Technological Forecasting & Social Change 79 (2012) 1583–1591

Contents lists available at SciVerse ScienceDirect

Technological Forecasting & Social Change

Adaptive foresight modular design and dynamic adjustment mechanism: Framework and Taiwan case study

Hao-Chu Lin [a,b], Pin Luarn [a], Ren-Horng Maa [c], Chao-Wen Chen [c,*]

[a] Graduate School of Management, National Taiwan University of Science and Technology, No. 43, Keelung Road, Section 4, Taipei, Taiwan, ROC
[b] Department of Industrial Technology, Ministry of Economic Affairs, No. 15, Fu-Zhou St., Taipei City 100, Taiwan, ROC
[c] Advanced Technology Planning Office, Department of Industrial Technology, Ministry of Economic Affairs, 6F., No. 51, Sec. 2, Chongqing S. Rd., Zhongzheng District, Taipei City 100, Taiwan, ROC

ARTICLE INFO

Article history:
Received 15 November 2011
Received in revised form 7 June 2012
Accepted 30 June 2012
Available online 22 July 2012

Keywords:
Technology foresight
Dynamic planning
Adaptive planning
Modular design
Taiwan

ABSTRACT

In response to future external environmental challenges and to foster a consensus on national development, over the past 30 years developed and developing countries have endeavored to set a national direction for development and allocation of R&D resources through a standardized operational model on foresight projects. However, major national foresight programmes that have a 4–5 year cycle have encountered many challenges. These challenges include prolonged planning time, resulting in not keeping pace with the ever-changing environment, massive resource investment unsuitable for countries with limited resources, and bottlenecks such as inoperability of the planning processes connected to follow-up project promotion. In this article, we propose a dynamic modular design perspective to overcome such difficulties and demonstrate the process and achievements of foresight planning using the Taiwan Industry and Advanced Technology Research Project as an example. Our research results can serve as a reference in national technology foresight planning for developing countries with limited resources in the rapidly changing technology development environment.

1. Introduction

Over the past 30 years, advanced countries have introduced national foresight projects, attempting to build a consensus on national development through the introduction and operation of foresight planning mechanisms [1]. Asian countries, including South Korea, Taiwan, and China, have invested in designing overall national foresight planning and a technology roadmap to converge on a future development direction and to strengthen national competitiveness through technologies [2,3].

For governments, foresight is an important policy instrument to strengthen the capability of a national innovation system. Foresight projects not only identify the future technology direction, but also converge various stakeholders to establish a common vision and action plans. Foresight projects also play a crucial role in establishing a future new value network, which involves combining emerging technologies, organizational partnerships, and establishing a resource allocation system [4].

When facing fundamental social and economic changes, foresight is generally considered a commendable tool for improving people's lives and the international competitiveness of a country. Foresight research necessitates adjusting stakeholder state of mind and accommodating different perspectives to obtain a consensus through a logical and organized approach [5]. Foresight does not merely forecast the future; it helps people clarify and fulfill tasks to be completed [6]. To seize opportunities and avoid threats, technology foresight has gradually become an important strategic tool for decision making. Examples include the Navigator Network, an early alert service developed by New Zealand in 2003, the direct involvement of business professionals in national innovation policymaking in the Netherlands in 2005, the third session of the German "Futur" foresight process, organized

* Corresponding author. Tel.: +886 2 23946000x2507; fax: +886 2 23587373.
E-mail address: nellchen@micmail.iii.org.tw (C.-W. Chen).

0040-1625/$ – see front matter © 2012 Elsevier Inc. All rights reserved.
doi:10.1016/j.techfore.2012.06.010

in 2001, which invited representatives from the community to participate, and Hungary's Technology Foresight Programme begun in 1997.

Intelligence collection, stakeholder networking, common vision, and priority setting are all critical factors in the research process, whether it is for national-level or organizational-level foresight research [7]. A general direction can be reasonably forecast, despite many future uncertainties. Foresight activities provide a crucial value in establishing networking and preparing for the future [6].

