MODELLING THE FRONT END OF THE NEW PRODUCT INTRODUCTION PROCESS FOR RAPID PRODUCT DEVELOPMENT

TRACK - PRODUCT AND PROCESS DESIGN

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ABSTRACT

In order to remain competitive, a company must organize the development of its new products around an effective and manageable product introduction process (PIP). Frequently, the product introduction process is an ad-hoc collection of separate procedures that follow one after another with responsibility being passed on until a product is eventually produced and introduced into the market. This situation is usually worse in the vital early stages of development before the product has been physically defined. This paper describes the development, industrial testing and validation of a Reference Model, which covers the stages from the development of a product strategy through to the formal approval of a new product for its detailed design and manufacture. It can be used for the effective management of the fuzzy front end of the new product introduction process. The paper concludes with a discussion of the application of the reference model to a case study company.

KEYWORDS

Product Introduction, Product Strategy, Reference Model, Detailed Design

INTRODUCTION

Survival in today's globally competitive market place is increasingly dependent on the effective management and control of innovation through the development of new products (Goldberg, 1998). In order to remain competitive, a company should organize the development and introduction of any potentially profitable new products around an efficient and manageable process (Cooper and Kleinschmidt, 1995). Effective new product introduction requires organizational focus to be on understanding the company as a 'Total System' (Olsen, 1993), incorporating market analysis, concept development, detailed design, manufacturing, product distribution, quality and customer satisfaction (Parnaby, 1995). This involves integrating these many elements into a unified and slick business process (Backhouse et al, 1995) that manages the substantial risks (Bernhardt and Wolverton, 1996) involved in technology-based innovation, products and processes.

The mechanism identified as the number one driver of new product success is the effective implementation of a high quality new product development process (Cooper and Kleinschmidt, 1995). A high quality development process requires organizational focus on the quality of execution and a thorough yet flexible process that can be adapted according to individual project requirements (Cooper and Kleinschmidt, 1995).

The Product Introduction Process, or PIP, begins with the clear definition of a market-triggered new product opportunity and achieves the realization of this opportunity through the design, manufacture and introduction of a competitive new product into the marketplace. The most important parts of this process are the early pre-detailed development stages (Khurana and Rosenthal, 1997). By the time the concept design is completed the business opportunity has been established, technical targets have been specified and the principles of the products operation have been finalized. The foundation of a successful PIP is for a company to invest time, money, and effort in these early stages and ensure the implementation of a high quality development process (Cooper, 1996).

Companies often concentrate resources on the later stages of the product development such as concept selection or design embodiment (Karlsson and Ahlstrom, 1996) but leave earlier stages to drift along and manage themselves. A major reason for this is that in these early stages of the Product Introduction Process the product often has not been physically defined and the definition of the problem is incomplete or inadequate (Smith and Rheinertsen, 1991). Many valuable months of product development time can be squandered during this so-called 'fuzzy front end' (Buckler, 1997) through indecision, inefficiency, and unnecessary delay (LaBahn et al, 1996), (Smith and Rheinertsen, 1992).

A tool successfully used to help implement integrated systems and business processes (Doumeingts et al, 1997) is the Reference Model. A Reference Model is a previously agreed upon and validated standard document or conceptual representation of a system. The Reference Model can be used as a 'watermark' (Los et al, 1992) representing activities, resources, information flow, data requirements and procedures depending on the application.

