

Investigation of Management Innovation Process Based on Conflict-solving Method by *TRIZ* Theory

Min WANG^{1,a}, Dong-Sheng ZHANG^{2,b,*}, Li ZHANG^{3,c}

^{1,2,3}School of Economics and Management, Hebei University of Technology, Tianjin 300130, China

^a18222906003@163.com, ^bzdsheng@sina.com, ^csupstomoch@sina.com

*Corresponding author

Keywords: Management innovation, Management conflicts, *TRIZ*, Enterprise environmental parameters.

Abstract. *TRIZ* theory has been widely applied to the technical innovation. However it still lacks of efficient conflict-solving tools in the field of management innovation. In the study, we overview the use of tool in *TRIZ* for solving the technical and management innovation problem, such as the *40 Inventive Principles* and *39 Technical Parameters* that have been commonly applied. Our overview found that the *40 Inventive Principles* can be used for the conflict-solving of management innovation, while the *39 Technical Parameters* should be revised before its application. The *Enterprise Environmental Parameters* are necessary to solve the *Management Conflict Matrix*. The *ideality* of the innovation should be measured in the process to get the optimal solution.

Introduction

At present, the nation has generally recognized the significant importance of innovation management, especially for the enterprise, where the innovation ability has become a core ability to meet with the competence. To promote the ability of innovation, methodology such as *TRIZ* can be applied. It has broad application prospects in the management field as reported by many domestic and abroad experts [1]. Mann (1999) argued that *TRIZ* can provide a powerful framework for the system definition and problem solution regarding the business, organization, management and so on [2]; for most of the *TRIZ* tools, the method should be directly or slightly modified to suit with several non-technical areas [2]. Zlotin and Zusman (2001) also believed that most of the basic *TRIZ* concepts, such as the conflict and system methods can be directly applied to problems in the non-technical field [3]. Following that, several *TRIZ* experts investigated *TRIZ* theory in many application cases in the field of management innovation. Fey and Rivin (1997) proposed a perspective of *TRIZ* methodology for management innovation [4]. Hipple (2004) used *TRIZ* to solve conflict in the practice of organization innovation [5]. Martin et.al (2004) applied principles of *TRIZ* for the strategic deciding in enterprises [6]. Vries et al (2008) applied it to eliminate the emotional conflicts among organizations and employees [7]. Those researchers found that the application of *TRIZ* in problem-solving must consider the actual situation of the management system. It is, however, less practiced and lack of experience in the management innovation process such as for the conflict-solving.

Therefore, this paper will introduce the basic *TRIZ* theory and the facing problems in the application process. Based on that, we intend to suggest the direction of further development of the theory for the management innovation.

TRIZ Theory

TRIZ means the ‘theory of inventive problem solving’ [8]. *TRIZ* research started from its creator Altshuller, who consider that the creative thinking about the nature itself and the technology has its own embedded rules [8]. The main purpose of the theory is to study the principle and law that followed by the mankind in the process of innovation to solve the technical problems. *TRIZ* not only puts forward the strategy of the problem solving method, but also provides a series of standardized

tools to guide the process of innovation, such as *Conflict Matrix*, *40 Inventive Principles*, standard solution, the interaction analysis and so on [1]. In addition, the *TRIZ* provides a useful measure to overcome the inertia of thinking. It was developed to solve problems, create new ideas and innovation in the processes of technology development [3]. The *TRIZ* yields a high advantage to solve the problems and promote the innovation than other measures as reported by Ilevbare, et al. (2013) [1]. This is because it can give more precise knowledge-based solution to the problem.

TRIZ in Technology and Management Innovation

The problem-solving process of *TRIZ* can be solved by the tool of *contradiction*. *Contradiction* is applied to account for the incompatibility of a system to acquire the desired outcomes. Several tools has been applied most commonly in the technological field for the concept of *contradiction*, such as the *40 Inventive Principles* and the *Contradiction Matrix* (also named as *Conflict Matrix*) [9]. The *40 Inventive Principles* gives the possible conceptual solutions to the technical contradictions of the system. The *Conflict Matrix* is a matrix of *39 Technical Parameters* that are arranged on the vertical and horizontal axis to interact with one another. It is used to point out the inventive principles that can be applied to solve the technical contradictions.

