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Optimal economic result and risk of parallel development of concept options in dynamic markets

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Abstract

New product development is an essential competence to organizations. Launching success products requires elaborate and precise knowledge about the technological platforms, like the most important market needs and characteristics, and the project team have to employ information systems to support the project decisions, which must be rapid and accurate. However, when the market characteristics are much dynamic and change rapidly or the development project aims at a really new product, the levels of uncertainties are greater, and the project team must employ more robust strategies of risk management. Option thinking is useful to develop several concept alternatives of some crucial subsystems of the new product in order to achieve new technical and market knowledge by repeating cycles of design, built and tested by several and different prototypes in parallel. These different prototypes develop, test and can accumulate knowledge about each one, different technologies, architectures and quality attributes or the usability for potential customers.

This study achieves the optimal number of concept options to develop in parallel in order to maximize the economic performance of the development project of a new product constituted of two important subsystems. Mathematical models simulating the sequential decision process are developed to determine the economic result and risk of a two-subsystem product innovation project. Our results point the parallel development of concept options as a robust strategy to manage new product development mostly in adverse conditions, that is, with greater levels of uncertainties.

Keywords: New product development; Economic result and risk of projects; Option thinking

Introduction

The management process for new product development (NPD) is rapidly becoming the most important competence that a company must have, especially if its business environment is dynamic and competitive. To meet increasingly diversified demand, organizations from all industry sectors have had to develop competences both in the production planning and control and in the innovation of products and manufacturing processes. For Clark and Wheelwright (1993), there is a growing concern among companies in improving their management of new product and process development because of the huge pressures on them in the international business environment. For the above authors, management of the innovation process is no longer just a concern of high technology companies, but is a fundamentally necessary competence for each and every company.

Time-to-market for the whole process, from mapping out the technological and marketing strategies to the development and subsequent launch of the product in the market, has undergone a drastic reduction in companies, mostly in competitive business environment. A well-known strategy on NPD that aims at reducing time-to-market is the Integrated Project (IP), which has been cited (Clark & Fujimoto, 1991; Clark & Wheelwright, 1993; Ettlie & Stoll, 1990; Kessler & Chakrabarti, 1996; Takeuchi & Nonaka, 1986; Tidd, Bessant, & Pavitt, 1997) as the development approach that better addresses the problem for reducing time-to-market. This is a methodology that seeks to deal with the development process by integrating the functions and

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decisions in a multidisciplinary way and by team collocation. The main objective is to anticipate problems and conflicts earlier so that they can be solved earlier, thereby considerably reducing the amount of resources and time spent on subsequent analyses and tasks that would need to be redone. IP seeks that all tasks of the project and all elements of the life cycle of the product, from conception to sales, including quality attributes, costs and customer requirements, should be considered by all in the NPD multidisciplinary team (Brown & Eisenhardt, 1995; Clark & Wheelwright, 1993; Takeuchi & Nonaka, 1986).

The Integrated Project has been considered responsible for constantly reducing not only the time-to-market but also for new product development and reduced production costs and certainly also for gathering products with greater levels of quality and functionality, mostly for new products with lower levels of innovativeness (e.g., Brown & Eisenhardt, 1995; Clark & Fujimoto, 1991; Clark & Wheelwright, 1993; Kessler & Chakrabarti, 1996; Smith & Reinertsen, 1998; Takeuchi & Nonaka, 1986; Vesey, 1991).

However, when the market characteristics are so dynamic and unknown, where its needs change much rapidly or the development project aims at a radically or really new product, the levels of uncertainties are greater and the project team must employ more robust strategies of risk management in order to increase the chances of hitting the target quickly. Option thinking is much useful to develop several concept alternatives of some crucial subsystems of the new product in order to achieve new technical and market knowledge by also employing and considering the integrated project philosophy, repeat cycles of design, and building and testing of several and different prototypes of concepts in parallel. These different prototypes of concepts develop, test and accumulate knowledge about each one, different technologies, architectures and quality attributes or the usability for potential customers.

In these conditions, the team cannot develop only one concept because the risk is very high and a failure could compromise the project. Few concept options lead to a less costly but successfully low NPD project. On the other hand, greater quantities of concept options can improve the potentiality of obtaining success in launching the product, but incurring higher costs. In this context, the most important question is how many concept options the project team should develop in parallel in order to maximize the expected economic performance of the new product project?

This research presents a methodology to achieve the expected economic performance and the risk of the parallel development of several concept options. We apply a mathematical modeling in order to represent the sequential decision process methodology that parameterizes some of the main characteristics of product development projects (e.g., performance uncertainty, complexity, development costs and potential revenue from the market). We also consider the economic result and risks of the strategy of only one concept development in order to be used as a simple reference for comparison with the results from the parallel development strategy.

The results show that parallel development of several concept options is a strategy that presents a hedge for economic performance mostly to the projects where there are higher levels of uncertainty. Risk is considered as the probability that the project does not achieve success in the development process.

The paper is structured in four sections. The second section gives the literature review on the subject. The third section presents the mathematical modeling and main assumptions, as well as computational results and analyses. The fourth section presents the main conclusions, and contributions to literature besides the suggestions for future researches.

Table 1
Market requisites and competences evolution of organizations.

Decades	Market requisites	Performances or strategies
1960	Price	Efficiency
1970	Price, Quality	Efficiency + Quality
1980	Price, Quality, Products Lines	Efficiency + Quality + Flexibility
1990	Price, Quality on Products Lines, Novelty	Efficiency + Quality + Flexibility + Innovation

Source: Bolwijn and Kumpe (1990).

Literature background

This section presents a brief discussion of the literature on innovation management, new products development projects and also on option thinking and parallel development, important for the conduction of this study.

The competence of innovation management

Changes in the businesses environments in the past three decades have imposed organizations to seek new strategies to produce, buy, sell, distribute and develop new products. From the 70s, organizations that have had to adapt to the new environment quickly began to form and Innovation has become the most desired competence.

For Clark and Wheelwright (1993), it is not that some companies simply increased the percentage of revenues yielded from research and development (R&D), but the process has been driven by large forces, as increase in international competition in segmentation and fragmentation of markets and also due to the diversification of new technologies.

Bolwijn and Kumpe (1990) created a phase model to understand and explain the relationships between criticism and diversification of the markets in the business environments with cycles of competences creation cycles by companies after surveying several organizations in Europe. For them, the companies were developing and accumulating competences along the past few decades. The companies that survive will be accumulating all the previous competences. The authors relate the market requisites with the competences and the performances that the companies had to develop as an answer and as evolution along time, as presented in Table 1.