Chapter 3
Neuro-Fuzzy Approach for Technology Strategic Planning

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ABSTRACT

In the chapter, a neuro-fuzzy-based technology strategic planning model is suggested. It is the result of an integrated and systematic hybrid of existing models presented in the literature of technology strategy planning and hybrid intelligent strategic planning. The neuro-fuzzy technique is used for modeling of technology strategies with MATLAB. The model is evaluated in Iran's petrochemical industry based on average test error and average train error which were satisfying. A list of technologies in the industry, the industry's ability in the development of technology, the attractiveness of technology in the industry, and patent indicators are identified based on experts' viewpoints. According to the location of technologies in decision matrices of technology strategies, technology strategies are proposed in three categories: research-driven, investment-driven, and knowledge-driven. Data is collected by the researchers in subsidiary companies who do research in specific fields of petrochemical industry and have the knowledge in those fields.

DOI: 10.4018/978-1-5225-7086-8.ch003

INTRODUCTION

Technology strategy is the first and most important step of technology management to develop a long-term strategic plan which determines investment priorities in technology development (Arasti & Packniat, 2011). The increase in knowledge, technological progress, changes, and high level of uncertainties in the environment pose real challenges to technology strategic planning. In recent years, academicians and researchers involved in strategic management have devoted increasing attention to developing computer-based systems to support the strategic planning process. Recently, artificial intelligent (AI) techniques (neural networks, fuzzy logic, neuro-fuzzy, etc.) have been successfully employed in strategic planning (Han et al., 2011).

Some related typical works in this field are web enabled hybrid approach to strategic marketing planning (Li, 2005), hybrid intelligent system for developing marketing strategy (Li, 2000), hybridizing human judgment with AHP, simulation, and a fuzzy expert system for formulation marketing strategies (Li & Li, 2009), knowledge based system for strategic planning (Huang, 2009), patent analysis-based fuzzy inference system for technological strategy planning (Yu & Lo, 2009), a strategic technology planning framework (Chen et al., 2009), and hybrid intelligent scenario generator for business strategic planning (Moaye & Bahri, 2009).

In this paper, a neuro-fuzzy model is used for technology strategic planning. The neuro-fuzzy model exploits the capability of both neural network and fuzzy logic systems. The fuzzy logic theory allows better representation of a given system behavior using a set of simple rules however it is unable to tackle knowledge stored in the form of numerical data (Moon et al., 2009). On the other hand, artificial neural network (ANN) is capable of learning virtually any smooth nonlinear function with a high degree of accuracy through a learning process. However, it shows limited capability in handling systems represented by linguistic information.

In this chapter, hybrid intelligent strategic planning and technology strategic planning models are reviewed and an integrated and comprehensive model for a technology strategic planning based on neuro-fuzzy technique is suggested. The suggested model is implemented in Iran's petrochemical industry. As a preliminary step, a technology tree based on the petrochemical industry strategic development plan and forty experts' viewpoints is defined. Then it is prioritized and analyzed for strategy formulation in each technology according to technology planning approach with a two-dimensional matrix of ability-attractiveness features. After defining technology strategies, the validity and reliability are determined through a questionnaire consisting of proposed strategies for each technology distributed to forty experts. Then neuro–fuzzy technique is used for modeling of technology strategies with the fuzzy logic toolbox of MATLAB 7.0.1. The neuro-fuzzy model and its results are evaluated based on average test error and average train error.