A System Method to Elicit Innovative Knowledge Based on Chance Discovery for Innovative Product Design

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ABSTRACT

In the past few years, supplying value-added and innovative products has become an important business strategy. In this paper, a system method of innovative knowledge elicitation based on chance discovery for new product design is proposed and described. This system contains three functional modules: (1) scenario graph generation module by using Keygraph, a visual tool of chance discovery; (2) innovative knowledge solicitation module by innovators market game (IMG), a kind of table game for collaborative innovation; and (3) innovative knowledge alternatives selection module based on the method of analytic hierarchy process (AHP). The experiment is taken to play IMG and make value cognition by humans based on the scenario graph generated by Keygraph. During the IMG, innovative knowledge as new value is co-created by humans. AHP is used to evaluate these innovative alternatives. The performance of the method is illustrated by using a case study on innovative product design. The results indicate this method can aid humans in eliciting innovative knowledge for creative product design at the early stage of product development.

Keywords: Analytic Hierarchy Process, Chance Discovery, Innovative Knowledge Elicitation, Innovators Market Game, Scenario Generation

INTRODUCTION

For responding to global competition, increasing activities in product design has been changing from investment-driven landscape to an innovation-driven economy. Companies have to transform themselves from production-focused to value-added design-focused businesses (Yan et al., 2009). Based on radical innovations, Lin and Luh (2009) developed a vision-based approach to explore potential opportunities that lead us to new perspectives for product design, where Visioning thinking, TRIZ (the theory of innovative problem solving), Image Scale, and Morphological Analysis are integrated for developing designs with a balance of rational/logical analyses and intuitive/creative thinking.
In the last few years, chance discovery has been widely applied in various research areas, especially in business. Chance discovery is a human-computer interaction process to detect rare but important chances for decision making. A chance in chance discovery means to understand an unnoticed event or situation which can be uncertain but significant for a decision by human beings (Ohsawa & McBurney, 2003). KeyGraph is a visualization tool with the KeyGraph algorithm which can generate scenario map for aiding human’s value cognition in the process of chance discovery (Ohsawa, Benson, & Yachida, 1998). In the case of marketing, product designers designed new products with KeyGraph, and made real business profits (Ohsawa & Fukuda, 2002). However, researchers gradually recognized a new problem in chance discovery where KeyGraph failed to visualize important events which are neither visible nor observed as data (Maeno & Ohsawa, 2007). In fact, only observable part of the real world as visible knowledge is presented in data. For scattered data, such as incomplete and ill-structured data, Ohsawa (2005) proposed a breaking-through method named data crystallization which aimed at presenting the hidden structure by inserting dummy items corresponding to unobservable, i.e., hidden events, into the given data recording past events. Hidden events will be visualized as the output of data crystallization. Horie, Maeno, and Ohsawa (2007) applied the method of data crystallization for designing new products in a real company. The results illustrated its effect on industrial decision making. Wang et al. (2010) proposed an effective method to discover emerging chance based on AHP and Grey Relational Analysis (GRA).

However, there are some problems in the mentioned above research as follows:

1. There are fewer approaches proposed under a systematic or united framework for the purpose of innovative product design from innovative knowledge elicitation to evaluate knowledge representation.

2. It’s imperative to integrate qualitative and quantitative analysis in a unified framework. Most existing methods have been developed by qualitative guidelines rather than quantitative evaluation. Actually, we human beings are good at qualitative data and weak in quantitative data (Matsumura, 2006).

This paper is organized as follows: A united systematic framework for innovative knowledge elicitation and evaluation is proposed. In this framework, there are three significant modules: scenario generation module, innovative knowledge elicitation module and innovative knowledge selection module. These three modules are presented in the following sections. Finally, a case study for innovative product design is used for system illustration.

A FRAMEWORK FOR INNOVATIVE KNOWLEDGE ELICITATION SYSTEM

A framework of the proposed innovative knowledge elicitation system (IKES) is shown in Figure 1, which includes three main functional modules: (1) scenario generation module, (2) innovative knowledge elicitation module, and (3) innovative knowledge selection module.

In this system approach, a scenario graph for human’s value cognition is generated by Keygraph with data crystallization based on chance discovery theory. This scenario diagram shows the topological relations between nodes. Herein, each black node corresponds to specific existing product. Based on the scenario graph as a game board, Innovators Market Game (IMG) supplies a dynamic interaction platform between consumers and product designers for innovative knowledge emerging, where customers proposed new requirements according to these existing products and designers combine these nodes together as many as they want for a new product as an innovative idea, referring to customers’ requirements and visual information in the game board. For innovative ideas
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