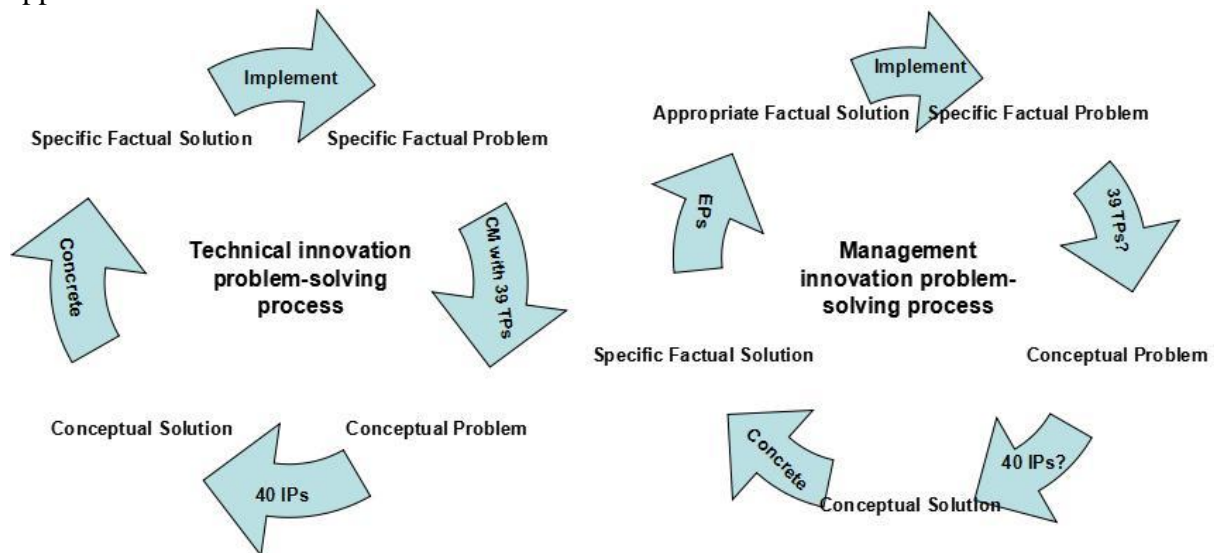


Figure 1 The general process for the problem-solving in technical and management field. IPs, TPs and EPs represent the Inventive, Technical and Environmental parameters, respectively. CM means the contradiction matrix of the TPs.

Figure 1 shows the process of solving technical and management invention problems by *TRIZ*. A specific factual problems was identified and defined at the beginning as a technical conflict regarding to the specific technology field. Later, one can turn the conflict into conceptual terms by using standard *39 Technical Parameters*. The *39 Technical Parameters* according to the problem can be filled into a *Conflict Matrix*. Once one or a few inventive principles were selected, several principles must be followed to produce a specific solution according to the specific problem. The role of the principle is to make the original innovation towards the direction of improvement. The principle must determine with carefully consideration according to the specific problems.

Previous practice has shown that more than one inventive principle should be considered for the *Conflict Matrix* [9]. *40 Inventive Principles* were most commonly applied to solve the normal technical conflict. It has to be noted that these 40 principles can only be applied to obtain the feasible direction but not the exact solution, because several choice was ignored during the process that leading to a diverged direction of solution. It is recommended to include all inventive principles for the problem-solving. Once all principles did not meet the requirements, it was necessary to redefine the principles.

In terms of the management innovation, the *Enterprise Environmental Parameters* must be considered in addition to the innovative and technical parameters [10]. As seen in Fig. 1, the enterprise environment parameters can be applied to screen the inappropriate solutions from the *Conflict Matrix* for the management innovation. The *Enterprise Environmental Parameters* must be correspondent to the practical situation of the enterprise, while technical innovation does not necessarily consider it.

In *TRIZ* process for the technical innovation, 39 *Technical Parameters* can be followed to turn the specific factual problem into a conceptual problem. While in management innovation, the parameters must be redefined according to the enterprises [11]. As well, the number of innovative principles must change accordingly.

In Fig. 1, the appropriate conceptual solution was different from the specific factual solution and specific conceptual solution. The latter was commonly applied in *TRIZ* to acquire usual solutions, which can be called as “ordinary solutions”. There may be many conceptual solutions deriving from the *Conflict Matrix*. However, for a specific conflict, a portion of the general conceptual solution must be eliminated according to the existing knowledge and experience of managers.

In terms of the technical innovation, the specific factual solution of the product can be directly acquired from the conceptual solution. While the management innovation problems cannot. This is because even though a specific factual solution is suitable for some businesses enterprises, but may not be appropriate to other enterprises. For example, if one get a specific solution as “use divisional system”, the solution is suitable for a large enterprises, but not appropriate for a small ones.