PRODUCT DEVELOPMENT PROCESS

This process starts with the initiation of a project and finishes with the specification of a new product's technical requirements and full approval for subsequent detailed design (Khurana and Rosenthal, 1997). Following a detailed review of the important issues associated with PIP in relation to successful new product development, a conceptual overview of the fuzzy front end has been developed. This high level conceptual model identifies four main development stages that are followed during the fuzzy front end of the PIP. These include the following:

1. Project Initiation: Research has identified that procedures should be in place to control the triggering and initiation of new product development (Baxter, 1995). As a result a product should be triggered by a strategic need for a company to introduce a new product identified by analyzing the market place and from a general awareness of the overall competitive situation (Graber, 1996).
2. Identification of Opportunity: Once the strategic need for a new product has been identified, procedures should be in place to identify a market opportunity that will meet these requirements. This stage should involve the identification of customer needs based on qualitative market research procedures (Urban and Hauser, 1993) and the detailed analysis of available competitive products (Baxter, 1995).
3. Early Feasibility Study: Procedures should be in place and used during the front end of the PIP to carry out a preliminary assessment of an identified market opportunity in terms of business and technical requirements. The financial implications of developing the product should also be determined along with the development of a preliminary project plan. A technical feasibility study should determine whether it is within the technical capabilities of the company to translate the identified market opportunity into a new product within the time and resource limitations of the project (LeBeau, 1995).
4. Product Definition: A complete specification of a new product's technical requirements should be developed that meets requirements of the market by incorporating the needs of the customer identified within the market opportunity (Griffin and Hauser,1993). With a specification now available, a new product can then be approved and formally released for detailed development (Siegel, 1991).

THE PIP FRONT END REFERENCE MODEL

In order to develop a detailed Reference Model of the front end of the PIP, the problem was simplified by dividing the process into a series of self-contained sub-stages or modules. The process was divided into a series of five modules, each with specific targets and product quality gates, covering strategic development through to the formal approval of a new product for its detailed design and manufacture. Each module contains a detailed representation of the procedures, tools, techniques, resources, decisions, information and formal documentation to effectively carry out all the necessary tasks.

Module 1: Market Orientated Product Strategy - This module should formally trigger new product development within a company and provide a direct link with corporate and business strategies. It involves the incorporation of an effective product replacement strategy and the detailed market analysis of competitors, product technology, and current company product

lines. The information generated should be used to help identify a strategic need to develop new products and achieve specified corporate objectives.

Module 2: Market Research and Product Opportunity Definition - After product development has been formally triggered, the market opportunity for the new product should be identified and clearly specified. Market research procedures should be performed with respect to a particular product opportunity in order to help establish a clear definition and obtain market requirements.

Module 3: Business Approval - Using the new product opportunity and customer requirements obtained from the market place, the overall project is justified in terms of business and financial commitment to a new product. This should include determining the overall cost of product development, estimating the projected sales performance and defining a product development time scale that conforms to the established opportunity window.

Module 4: Technical Approval - This module achieves company commitment to the new product in terms of its overall technical feasibility. This involves matching the needs of the market place with the capabilities of the company and the formation of a multi-functional Product Development Team, formally assigned to develop the new product.

Module 5: Product Approval & Full Specification - This module defines a full design specification for the new product. It involves the specification of market, production, life-in-service, and conformance requirements of the new product. After the Design Specification has been developed and accepted by all potential stakeholders, the project has been formally approved with the company fully committing itself to the detailed design of the specified new product.

THE GO/NOGO PROCESS QUALITY STAGE-GATE SYSTEM

Although product development is a necessary requirement within a dynamic and global market place, innovation is a risky business and the consequences of failure are severe. Many tough decisions need to be made during product development. The Product Introduction Process (PIP) should be viewed as a process that progressively and systematically reduces the risk of product failure.

Fundamental to the implementation of a high quality process and the management of development risks is the incorporation of an effective Go/NoGo stage-gate system within the front end of the PIP. At the entrance of each development stage is a Go/NoGo gate that helps manage the process and serves as a quality control checkpoint. The stage-gate mechanism requires a number of elements (Cooper, 1996) to function effectively and include the following:

1. Inputs: The inputs into the stage-gate are the required process Deliverables. These are produced from the results of the actions of the preceding development stage and are based on predefined process documentation.
2. Stage-Gate Criteria: The stage-gate criteria are the questions or metrics on which the project is judged in order to make the respective Go/NoGo decision. These include both qualitative (product superiority; strategic fit; market attractiveness) and quantitative

(financial return; development cost; product sales life) requirements, and can include must meet (mandatory) as well as should meet (desirable) criteria.

