Editorial

Runhua Tan

Institute of Design for Innovation
School of Mechanical Engineering
Hebei University of Technology
Tianjin, 300130
People's Republic of China
E-mail: rhtan@hebut.edu.cn

Biographical notes: Runhua Tan is Professor and Director of the Institute of Design for Innovation, also Vice President of Hebei University of Technology, PR China. He received his BSc and MSc degrees from Hebei University of Technology, in 1982 and 1984, and his PhD degree from Zhejiang University in 1998. He received a visiting scholarship from the government of China and Brunel University from 1994 to 1995. Professor Tan is Vice Chair (Asia) of the Workshop Group CAI of IFIP-TC5. He is the author/coauthor of 90 journal papers. He has been a member of the editorial board for both the *Chinese Journal of Mechanical Engineering.* Currently, his main research interests include design theory and methodology.

After years of cost cutting, right sizing, downsizing and quality improvement efforts, most companies have discovered that these efforts alone are not enough to ensure their long-term survival. Being the low cost producer of an out-of-date product or having the highest quality of a product about to be replaced by a more innovative competitor will not ensure long-term survival or profitability. Actual approaches supporting designers to overcome the above difficulties nevertheless remain unchanged in organisations since value engineering-like concepts and brainstorming derived practices have been introduced. This introduction led many worldwide scientific communities to conduct research aiming at building new methods and tools to face problems arising from complexity increases.

Conceived over 50 years ago in Russia by Altshuller, the theory of inventive problem solving (TRIZ) has only recently reached the west and east. Faced with increasing demands and rising expectations from the market, several companies are now using this approach to create new and improved products in a way that does not rely entirely on inspiration and chance discoveries. In order to meet the demands of the companies perfectly, TRIZ itself is being developed. There are several other methods and tools that have been used in new product development successfully. These include Axiomatic Design (AD) and Quality Function Deployment (QFD). The trends of design theory and methodology move towards the integration of different methods and tools, including TRIZ, to form new methods and tools which are more powerful for creativity and innovation.

This special issue collects ten papers offering different viewpoints of creativity and innovation employing TRIZ. In the first paper, ‘From TRIZ to OTSM-TRIZ: addressing complexity challenges in inventive design’, Cavallucci and Khomenko propose OTSM-TRIZ, which is a kind of new extension of TRIZ. The special feature in this paper is that the traditional Chinese yin-yang diagram has a new application in their OTSM-TRIZ. The contradiction network formed using yin-yang shows a helpful method for analysis and innovation of complex engineering systems.

In the second paper, ‘FBES model for product conceptual design’, Cao and Tan present a function-behaviour-effect-structure model for application in conceptual design process. There is a knowledge base tool of effects in most Computer-aided Innovation (CAI) systems based on TRIZ. However, using the knowledge base effectively is still a problem. The FBES model is an extension of FBS (Function-Behaviour-Structure) model, in which the effects of TRIZ are applicable in conceptual design with ease.

Today, new product development is faced with great pressures: more customer satisfactions, higher quality, lower cost and faster lead time. In the third paper, ‘One-Day-Design-Studio (ODDS): a resource-based extended tool for rapid innovation by TRIZ’, Zhao, Lin, Wang and Xie propose a new conceptual design tool called ODDS, which is a service platform integrated with QFD, TRIZ and DKRs methods and tools. ODDS aims to support the innovation process in order to respond to market changes rapidly. The features in ODDS are that HOQ of QFD and Contradictions Matrix of TRIZ are integrated.

In the next paper, ‘Computer-aided analysis of patents and search for TRIZ contradictions’, Cascini and Russo propose a computer-aided approach for supporting the analysis of patents. According to its textual description, it is necessary to speed up identifying the technical/physical conflict(s) overcome by an invention. There is no specific means to support the analysis of patents with the aim of identifying the contradiction underlying a given technical system. This paper shows a process on how to solve this problem.

The integration of TRIZ with other methods and tools is a trend to form more suitable methods and tools. In the paper, ‘A conceptual design model using axiomatic design and TRIZ’, Zhang and Liang propose a conceptual design model that combines AD and TRIZ. In this model, AD is used to build the functional-structure model of the products to be developed and analytic hierarchy process to calculate the coupling strengths. TRIZ is used to solve the coupling problems.

In the sixth paper, ‘Practical problem solving by TRIZ enriched with weighted average scoring’, Yu and Lau propose a kind of methodology that employs the su-field analysis followed by WASS evaluation. The method enriches TRIZ into a more effective system to identify the best solution objectively.

The next paper titled ‘Research on technical strategy for new product development based on TRIZ evolution theory’, Zhang and Xue present various evolution S-curve models of core technology such as the dynamic model and the parallel model. TRIZ technology evolution theory and system operator were proposed. The application of this method can help technology managers identify technologies that possess competitive power. Identifying these technologies will allow them to forecast their evolution trend and evaluate their competitive potential.

In the eighth paper, ‘Process of two stages analogy-based design employing TRIZ’, Tan defines two analogy processes for conceptual design using TRIZ and Analogy-Based Design (ABD). By means of integrating the first- and the second-stage process, a new process for ABD is formed, which is a process model for two stages ABD. The definition of Unexpected Discoveries (UXDs) is applied as a kind of cue to produce new ideas for invention.

In the next, ‘A method of product improvement by integrating FA with TRIZ software tools’, Hua, Huang and Wang propose a method of integrating Functional Analysis (FA) with TIZ software tools to assist engineers in finding innovative solutions. Components that need to be innovated are specified by applying a House of Quality (HOQ) analysis. Technical innovation is then executed by applying TRIZ software tools.

In the last paper, ‘Defining breakthrough product design solutions’, Mann defines necessary definitions of what qualifies a design solution to be classed as a breakthrough. Three key areas are identified; one relating to functional connectivity and two to the concept of Evolution Potential. The Evolution Potential process has been designed to enable objective assessment of incumbent and new technology solutions, relative to a globally generic discontinuous evolution benchmark.

The guest editor would like to thank all the authors for submitting and revising papers for this special issue. The editorial board also wish to extend our thanks to the referees in providing their valuable comments to all the papers, which are most essential for controlling the quality of this special issue. Also, the guest editor would like to thank all the Chinese authors of this special issue for having sent their recent research results to this issue; it is important to let the world know what we are doing in this new field. Last, the guest editor would like to express my sincere gratitude to Dr. Mohammed Dorgham, the Editor-in-Chief, and Ms. Liz Harris, the Journal Manager, for their advice, help and support in making this special issue come true.