieu. Increased competition and reduced product life cycles put force upon companies to develop new products faster. In response to this pressing need there should be some new approach compatible in flexible circumstances. This paper presents a solution based on the Stage-Gate system, which is closely linked with virtual team approach. Virtual teams can provide a platform to advance the knowledge-base in a company and thus to reduce time-to-market. This article introduces conceptual product development architecture under a virtual-team umbrella. The paper describes all the major aspects of new product development (NPD), NPD process and its relationship with virtual team, Stage-Gate system and finally presents a modified Stage-Gate system. It also provides the guidelines for the successful implementation of virtual team in new products development.**

Keywords – **Modified Stage-Gate System, Virtual Product Development, Conceptual Model**

1.0 INTRODUCTION

New product development (NPD) is widely recognized as a key to corporate prosperity [1]. Different products may require different processes, a new product idea needs to be conceived, selected, developed, tested and launched to the market [2]. The specialized skills and talents required for the development of new products often reside (and develop) locally in pockets of excellence around the company or even around the world. Firms therefore, have no choice but to disperse their new product units to access such dispersed knowledge and skills [3]. As a result, firms are finding that internal development of all technology needed for new products and processes are difficult or impossible. They must increasingly acquire technology from external sources [4].

Virtualization in NPD has recently started to make serious headway due to developments in technology-virtuality in NPD now is technically possible [5]. Automotive OEMs (Original Equipment Manufacturers) have formed partnerships with suppliers to take advantage of their technological expertise in development, design, and manufacturing [6]. As product development becomes more complex, supply chain also have to collaborate more closely than in the past. These kinds of collaborations almost always involve individuals from different locations, so virtual team working supported by IT, offers considerable potential benefits [7]. May and Carter [8] in their case study of virtual team working in the European automotive industry have shown that enhanced communication and collaboration between geographically distributed engineers at automotive manufacturer and suppliers sites make them get benefits are better quality, reduced costs and a reduction in the time-to-market (between 20% to 50%)for a new product vehicle.

Although the uses of the internet in NPD have received considerable attention in the literature, very little is written about the collaborative tool and virtual team implementation in NPD. On the other hand, Stage-Gate system which defines different steps of product development has some criticism and according to extent of information and communication technology (ICT) need to modify. In forthcoming chapters the major aspects of new product development (NPD), NPD process and its relationship with virtual team, Stage-Gate system and finally presents a modified Stage-Gate system will be described.

2.0 NEW PRODUCT DEVELOPMENT

Product development definition used by different researchers in slightly different ways but generally it is the process that covers product design, production system design and product introduction processes and start of production [9]. A multidisciplinary approach is needed to be successful in launching new products and managing daily operations [10]. In the NPD context, teams developing new products in turbulent environments encounter quick depreciation of technology and market knowledge due to rapidly changing customer needs, wants, and desires, and technological know-how [11].ICT helps establish and maintain communicative and cooperative relationships both inside and outside the organisation, and makes NPD processes quicker, simpler and less risky [12]. Adoption of collaborative engineering tools and technology (e.g., Web-based development systems for virtual team coordination) was significantly correlated with NPD profitability [13]. ICT enhance the NPD process by shortening distances and saving on costs and time [12].

Kafouros et al. [14] found that internationalization enhances a firm's capacity to improve performance through innovation. Since efficiency, effectiveness and innovation management have different and contradictory natures, it is

very difficult to achieve an efficient and innovative network cooperative NPD [15]. Supplier involvement in NPD can also help the buying firm to gain new competencies, share risks, move faster into new markets, and conserve resources [6].

2.1 NPD and Virtuality

New product development (NPD) has long been recognised as one of the corporate core functions [16]. During the past 25 years NPD has increasingly been recognize as a critical factor in ensuring the continued existence of firms [17].The rate of market and technological changes has accelerated in the past years and this turbulent environment requires new methods and techniques to bring successful new products to the marketplace [18]. Particularly for companies with short product life cycles, it is important to quickly and safely develop new products and new product platforms that fulfill reasonable demands on quality, performance, and cost [19]. The world market requires short product development times [20] therefore in order to successfully and efficiently get all the experience needed in developing new products and services, more and more organizations are forced to move from traditional face-to-face teams to virtual teams or adopt a combination between the two types of teams [21].

Given the complexities involved in organizing face-to-face interactions among team members and the advancements in electronic communication technologies, firms are turning toward employing virtual NPD teams [22-24]. IT improve NPD flexibility [25]. New product development requires the collaboration of new product team members both within and outside the firm [2, 26, 27] and NPD teams are necessary in almost all businesses [5]. In addition, the pressure of globalization competition companies face increased pressures to build critical mass, reach new markets, and plug skill gaps , NPD efforts are increasingly being pursued across multiple nations through all forms of organizational arrangements[28]. Given the resulting differences in time zones and physical distances in such efforts, virtual NPD projects are receiving increasing attention [26]. The use of virtual teams for new product development is rapidly growing and organizations can be dependent on it to sustain competitive advantage[29].