3. Resources: Each respective stage-gate should be staffed by the appropriate company personnel who can take full responsibility for the result. In addition, any tools or techniques to help with the decision process should be made readily available.
4. Outputs: The main output of a stage-gate is the result that is obtained from the review in the form of a Go or a NoGo decision. A Go result is obtained when all the decision criteria have been met and the product is allowed to progress onto the next stage of the development process knowing that a particular risk of failure has been minimized. A NoGo result is obtained when the new product has failed to reach the decision criteria and the development process is stopped.

After a NoGo decision has been reached a company is faced with two choices; recycle or Kill. The Go/NoGo stage-gate system is only effective within the front end of the PIP if the project kill decision is a real option and a company is fully prepared to cut its losses when a project has been highlighted as a significant risk.

TESTING AND VALIDATION OF THE REFERENCE MODEL

The Reference Model has been used in seven case study companies to test its validity. They have a diverse range of profiles and operate in a number of different industries. The case studies were carried out using a process of preliminary and detailed interviews. The data collected from each individual case was then processed using the Reference Model. The output generated by the Reference Model was then presented to the respective companies in the form of a report along with a verbal presentation of the case study findings given to senior management. The report provided each company with a detailed assessment of the strengths and weaknesses of the current product development process and a set of process models including AS-IS, TO-DO, and Ideal configurations. In addition to the detailed feedback each company was provided with an executive summary of the case study findings, a list of strategic recommendations, and a description of how the PIP model was constructed along with the main elements. This helped the companies interpret the results and structure the large amount of information contained in the report. Feedback from the companies indicated that the outputs generated by the reference model were accurate representations of the PIP used by them.

PRACTICAL APPLICATION OF THE REFERENCE MODEL

The reference model is relatively easy to use. As part of the system architecture, a user interface has been designed to input information regarding the process currently used by a company to develop and introduce new products into the market place. This interface consists of approximately 300 questions based on practices and parameters that influence the pre-detailed development stages of new product introduction.

This use of the model is illustrated for company A, which manufactures products for the domestic and industrial markets and distributed commercially through an extensive retailer and distributor network. Products are produced for the UK and European Union markets and market share is currently decreasing under intense competition from a major competitor. The

company employs a total of 250 personnel and has an organizational structure with a 3 layer operational hierarchy below the chief executive and managing director. Products are assembled from 50 to 100 individual parts and are classed as multi-assembly. The market life of these products is approximately 4 years. The company follows a comprehensive business strategy headed by a formal mission statement and currently has 8 new products in various different stages of the development process. The application of the model resulted in the identification of the following strengths and weaknesses.

Module 1: Company A - Market Orientated Product Strategy

Strengths: The company has set strategic targets for developing and replacing its products. Almost all of the necessary information to effectively trigger new product development is already recorded and stored within the company. The company also follows formal procedures to monitor the market place including the status of its current product range, the performance of competitors, and the availability of relevant technology.

Weaknesses: The company does not utilize Product Life Cycle theory to monitor and forecast the market performance of its products. The company does not adequately record the initiation of a development project by documenting all relevant market trigger and specific product replacement details for every new product. In addition, the company needs to set up a team of personnel to manage and control the trigger of all new product development.

Module 2: Company A - Market Research and Product Opportunity Definition

Strengths: The majority of the information required to carry out detailed Competitive Product Analysis and Market Needs Research procedures is stored within the company. The company also consults a variety of different sources of information when assessing the market for an opportunity to develop a new product.

Weaknesses: In overall terms this is the weakest stage of the current process. All market research procedures carried out to identify and specify a market opportunity to develop a new product are ad-hoc with no definition of important procedures available. The company does not document any assessment of competitive products and consequently important information is not taken into consideration during product opportunity definition and assessment procedures carried out downstream in the development process. Market Needs Research procedures performed in the market place are carried out informally and are unstructured. The company does not adequately record its market research. Finally, the company does not have an effective mechanism for assessing an identified market opportunity for sufficient market differentiation.