The primary objective of technology foresight is not to forecast the future or describe scenarios; rather, it is intended to determine if the development trends of external environment and internal conditions are able to respond to these trends and incorporate future uncertainties into the decision-making process [8]. The determining process of foresight activities can improve the adaptability of a strategy for the present situation and the future environment through public participation and implementation. It can associate closely with the dynamic environment and connect directly with decision-making and follow-up action plans. Major features of strategic foresight include knowledge production, reflection, and action [9].

Konnola [10] indicated that the objectives of foresight projects include support for priority-setting, networking, and building a shared vision. These objectives are closely related to managing public policies.

Foresight mechanisms and design processes play vital roles in foresight projects. How to establish a common vision among participating stakeholders and shape the future through mechanism design is a major challenge. Eriksson and Weber [11] suggested an adaptive foresight (AF) concept that considers both robustness and flexibility and combines theories of foresight projects and adaptive strategic planning to redesign a foresight planning process. Adaptive foresight planning improves the connectivity of conventional foresight planning and decision making, and ties foresight planning results and promotion action closely.

To enhance systematic foresight planning, Konnola [12] proposed a foresight portfolio concept that focuses on how to incorporate a modular design concept in foresight planning. It is based on the experience of the VTT Technical Research Centre of Finland, a contract research organization involved in foresight planning for the European Union and Finland. Konnola [12] categorized the technology roadmap frequently employed by VTT in planning into five modules and proposed an approach for designing diverse foresight processes under different scenarios.

In this article, we examine and discuss the foresight process of the Taiwan Industry and Advanced Technology Research Project and propose a revised modular foresight planning design model based on the foresight planning classification model and modular foresight design proposed by Konnola [12]. We also recommend a foresight research approach based on a dynamic feedback mechanism and discuss the actual experience and accomplishment of foresight activities using a Taiwan case to enhance the robustness and flexibility of foresight planning for creating an adaptive strategy. The research results can serve as a reference for other countries, particularly for developing countries designing a national technology foresight mechanism.

2. Classification of foresight projects and modular design

The design of different types of foresight research activities requires a structured methodology to elucidate the expected foresight process management and research results [13]. Adaptive foresight emphasizes the balance between creating a future and adapting to the future by developing and modifying goals, visions, and strategies. This is done through repetitive monitoring and learning processes to fulfill the actual demands of national development and obtain a balance between external elements and internal operations. This is particularly critical for countries with limited resources. Important research stages include networking among stakeholders, scenario exploration, formation of visions and objectives, approach to development, and strategy selection [11].

Konnola [12] classified national foresight projects based on four dimensions: prioritized types of outcomes, chosen future perspective, chosen management approach, and chosen emphasis in stakeholders.

Konnola [12] further categorized prioritized types of foresight planning outcomes into informative outcomes and instrumental outcomes, chosen future perspective into the consensual future perspective and the diverse future perspective, chosen management approach into fixed management and autonomous management, and chosen emphasis in stakeholders into extensive stakeholder engagement and exclusive stakeholder engagement.

Konnola [1] further classified foresight planning into four categories with prioritized type of outcomes on the vertical axis and chosen future perspective on the horizontal axis. They discussed the influence of foresight planning on sustainability, security, and the information society in a number of developed and developing countries.

The existing foresight planning found in developed and developing countries can be classified into four categories based on prioritized type of outcomes and the chosen future perspective: the informative and consensual type, the instrumental and consensual type, the informative and diverse type, and the instrumental and diverse type. These four types are further discussed as follows.

2.1. Informative and consensual type

The major objective of the informative and consensual type of foresight planning is to understand existing and future technology challenges. This type of foresight planning may not have clear and comprehensive follow-up action plans or policy implications. This approach is ideal for understanding emerging issues or proposing a common view for target visions and objectives.