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Technological invention to product innovation: A project management approach

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Abstract

The optimal allocation of resources at the firm level to transform emergent technological invention into commercially successful products depends on the effective assessment and selection of projects. This study develops a multidisciplinary model for differentiating, prioritizing, and selecting investment in technological projects within an organization's portfolio. Approaches from project portfolio and strategic technology management are integrated to explore how a particular product within a diverse project portfolio may be prioritized and developed. Our results suggest that the application of the suggested model to a portfolio of biotechnology projects may enhance the assessment of internal capabilities and external competitiveness, thereby providing a basis for firms to prioritize and preferentially allocate scarce resources within a portfolio of heterogeneous technologies.

Keywords: Biotechnology; Legitimacy; Project portfolio management; Project screening criteria and evaluation

1. Introduction

Firm growth and sustainability depend in part on the effective allocation of resources and risk management at the organizational level. Tools for effectively assessing organizational projects in order to select those that contribute to organizational goals therefore becomes important (Peerasit and Milosevic, 2009), especially in the context of limited resources (Rad and Levin, 2006), nascent technologies seeking legitimacy (Aldrich and Fiol, 1994), and frequent project failure (e.g., Johnson et al., 2001; Kutsch and Hall, 2005; Luna-Reyes et al., 2005; Leach, 2005). To explore this dynamic process, we develop and apply a model for differentiating, prioritizing, and selecting projects within an organization's portfolio. The merit of refining project portfolio tools is based on their potential to improve the product innovation process by ensuring that scarce organizational resources are spent on projects that are based not only on advanced innovation, but also have a reasonable probability of turning into successful products (Peerasit and Milosevic, 2009).

This exploratory study integrates portfolio management and technology management approaches by extending the Diamond Model of project management (Dvir et al., 2006; Shenhar and Dvir, 2007) through integrating it with strategic technology management criteria (e.g., Porter, 1985, 1991; Curry and Brown, 2003; Manion and Cherion, 2009). The empirical context for this investigation is a research and development-based organization and its portfolio of diverse, nascent biotechnology product candidates aimed at a single wound healing application. Specifically, Industrial Research Limited (IRL), a New Zealand Crown Research Institute (CRI), has a portfolio of five wound healing products based on heterogeneous, nascent technologies was the focus of analysis and a mixed-methods research design.

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The question this paper poses is: How are nascent high technology products within an organizational portfolio differentiated, selected and prioritized among competing projects under conditions of uncertainty? From a theoretical standpoint, we develop an extension of technology management tools through the integration of portfolio and strategic project management insights. From a practical standpoint, this refinement holds potential as a way of enhancing the effective evaluation and prioritization of more promising innovative product candidates, which would assist in organizational resource allocation, risk management and strategic alignment.

2. Portfolio planning and alignment

In the context of project management, innovation is the capacity to translate invention or insight into commercially valuable goods and services (Christiansen, 2003). As part of the innovation process, the capacity for risk management (versus risk elimination) is critical to managing scarce resources, particularly in an environment of multiple projects vying for the same scarce capital under conditions of uncertainty (Cooper et al., 2001; Dey, 2006).

However, allocating investment to innovative products is a necessary but insufficient factor in ensuring economic growth and development. According to the literature most organizations spend their capital budgets on projects that fail to promote targeted goals (e.g., Johnson et al., 2001; Kutsch and Hall, 2005; Luna-Reyes et al., 2005; Leach, 2005). As a result, projects should be carefully assessed and selected to ensure they become successful products that contribute to organizational goals. These processes are usually studied under the developing area of project portfolio management, which is used to maximize the contribution of projects to the overall welfare of the enterprise (Rajegopal et al., 2007; Theeuwes and Adriaansen, 1994). For example, Blau et al. (2004) proposed a portfolio management approach that selects a sequence of projects, allowing the expected economic returns to be maximized at an acceptable level of risk for a given level of resources in a new product development pipeline. The primary benefit of most project portfolio management systems is that only projects that significantly contribute to organizational growth are selected and/or continued (Rad and Levin, 2006). The implication being that projects should be fully aligned with the strategic business goals of the enterprise (Dey, 2006; Manion and Cherion, 2009; Peterson, 2006; Zwikael and Linenberg, 2000) without exceeding available capital resources (Huang, 2007).

The project management literature suggests various project selection models that broadly fit into two approaches: financial and strategic alignment models (Rad and Levin, 2006). Financial models include payback period, net present value or discounted cash flow, net annuity value, and internal return rate (Huang, 2007). Strategic alignment models involve identification of objectives and linkages between projects and goals (Zwikael and Linenberg, 2000), scoring models (e.g., Cooper et al., 2001; Martino, 2003; Meredith and Mantel, 2006), analytical hierarchy process (AHP) models (e.g., Saaty, 1980), utility function, goal programming, fuzzy theory, 0–1 mathematical modeling, and 0–1 integer linear programming (Dey, 2006).

A focus on strategic alignment enables effective innovation management processes, organizational growth, and changes the locus of action by: (1) achieving consensus among the organization's executives on the importance and priority of each project, (2) aligning the decision-making team, and (3) understanding budgetary impacts on business growth (Zwikael and Linenberg, 2000). The most common application of strategic alignment is made during project prioritization (Mavrotas et al., 2006; PMI, 2008) and project selection (Srivannaboon and Milosevic, 2006).

A specific model within the field of project management is the Diamond model for project classification (Dvir et al., 2006; Shenhar and Dvir, 2007). This is often called the NTCP model as it focuses project assessment on novelty, technology, complexity, and pace. The model ties strategy and project management together, which is a response to the observation that project management success is often too narrowly defined and may be disconnected from firm level performance (Shenhar and Dvir, 2007). However, the Diamond model remains internally focused (i.e., intra-organizational or 'context-free') rather than situating projects within the wider context of firm strategy and market competitiveness (Koria, 2009; Porter, 1991). To integrate the broader strategic context of market attractiveness and prioritization of scarce resources for technological products, we added three additional factors that have been found in the literature to have significant importance: market size, growth rate, and development costs (Morgan and Strong, 2003; Porter, 1985; Zider, 1998; Edmondson and Nembhard, 2009). Fig. 1 presents the seven dimension model suggested for technology management profiling.

Next, the modified Diamond model will be considered in the empirical context of a research and development-based firm's assessment of a diverse portfolio of technologies under consideration as product development candidates for wound healing applications.

3. Industrial research limited (IRL): wound healing technology and product development

Crown Research Institutes (CRI), established in 1992, are an important part of the New Zealand economy working towards New Zealand's Intellectual Property (IP) driven growth (Clark, 2002). CRIs are quasi-public companies established to undertake scientific research and related activities to advance technologies into commercial applications. The eight CRIs are owned and monitored by the New Zealand Government, while also having accountable and independent boards. CRIs may consequently be defined as being driven by a mix of private and public objectives (CCMAU, 2008; Statistics New Zealand, 2007).