2.2 New product Development Process

New business formation activities vary in complexity and formality from day-to-day entrepreneurial or customer prospecting activities to highly structured approaches to new product development [30]. Today's uncertain and dynamic environment presents a fundamental challenge to the new product development process of the future [31]. New product development is a multi-dimensional process and involves multiple activities [27]. Kusar al. [32] summarized different stage of new product development which in earlier stages , the objective is to make a preliminary market, business, and technical assessment whereas at the later stages the propose is to actually Design and develop.

- Definition of goals (goals of the product development process)
- Feasibility study (term plan, financial plan, pre-calculation, goals of market)
- Development (first draft and structure of the product, first draft of components, product planning and its control processes)
- Design (design of components, drawing of parts, bills of material)

2.2.1 Stage-Gate System in NPD

Several authors proposed different conceptual models for the NPD process, beginning from the idea screen and ending with the commercial launch. The model of Cooper, called the Stage-Gate System is one of the most widely acknowledged [33]. The Stage-Gate System model (Figure 1) divides the NPD into discrete stages, typically five stages. Each Stage gathers a set of activities to be done by a multifunctional project team. To enter into each stage, some conditions and criteria have to be fulfilled. They are specified in the Gates. A Gate is a project review in which all the information is confronted by the whole team. Some criticism of the method has surfaced, claiming that the steering group assessment in the gate step halts the project for an unnecessarily long time, making the process abrupt and discontinuous [19]. A closer integration of management through virtual team in the process might be a solution for avoiding such situations.

2.2.2 Stage-Gate Process

This process is a method of managing the new product development process to increase the probability of launching new products quickly and successfully. The process provides a blueprint to move projects through the different stages of development: 1) idea generation, 2) preliminary investigation, 3) business case preparation, 4) product development, 5) product testing, and 6) product introduction. This process is used by such companies as IBM, Procter & Gamble, 3M, General Motors, and others. The process is primarily used in the development of specific commercial products, and is more likely to be used in platform projects than in derivative projects.

Auto companies that have modified their Stage-Gates procedures are also significantly more likely to report (1) use of virtual teams; (2) adoption of collaborative and virtual new product development software supporting tools; (3) having formalized strategies in place specifically to guide the new product development process; and (4) having adopted structured processes used to guide the new product development process[13].

3.0 MODIFIED STAGE-GATE WITH VIRTUAL PRODUCT DEVELOPMENT TEAM

Virtual product development team by using collaborative tools can effectively be used both in the earlier and later stages of the NPD process. Past research has mainly focused on the role of Internet in NPD [34]. Almeida and Miguel [35], have been identified in the literature that it seems to exist a lack of a conceptual model that represents all dimensions and interactions in the new product development process. On the other hand, some criticism of Stage-Gate method has surfaced, claiming that the steering group assessment in the gate step halts the project for an unnecessarily long time, making the process abrupt and

discontinuous [19]. A closer integration of management through virtual team in the process might be a solution for avoiding such situations. Integration is the essence of the concurrent product design and development activity in many organizations [36]. Ragatz et al. [37] suggest that integration of the supplier's technology roadmaps into the development cycle is critical to ensuring that target costs are met.

In line to compensate lack of conceptual model that represents all aspects and interactions in the new product process and decrease criticism of Stage-Gate system, a solution called Modified Stage-Gate system introduced. Figure 2 illustrates new model architecture of virtual product development process. The architecture is structured in a two-layered framework: Traditional Stage-Gate system and collaborative tool layer which is supported by virtual team. Merge of Stage-gate system with virtual product development team lead to increase new product performance and decrease time-to-market. The following sections will describe some elements of the collaborative tool layer in more detail.

