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The issue of weightings in technology portfolio management

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Abstract

This research explores the underlying components of technological competitiveness and technological attractiveness. It starts with a list of 32 criteria identified in the literature; 16 are used for depicting technological competitiveness and 16 are used for describing technological attractiveness. These criteria were submitted to a panel of technical experts for evaluation. Results of the investigation show that the attractiveness of a given technology depends mainly on the potential impact of this technology on the competitive issues, the market volume and the span of applications it opens, its performance relative to other technologies, the competitive intensity of the technical area and, finally, the barriers to imitation. Results also show that technological competitiveness depends above all on the value of the 'applied research' and the 'development' teams' competencies, the relatedness of the technology to the company's core business, the time advantage *vis-à-vis* the competition and the potential for financing.

Keywords: Technology; Portfolio management; Technological competetiveness

One of the main tasks of Chief Technology Officers (CTOs) is to get the best use of resources. The R&D issue is to define where R&D (Research and Development) efforts should be directed and organized. This means allocating resources (capital, people, physical facilities, equipment, etc.) across an array of significantly different technology programs. The question is twofold: (1) which programs should be slowed down, scaled back, or even cut off? Which ones should be sustained, expanded, or boosted? Which new projects should be launched?—and, (2) which means should be chosen (in-house R&D, acquisition, inter-firm alliance, etc.) to carry out development aims?

This text addresses the first of these two questions. In order to formalize and to systematize this decision process, models of technology portfolio were designed in the 1980s to help CTOs tackle this major task. Seminal approaches to technology portfolio modelling should be attributed to Little (1981), Foster (1981) or Harris et al. (1981). For example, Foster (1981) suggests drawing an R&D audit matrix combining 'prospects for increased productivity' and 'prospects for increased yield'. Harris et al. (1981) recommend building the technology portfolio by relying on 'technology importance' for competitive advantage and 'relative technology position' in comparison to competitors. More recent approaches deal with interdependences between projects (Ouellet and Martel, 1995), try to take account of diversification risk effects (Ringuest et al., 1999), describe strategies to pursue regarding which category of the technology portfolio one given technology falls into (Hsuan, 2001), or put the emphasis on the search for optimal portfolios, i.e. suited to the new product development strategy of the firm (Balachandra, 2001).

Most of the conventional technology portfolio models rely on the same general framework. These tools assume that every technology can be examined and scaled along two dimensions. This dichotomy can be related to what the Greek philosopher Epictete said: "Amongst things that exist, some depend on us and some do not". This pattern is verified in many circumstances; it is, for example, the case in the field of strategy with the Swot framework. The strengths and weaknesses of the company depend on its internal resources; the firm is free to adopt the behavior it wants regarding these internal resources that are supposed to be under its control. But, on the contrary, the opportunities and threats depend mostly on what is happening in the environment. As a matter of fact, the firm has little impact on external elements such as the actions of competitors, suppliers and regulators as well as the choices made by customers.

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The same principles apply when it comes to technology portfolios. They allow for the definition of a clear dichotomy between two families of elements. There are things that are mainly under the firm's control, assets that depend on the firm's behavior and decisions; I will refer to these factors as "the company's technological competitiveness". And, there are things that do not depend on the firm's actions, that are beyond its control: I will refer here to these elements as the "the attractiveness of the technology".

As such, technology portfolios provide a framework for assessing the situation of a firm regarding its portfolio of technologies. Finally, these tools are also useful for strategy formulation because they offer guidance to the resource allocation process. The process of construction may be organized in four stages:

1. drawing a complete list of the various technologies incorporated by the firm in its product, processes, information and management systems,
2. assessing the attractiveness of each technology of the firm's portfolio, i.e. its impact for creating value,
3. assessing the degree to which each technology is within company control,
4. plotting a map of each technology of the portfolio along the two axes.

As shown in Fig. 1, technology portfolio mapping gives insights into the directions where efforts should be made. By combining these two dimensions (the company's technological competitiveness and technological attractiveness), resource allocation strategies for technology programs could be derived from the positioning of each technology on the portfolio map: redirection of resources for 'dead-end' technologies; recycling into other environments for 'leftover' technologies; strong allocations for 'unstable' positions; and sustained exploitation for 'core' technologies.

This paper sheds light on the measurement of technological attractiveness and technological competitiveness. It is hypothesized that each of these two dimensions can be described using a multi-criteria approach and that all criteria do not have the same weight. The paper is divided into three parts. Part 1 relies on the existing management literature for identifying a set of criteria. Part 2 explains the research methodology used for affecting weightings to these criteria. Part 3 presents the results of the empirical investigation and discusses these results.

1. The criteria developed in the literature

The aim of this first section is twofold: (1) to list and briefly examine the impact of a large array of criteria on the attractiveness of one given technology. These criteria are important for value creation. It was stressed in the introduction that they are intrinsically related to the technology and are beyond the control of the firm. This means that technological attractiveness is identical for all companies competing in this technology; (2) to list and evaluate the value of a range of criteria for auditing a firm's competitive position on a given technology. Usually these criteria express internal factors that are within the firm's control. So, on this axis, the position of one given company could be very different from the position of another.

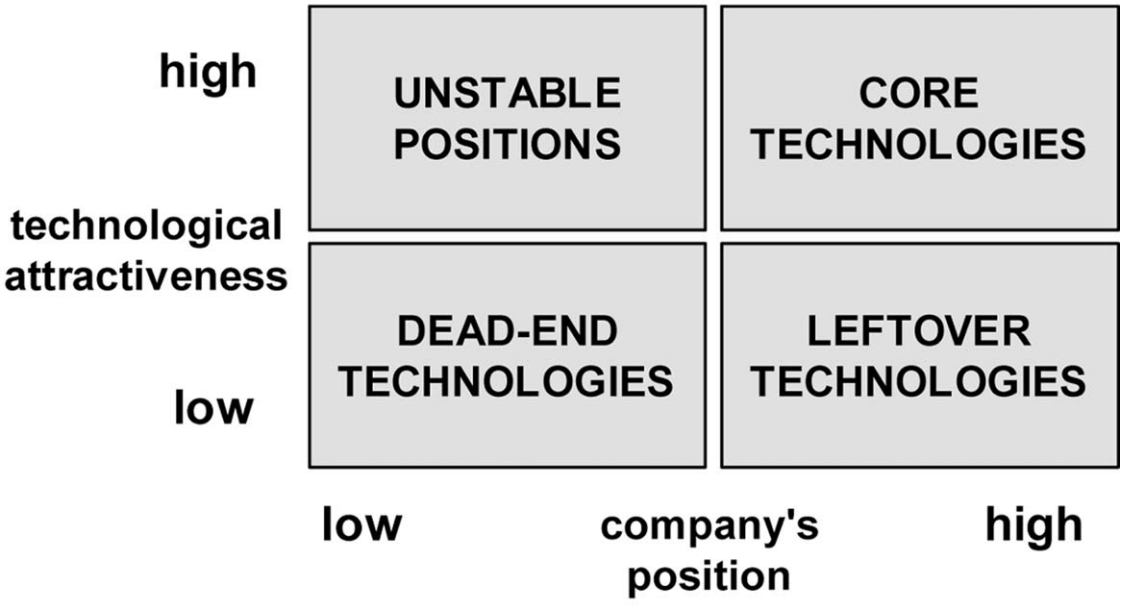

Fig. 1. Technology portfolio models.