Module 3: Company A - Business Approval

Strengths: The company carries out detailed procedures to assess the financial feasibility and business opportunity of a new product and, in overall terms, this is the strongest part of the current process. As part of this assessment, the market performance is forecast, a market entry price is set, and a preliminary product development plan is produced. All the information used for the business and financial approval of a new product opportunity is also fully documented.

Weaknesses: The company does not have a forecasting model. The company needs to develop a set of fully traceable procedures and techniques to forecast product sales and help predict the market performance of new products before they are introduced into the market place. The company has not defined the criteria used to assess the financial viability and business opportunity of a new product.

Module 4: Company A - Technical Approval

Strengths: The company has a fully multi-functional design team to help develop its new products and documents member involvement. The development team is assigned a heavy weight leader with the responsibilities and mandate to manage the project effectively. Formal procedures are carried out internally, within the team, to formally review its relative performance and the progress of the project. The company is actively seeking to establish an effective two-way relationship with its suppliers. The company is currently undertaking a formal certification programme with fewer quality suppliers involving the collection of comprehensive data on their organization and proof of product quality. The company has also implemented a formal policy for the continuous improvement of suppliers involving the setting of long-term targets for improving products and manufacturing processes.

Weaknesses: There are a number of important mechanisms that are not currently employed that will help make the Product Development Team operate more effectively. In order to promote project 'ownership' the company should minimize member rotation and provide a suitable and permanent location for full time members to work. Suppliers are not involved in the development process early enough. The company does not carry out formal procedures to assess the technical feasibility of a new product opportunity before approving it for detailed development.

Module 5: Company A - Product Approval and Full Specification

Strengths: The company produces a detailed Design Specification before going on to the detailed design stages of the development process. The company also ensures that each of the functions involved in the development of a new product approves a Design Specification before being released for detail design.

Weaknesses: The company does not produce a Design Specification that meets all the necessary requirements. Company personnel also make unauthorized alterations to a Design Specification. Major changes should only be made with the full approval of all the individual functions involved in the same way that it was approved.

It was found that Company A is currently in the process of overhauling the front end of its PIP and, consequently, is in a transitional period. In overall terms the process is effective and a framework for the implementation of most of the recommendations is already in place. The current process is very strong in the area of assessing the financial feasibility of a new product and recommendations in this area are minor. The company has also embraced the important principle of Simultaneous Engineering and has built up a good working relationship with its suppliers. The main areas for concern occur during the very early product trigger and opportunity definition stages of the PIP where important procedures are either ad hoc or non existent. In addition, the company does not have an effective mechanism

for identifying products that represent a significant risk during the development process. The evidence from the study shows that many principles have already been applied in part but without a formal definition of the process cannot be improved effectively to maintain the quality of procedures.

CONCLUSION

This paper has described a Reference Model that provides support to companies wishing to implement a high quality front end to their Product Introduction Process. These early stages have been identified as the most important part of New Product Introduction but remain the weakest in a significantly high proportion of companies. Even though the need to address this situation has been clearly established within the available literature, there is little direct support available to companies. At the center of the Reference Model is an idealized representation of the front end of the PIP. This configuration combines established best practice together with a single process, which is used by the Reference Model as a basis for implementing the principles, contained.

The Reference Model can be used as a tool that assesses the current new product development process and establishes the situation that exists within a company. An Object-Oriented model of this process is then compared to an idealized representation of the front end of the PIP to produce a model of the existing gap. This process configuration becomes the foundation for identifying the weaknesses of the current process and making recommendations for its improvement. The identification of how the company introduces its new products helps incorporate existing mechanisms into the new process and utilizes the infrastructure already available. This minimizes the need to dismantle established practices and reduces the cultural shock of implementing new principles.

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