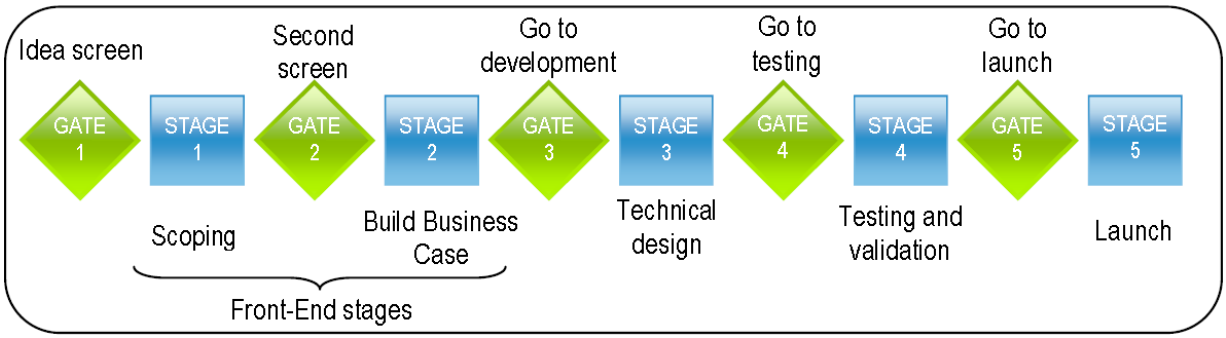

Figure 1 The Stage-Gate System model (source [38])

3.1 Virtual Team

Gassmann and Von Zedtwitz [39] defined "virtual team as a group of people and sub-teams who interact through interdependent tasks guided by common purpose and work across links strengthened by information, communication, and transport technologies." Another definition suggests that virtual teams, are distributed work teams whose members are geographically dispersed and coordinate their work predominantly with electronic information and communication technologies (e-mail, video-conferencing, telephone, etc.) [40], different authors have identified diverse. We define, virtual team is small temporary groups of geographically, organizationally and/or time dispersed knowledge workers who coordinate their work predominantly with electronic information and communication technologies in order to accomplish one or more organization tasks.

3.2 Capturing Customer Requirements

Collaborative tools allow firms to respond quickly to specific customer requirements with new, high-quality, innovative products, and it enables firms to build cross-functional competencies, enhance flexibility and share knowledge [41]. Capturing customer requirements is represented throughout product development will facilitate performing quality function deployment [42].

3.3 Collaborative Capabilities

Enabling collaborative capability through virtual teamwork represents a fundamental transitioning to more effective organizational work practices [43].

The use of virtual team will change the communication pattern both within and outside the firm. Successful collaborations require more than the mere use of electronic communication and involve new skills and a supportive context that provides commitment and resources to facilitate collaboration [2].

3.4 Company Resources

Virtual team provides cost savings to employees by eliminating time-consuming commutes to central offices and offers employees more flexibility to co-ordinate their work and family responsibilities [44]. Virtual teams overcome the limitations of time, space, and organizational affiliation that traditional teams face [45] and able to digitally or electronically unite experts in highly specialized fields working at great distances from each other [46].

3.5 Top Management Support

Top management support is a strong motivational factor in the entire new product process. Although collaborative tools are able to assists top management but many managers are uncomfortable with the concept of a virtual team because successful management of virtual teams may require new methods of supervision [47]. Management commitment provides organizational support for change, generates enthusiasm, provides a clear vision of the product concept and assures sufficient allocation of resources [18].

3.6 Information Sharing

Information sharing has been identified as an important success factor in NPD [48]. The positive impact of information sharing on the success of new products has long been established in the NPD literature [49-52].

