Chapter 2
Innovation Risk Path Assessing for a Newly Emerging Science and Technology:
Illustrated for Dye-Sensitized Solar Cells

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ABSTRACT

For "Newly Emerging Science & Technologies" ("NESTs"), uncertainty is the major challenge. Technological innovation for NESTs faces many kinds of risks that dramatically affect their development paths. This chapter combines methods of risk utility theory and technology path research and explores a new innovation risk path modeling method for NEST development. Here, the authors apply selected tools from risk utility theory and technology path research to the NEST of special concern—Dye-Sensitized Solar Cells (DSSCs). The case for DSSC commercialization is promising, but challengeable. The prospects for future development of DSSCs are good, with identifiable markets. Multi-party collaboration appears necessary in order to overcome challenges to development. If key technology component selection, technical stability, maturation rate, and other core issues can be improved, commercial innovation has tremendous potential. However, significant competing technologies, as well as uncertain environmental influences, complicate matters. This combination of qualitative and quantitative approaches should yield robust assessment and should allow for better communication of those results. It is useful for technology managers and policy-makers to grasp the development process and prospects for a specific NEST to facilitate innovation management.

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INTRODUCTION

"NESTs" are a loose category to which our European colleagues are drawing special attention (Jacobsson and Johnson, 2000; Foxon et al., 2005; Markard, 2006; Robinson and Propp, 2008). Classical technology forecasting methods were devised to address incrementally advancing technological systems (e.g., Moore's Law well describes some six decades of semi-conductor-based advances). Those methods keyed on technical system parameters, somewhat more than on socio-economic system aspects, because they were initially driven by Cold War tendencies to concentrate on functional gains more than on cost and market issues. Today's NESTs are more apt to incorporate science-based advances (e.g., in the biotechnologies and nanotechnologies), which tend to occur sporadically, sometimes with disruptive effects. Analyses of NESTs are often related to economic opportunities, with significant concern for identifying and mitigating potential "unintended, indirect, and delayed" societal consequences. We seek to contribute to the development of analytical tools to relate early-stage scientific advances to long-term implications (i.e., potential applications and their implications).

The previous research provides the research base and useful insights on risk indicator and system, project evaluation methods, the concept of risk, risk identification, risk assessment, and risk early warning. However, these previous studies all assumed a static point of risk assessment without consideration of effectiveness of utilities of different risk levels in different stages of the dynamic technological development. At this point, no systematic research method on dynamic development of new technology products has been devised. To solve this problem, we attempt to evaluate the effectiveness of the risks in the process of development of new technological products from the point of view of the technical pathway. This study combines the theories of risk utility evaluation and technological pathway and contributes to the literature on those two theories.

Here we applied selected tools from risk utility theory and technology path research to the NEST of special concern—Dye-Sensitized Solar Cells ("DSSCs").

BACKGROUND

Innovation Risk

Theoretical Risk of Technology Innovation

Technological innovation is a high-risk activity. Mansfield conducted a statistic analysis in 1981; the statistic result shows that, in the technology R&D stage, only 60% of high-tech research experiences success, and only 30% of the successful researches can be successfully applied to market needs and be developed into products accordingly. However, only 20% of those high-tech products ultimately see success on the market. That is, from the beginning of new technology research and development to the final market, the success rate amounts to less than 2.2% (Chen and Liu, 2007).

Technological innovation risk refers to the possibility of loss that may occur in the process of technology innovation. This risk is due to various uncertain factors, including the difficulty of the project and the constraints of innovation capabilities, which may result in the revocation, suspension, or failure of innovation activity or its failure to reach the intended target (Xie, 1999). For new and emerging technologies, which hold a great inherent uncertainty, understanding the role and impact of such risks is particularly important.

Management of technological innovation aims to reduce the risk of innovation and seeks the ultimate success of innovation. Technological innovation and rational risk evaluation are not only conducive to risk prevention, but also improve the