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Portfolio management of R&D projects: implications for innovation management

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Abstract

Globalization of markets and new business practices are prompting high-tech firms to reconsider their competitive strategy. The increasing complexity of technologies in addition to shorter product life cycles are also forcing firms to rely on R&D as a source of strategy. More importantly, firms are inclined to evaluate their technologies from a portfolio's perspective in which a set or a sub-set of R&D projects is evaluated together, in relation to each other. Portfolio techniques can help strategic managers in evaluating whether a portfolio of products is adequate from the perspective of long-term corporate growth and profitability. Obviously, when R&D projects are evaluated relative to one another, technical capability management of such projects must be carried out concurrently. In this paper, R&D Project Portfolio Matrix is used as a tool for analyzing a portfolio of R&D projects by linking competitive advantages of a firm to benefits these projects may provide to customers. Examples of batteries for electric vehicles (EV) and hybrid electric vehicles (HEV) are provided to illustrate how such a matrix is used, and some of the implications for innovation management of such projects.

Keywords: Portfolio management; R&D; Innovation; Competitive advantage; Automotive industry

1. Introduction

In recent years, there has been an increasing interest in the area of portfolio management of R&D projects. Portfolio matrices have been used by Boston Consulting Group (BCG), McKinsey, and others (Abell and Hammond, 1979) to characterize product–market alternatives in terms of the attractiveness of the market, growth rate of the market, and the ability to create a distinctive advantage, such as high market share and competitive leadership of a firm's own projects. The portfolio approach to R&D management points out the different cash flow implications and requirements of different projects. Also worth mentioning is the graphic presentation of the projects, allowing managers to identify relevant adjustments with respect to the composition of a company's portfolio.

Portfolio techniques are powerful tools in that they allow products and R&D projects to be analyzed in a systematic manner, providing an opportunity for the optimization of a company's long-term growth and profitability. One of the main challenges of portfolio techniques is the selection of variables and sound indicators. The question arises as to how many variables need to be taken into consideration in order to make correct assessment of the projects. How can these variables be combined in order to ensure orthogonality? How does subjectivity influence consensus across different organizational functions for managing a portfolio of R&D projects? What are the implications for innovation management?

In the seventies, BCG Growth-share Matrix was a popular strategic analytical tool applied by multinational corporations for aiding in assigning priorities, investment, and resource allocation decisions. Similarly, the McKinsey Matrix[1] suggests a priority for resource allocation by taking into account critical internal and exter-

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[1] Other names used to describe the McKinsey Matrix include GE Matrix and Industry Attractiveness–Business Strength Matrix. For a detailed procedure of its application, see Hax and Majluf (1983).

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nal factors. Its primary importance is to assign priorities for investment in the various businesses of the firm. The popularity of these matrices, however, was matched with equally outspoken criticisms.

Some criticisms of the BGC Matrix are derived from the difficulties in measuring market share and market growth rates. Common pitfalls include difficulties in defining the relevant market, wrong assumptions about the validity of the product life cycle, the value of the market share, the effect of market structure, market stability, interrelatedness of product–market segments, divesting the dogs, and viewing the portfolio as a closed system (Slatter, 1980). The McKinsey Matrix, furthermore, includes a wide variety of factors in addition to market share and market growth rates used by the BCG Matrix. Some of the challenges of using this matrix are derived from difficulties in identifying and assessing external and internal factors, difficulties in dealing with multi-attributes leading to high ambiguity in measuring business strength and industry attractiveness, and the use of Net Present Value as the evaluation tool (Hax and Majluf, 1983).

A literature review in portfolio management of technology and innovations reveals that most of them have very limited definitions in characterizing project success. The BCG Matrix, a four-cell matrix, uses relative market share and industry growth rates as determinants of success (Slatter, 1980; Henderson, 1979). Similar to the BCG Matrix, the McKinsey Matrix uses competitive position of a company and industry attractiveness in a nine-cell matrix (Hax and Majluf, 1983; Segev, 1995). One of the first product portfolio models is the Product Portfolio Matrix. This matrix was developed as a guide to allocation of a firm's resources based on business strength and industry attractiveness, but it offers no advice for the types of technologies and associated products with which the firm should be involved (Day, 1977). In order to address this issue, the Technology Portfolio was developed by Capon and Glazer (1987) which is a framework used for integrating technology and marketing strategies. Although the Product/Process Development Projects Matrix by Wheelwright and Clark (1992a,b) characterizes product changes relative to process changes and their impact on allocation of resources, it does not address other factors influencing the success of a company. Cooper and Kleinschmidt (1993) introduced the Performance Map which basically used factor analysis techniques to identify the success dimensions of new products. It also measures five performance types in relation to two performance dimensions: time performance and financial performance. Perhaps a more comprehensive framework is introduced by Arthur D. Little (Roussel et al., 1991) in which four key elements of individual projects are evaluated: technological competitive strength, technology maturity, competitive impact of technologies, and R&D project attractiveness.

It is no surprise that identifying success factors of an innovation is not straightforward. Based on the competitive structure of the markets, each industry faces unique sets of challenges that are irrelevant to other industries. Hence, portfolio techniques usually serve to solve a particular set of complex issues faced by R&D management, unique to each firm. Naturally, the knowledge and technical feasibility that goes hand-in-hand with the R&D projects must be managed concurrently. Equally important is the assessment of these projects with respect to customer value as well as competing technologies.

In this paper, the R&D Project Portfolio Matrix is used as a tool for highlighting possible gaps between the competitive advantages of a high-tech firm and customer value. It is argued that R&D projects of a firm should be evaluated vis-à-vis the benefits these projects offer to customers. The paper is organized as follows. Firstly, some issues on the management of innovation are discussed. Secondly, the concept of a balanced portfolio is explained followed by the introduction of the R&D Project Portfolio Matrix. Next, dynamic issues of R&D projects are examined. Finally, the application of the matrix is illustrated with examples of R&D projects under development for electric vehicle (EV) and hybrid electric vehicle (HEV) batteries.

1.1. Management of innovation

An increasing number of scholars highlight the importance of linking technological capabilities of a firm with its customers. For instance, Cordero (1991) argues that the rate of product obsolescence is accelerating in many industries because customers are willing to pay for innovative products, and firms that cannot supply innovative products faster than competitors, lose competitiveness. He also highlights the importance of organizing product development and product manufacturing for speed, both complemented with time-saving techniques. Similarly, Pavitt (1990) and von Hippel (1986) argue that one measure of success and profitability within a firm is the ability to satisfy user's needs better than the competition. As many firms are pressured to introduce products with more variants per model and at a faster rate than before, 'time-to-market' has become a measurement for gaining competitive advantage.

The innovation process encompasses a range of activities that contribute to producing new goods and services in new ways. An innovation occurs when a new good, service or production method is put into commercial use for the first time (Hall, 1994), creating new markets and supporting freshly articulated user needs in the new functions it offers; and in practice, an