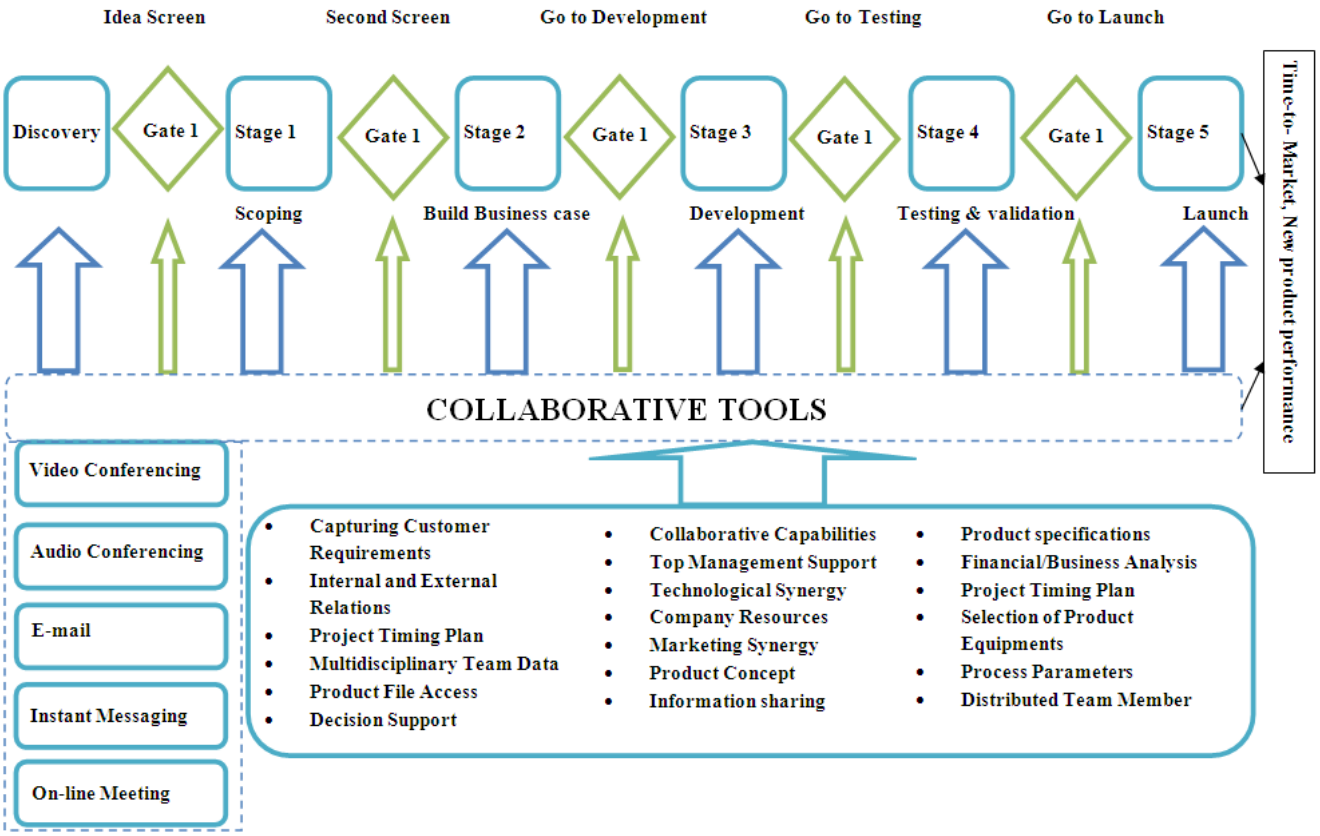

Figure 2 Modified Stage-Gate: Model architecture of Virtual product development Process

4.0 KEY FACTORS FOR SUCCESSFULLY IMPLEMENTING VIRTUAL TEAM IN NPD

NPD is continuing to be an area that is receiving increased attention, both in practice and academic spheres [53]. Eppinger and Chitkara [54] studied global product development (GPD) base on virtual team, for companies in the manufacturing sector by conducting interviews with 30 executives and surveying over 1150 product development executives and professionals from large manufacturing companies. They reported the following ten key success factors for successful GPD:

- Management priority and commitment – Commitment from management to make the necessary organization, process and cultural changes to make GPD work.
- Process modularity for global distribution – Ability to separate activities into modular work packages for global distribution.
- Product modularity to develop subsystems or components in different locations – Ability to break down into subsystems for global distribution.
- Core competence so the company does not become completely reliant on suppliers or contractors – Good understanding of what the company's core competencies are, so that do not get outsourced.
- Intellectual property, which becomes more difficult to protect – Defining process and products in a modular way to protect IP.
- Data quality, which concerns availability, accessibility, and audit ability – Ability to update and share data with teams in multiple locations.
- Infrastructure (including networks and power supplies) to support activities in all locations – Unified infrastructure, systems, technologies, and processes that are shared between all locations.
- Governance and product management is needed to coordinate and monitor the entire effort – Ability to coordinate and monitor program, including detailed project planning.
- Collaborative culture is necessary and is helped by a consistent set of processes and standards – Building and sustaining trust, ensuring teams have consistent processes and standards.
- Organization change management requires planning, training, and education of those in key roles for global Product Development – plan and train for new roles, behaviours, and skills.

5.0 CONCLUSION

The internet, incorporating computers and multimedia, has provided tremendous potential for remote integration and collaboration in business and manufacturing applications. Most companies today are divided in different departments located in different geographical places and dealing with specialized tasks. So using collaborative tools enables authorized users in geographically different locations to have access to the company's product data and carry out

product development work simultaneously and collaboratively on any operating systems.

The modified Stage-Gate system has demonstrated to be a good development platform for the NPD. In order to integrate and share the information and knowledge available within geographically distributed companies, this model can be a reference model. The proposed model architecture of virtual product development process, does not aim to replace existing systems in companies but rather to be a support tool for communicating and sharing knowledge among the disperse partners. Modified Stage-Gate system will lead to the production of better and more cost effective products, developed in a shorter period of time.

In highly competitive era which forces companies to launch new product faster, the decision on setting up virtual teams and using a modified NPD process is not a choice but a requirement. The theme of virtual teams and application of collaborative tool in NPD has not been much explored and researchers in this field are encouraging more studies and analyses to be made.

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