



ELSEVIER

Available at  
**WWW.MATHEMATICSWEB.ORG**  
POWERED BY SCIENCE @ DIRECT®

Simulation Modelling Practice and Theory 10 (2002) 297–320

**SIMULATION  
MODELLING**  
PRACTICE AND THEORY

www.elsevier.com/locate/simpat

# Exploration, exploitation and adaptive rationality: the neo-Schumpeterian perspective

Jeho Lee <sup>a,1</sup>, Young U. Ryu <sup>b,\*</sup>

<sup>a</sup> Graduate School of Management, Korea Advanced Institute of Science and Technology, 207-43 Cheongryangri-dong, Dongdaemun-gu, Seoul 130-012, South Korea

<sup>b</sup> School of Management, The University of Texas at Dallas, P.O. Box 830688, JO 44, Richardson, TX 75083, USA

Received 13 October 2001; received in revised form 14 March 2002; accepted 22 May 2002

---

## Abstract

Resource allocation between exploration of emerging technological possibilities and exploitation of known technological possibilities involves a delicate trade-off. We develop a model to represent this trade-off under the time-pressing situation where the firm's existing basis of survival is constantly challenged by competitors' innovation and imitation. We examine how the employment of an adaptive rule improves a balance between the exploration and the exploitation. Simulation experiments show that an adaptively rational decision rule, or a step-by-step exploration of unknown opportunities based on feedback on returns, is more likely to increase firm survival under diverse conditions than an all-or-nothing approach regarding the unknown opportunities. Furthermore, our study suggests that the adaptively rational rule is self-protected from too much loss, while its potential pay-off can be unbounded above.

© 2002 Elsevier Science B.V. All rights reserved.

*Keywords:* Exploration and exploitation; Innovation; Evolution; Schumpeterian competition

---

---

\* Corresponding author. Tel.: +1-972-883-4065; fax: +1-972-883-2089.

E-mail addresses: [jlee@kgs.m.kaist.ac.kr](mailto:jlee@kgs.m.kaist.ac.kr) (J. Lee), [ryoung@utdallas.edu](mailto:ryoung@utdallas.edu) (Y.U. Ryu).

<sup>1</sup> Tel.: +82-2-958-3678; fax: +82-2-958-3124.

## 1. Introduction

The trade-off between exploration of new possibilities and exploitation of known possibilities has been considered a fundamental feature of adaptive systems [13,19,20]. In the management literature, this issue has also received significant attention since March [28] introduced it. The issue often causes a strategic dilemma in high-tech industries, where the exploration of a new technology puts tension on the resources for developing new products with a known technology.

For example, the emergence of a new technology called “combinatorial chemistry” opened up new possibilities in the pharmaceutical industry when it had witnessed a sign of diminishing returns to innovation with the existing technology until the early 1990s.<sup>2</sup> The new technology was claimed to dramatically speed up product development cycle. Eli Lilly was among the firms that considered whether to adopt the new technology or not [35]. However, the technology was untried and controversial at the time. Some scientists at Lilly argued that the investment in the new technology would not only delay time to market for products under development but also waste scarce resources, which could be better used with the known technology to enrich the company’s new product pipeline. Others argued that the exploration of combinatorial chemistry would greatly increase Lilly’s R&D productivity, which would become a strategic asset for R&D warfare in the future. The Lilly’s decision problem represents a typical example of the tension between exploration and exploitation, which is tantamount to the problem of deciding to what degree the present should be mortgaged for the future [20].

How should a firm balance the effort between exploration and exploitation? Much of prior research has addressed the difficulty for incumbents to explore a new technology. Theoretical work on learning highlighted the natural tendency that incumbents with the experience in a known technology are inert to or blinded to new technological opportunities (e.g., [7,23,27]). A popular explanation for this tendency was “competency trap” or “learning myopia”—this is associated with the reduced incentive to learn a new technology as incumbents achieve a high level of efficiency with the existing technology [26,27]. However, this literature has warned managers that incumbents trapped in the existing technological paradigm may have difficulty in surviving later when a new paradigm proves its superiority. Indeed, a number of empirical studies showed that incumbents failed in the face of radical technological change (e.g., [5,18,37,38]).

Although much of prior work has contributed to the understanding of the trade-off between exploration and exploitation, scanty attention has been paid to the management issue of how a firm can improve the balance between exploration and exploitation. At least, few formal models exist to address this management issue.

---

<sup>2</sup> Declining innovative productivity in the pharmaceutical industry was consistently observed by many researchers (e.g., [15,34]). In particular, Chabala [4] noted that despite a ten-fold increase in R&D spending from 1976 to 1994, the number of new chemical entities discovered per year reached a plateau.

متن کامل مقاله

دریافت فوری ←

**ISI**Articles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات