Patent based QFD Framework Development for Identification of Business Model of Prospective Technology

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Extended Abstract

Research and development (R&D) planning for emerging technology that reflects future social needs of customers have a crucial role in national economy. For the selection of prospective technology, many studies used various methodologies such as Delphi (Chang and Wang, 2005; Czaplicka-Kolarz et al., 2009), bibliometrics (Daim et al., 2006), and patent analysis (Liu and Shyu, 1997; Abraham and Morita, 2001). However, these methodologies do not reflect customer needs for the selection of prospective technology in a systematic manner.

In order to improve this limitation, we suggest a patent based Quality Function Deployment (QFD) framework that enables to reflect future needs of customers and patent trend in setting R&D planning priorities at the lowest level of technology classification. Quality Function Deployment (QFD) is a method that identifies and ranks customer desires, details the technical requirements needed to fill customer desires, and provides an organized plan to achieve customer satisfaction (Kathawala and Motwani, 1994). QFD was originally developed for product design but it has been extended to various application areas (Hauser and Clausing, 1988; Liberatore and Nydick, 2008; Reich and Paz, 2008).

In this paper, we propose a hierarchical QFD based technology foresight framework that reflects customer needs for the selection of prospective technology which can be applied to strategic R&D planning. As the empirical analysis, we applied the proposed QFD to robot technology.

In the first stage house of quality (HOQ), we consider mega trends of society as customer's needs (WHAT) and try to find kinds of products /services (HOW) that can meet those trends by reflecting the opinion of both generalist and specialists on their relationship and importance of attributes of mega trends.

We set up the WHAT of the first stage HOQ as mega trend by reflecting the demand for future life investigated by ETRI (2008). ETRI (2008) classified the mega trend into three categories such as fun, convenience and safety. In addition, for HOW list that corresponds to this WHAT list, we utilize the classification of robot products investigated by Ministry of Knowledge Economy (2008). It includes cleaning robot, assistant robot, health care robot, medical robot etc. A typical survey is used to find interrelationship between the WHAT and HOW attributes and relative importance of WHAT. We interviewed 34 generalists and 17 specialists in Robot area. This information is then used to find the importance of Robot product. As a result, among the robot technology products, assistant robot turn out to be the most important product followed by support robot and nursing robot.

The second stage HOQ considers both future technology products/services (WHAT) and primary level of technology classification (HOW). Here, future technology products/services are same as HOW attributes of the first stage HOQ. For

HOW attributes in the second stage, 12 categories of primary level of robot technology are used based on 'Robot technology classification' (reported by National IT Industry Promotion Agency of Ministry of Knowledge Economy (2008).

In the second stage, Patent co-word analysis is used for identifying the relationship between WHAT and HOW while patent network analysis is used for setting the importance of WHAT attributes. Specifically, TPF (Triadic Patent Families: patent published in US Patent and Trademark Office, Europe Patent Office, and Japan Patent Office) and USP (US patent) are used for co-word analysis. The weight of WHAT list in the second stage consists of four factors: importance (I), urgency (U), ripple effect (R) and priority of prior stage (P). Importance of product in WHAT list reflects the cited frequency of TPF from other patents. Urgency of WHAT list is set based on the TPF's recent frequency. Ripple effect of WHAT list utilizes the centrality information obtained from the patent network analysis. Priority of WHAT list corresponds to that of HOW list in the previous stage HOQ. By multiplying I, U, R by P, consequently, one can find the relative importance of primary level technologies.

The patent data was obtained from SCOPUS website, covering the period between 1995 and 2009. In the second stage, we found the most important primary level of robot technology as control technology, followed by sensor, driving, H/W, and battery technology

Third stage HOQ considers both primary level of technology classification (WHAT) and more detailed secondary level of technology classification (HOW). Same as the second stage, WHAT elements of the third stage HOQ are same as HOW elements of the second stage HOQ. 45 categories of secondary level of robot technology (HOW) were used. As a result of the analysis of the third stage, performed in a similar manner to the second stage, we found out that position sensor technology is the most prospective secondary level technology followed by distance sensor technology and motor technology.

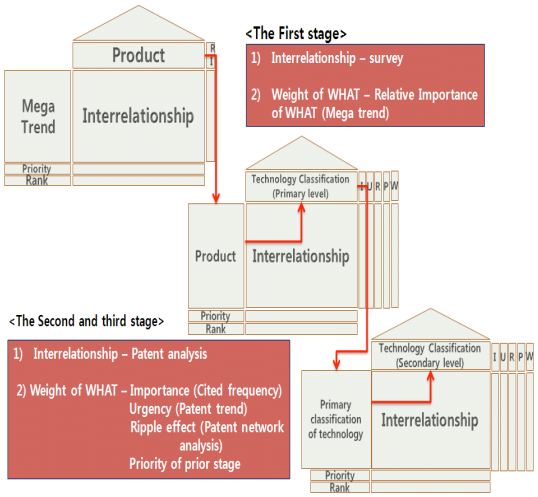

Figure 1. Proposed framework for hierarchical QFD

After finding the priority of secondary level of technology, one can conduct reverse QFD to find important WTAT list in relation to only those HOW lists selected based on priority. Using this approach, one can suggest business models which closely reflect prospective technology as well as customers' needs. We suggest three business models as follows.

Business Model I: Entertainment robot for intelligent tools with learning ability. For successful business for entertainment robot, R&D plan needs to be focused on control and hardware technologies that are related to distance, position and motor technologies.

Business Model II: Cleaning robot for healthy life. Its R&D plan needs to be focused on control and driving technologies that are related to distance, position, and motor technologies.

Business Model III: Pet robot for security. Its R&D plan needs to be focused on control and driving technologies that are related to distance, position and motor technologies.

Our study is expected to contribute to the establishment of strategies for effective R&D planning for new technology and for related business model.

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