There is another type of *Enterprise Environmental Parameters* need to be taken into account. For example, if the “separation of powers” or “diversity” is a specific factual solution, but the “separation of powers” to what degree? “diversity” to what degree? All these question should be considered in the *Enterprise Environmental Parameters*. To deal with this, we use the degree of “appropriate solution” in the systematic chart as shown in Figure 1.

40 Inventive Principles and 39 Management Parameters for Conflict-solving

TRIZ experts thought the 40 *Inventive Principles* cannot be directly applied in expressing the conflicts [12, 13]. D. Mann (2004) [12] and O. Farias (2006) [13] further studied the 40 *Inventive Principles* for management innovations. Table 1 shows an application example about the inventive principles. Mann introduced *TRIZ* to the field of management innovation firstly [12]. His idea was important for the next development of management innovation tools. He thought most of the *TRIZ* tools should be directly and slightly modified before applying to non-technical areas. For instance, 40 *Inventive Principles* can be applicable in the business field. Due to the fact that management field was diversified, multidimensional and complicated, it was necessary to develop the tools of inventive principles in *TRIZ*. Besides, to have sophisticated experience in business innovation would greatly benefit the use of the tool. Moreover, the conflict management should consider the *win-win* (win - win) case, rather than the *zero-sum* (win - lose) strategy.

In these processes, the *Management Parameters* should involve several parameters such as the features, dimensions, time, cost, risk and interface. Mann and Farias listed 31 *Management Parameters* that were important to the conflict-solving in management innovation as shown in Table 2. Mann's research focuses on the area of enterprise operation cohesion, while Farias focuses on the areas of supply chain management. One can see from Table 2 is that the common principles should include the reliability, efficiency, profitability, maintenance, inventory management, integrated level, quality, innovation, risk management, cost management, time management, support, service level, and so on. Other parameters such as information flow, interaction with other chains and on differs slightly between two researches. The basic framework of two researches was similar. One thing seen from Table 2 is that the *Management Parameters* should be revised according to the specific problem before the application in the management innovation.

Table 1 40 Inventive Principles in management innovation

1 Segementation	11 Beforehand cushioning	21 Hurry(Skipping)	31 Hole (Porous materials)
2 Taking out	12 Remove tension (Equipotentiality)	22 “Blessing in disguise” or “Turn lemons into lemonade”	32 Color changes
3 Local quality	13 The Other Way Round	23 Feedback	33 Homogeneity
4 Asymmetry	14 Spheroidality-curvature	24 Intermediary	34 Recover (Discarding and recovering)
5 Merging	15 Dynamics	25 Self-service	35 Parameter changes
6 Universality	16 Slightly (partial or excessive actions)	26 Copying	36 Phase transitions
7 “Nested Doll”	17 Another dimension	27 Cheap short-living objects	37 Relative change (Thermal expansion)
8 Counterweight (Anti-weight)	18 Mechanical vibration	28 Another sense (Mechanics substitution)	38 Enrich (Strong oxidants)
9 Preliminary anti-action	19 Periodic action	29 Fluid (Pneumatics and hydraulics)	39 Calm (Inert atmosphere)
10 Preliminary action	20 Continuity of useful action	30 Thin and flexible (Flexible shells and thin films)	40 Composite structures

The table was referred to the literature by Mann (2004) [12], in the bracket is the modification by Farias (2006)[13].

Table 2 31 Management Parameters in management innovation

1 Quality management (Spec/Capability/Means)	12 Supply costs	23 Information flow (Communication flow)
2 Costs management	13 Supply times	24 System affected harmful effects
3 Time management	14 Supply risks	25 Interaction with other chains (System generated side effects)
4 Risks management	15 Supply interfaces	26 Management convenience
5 Interface management	16 Reliability	27 Adaptability/Versatility
6 Production management	17 Supply costs	28 System complexity
7 Production costs	18 Support times	29 Control complexity
8 Production times	19 Support risks	30 Competitiveness pressure
9 Production risk level	20 Support interfaces	31 Stability
10 Production interfaces	21 Demand forecasting (Customer revenue/Demand)	
11 Supply quality (Customer revenue/Demand)	22 Information amount	

The table was referred to the literature by Mann (2004) [12], in the bracket is the modification by Farias (2006)[13].

Process Model to Solve the Management Problems

In spite of *Innovative Principles* and *Management Parameters*, *TRIZ* also has complete process to solve the technical and management innovation conflict. The process model for technical innovation did not consider the *Enterprise Environmental Parameters* [8]. Several process models based on management innovation still did not consider the parameters [14, 15, and 16]. In order to consider the parameter in the *TRIZ*, this paper proposed a new process model of management innovation based on the above discussion as shown in Figure 2.

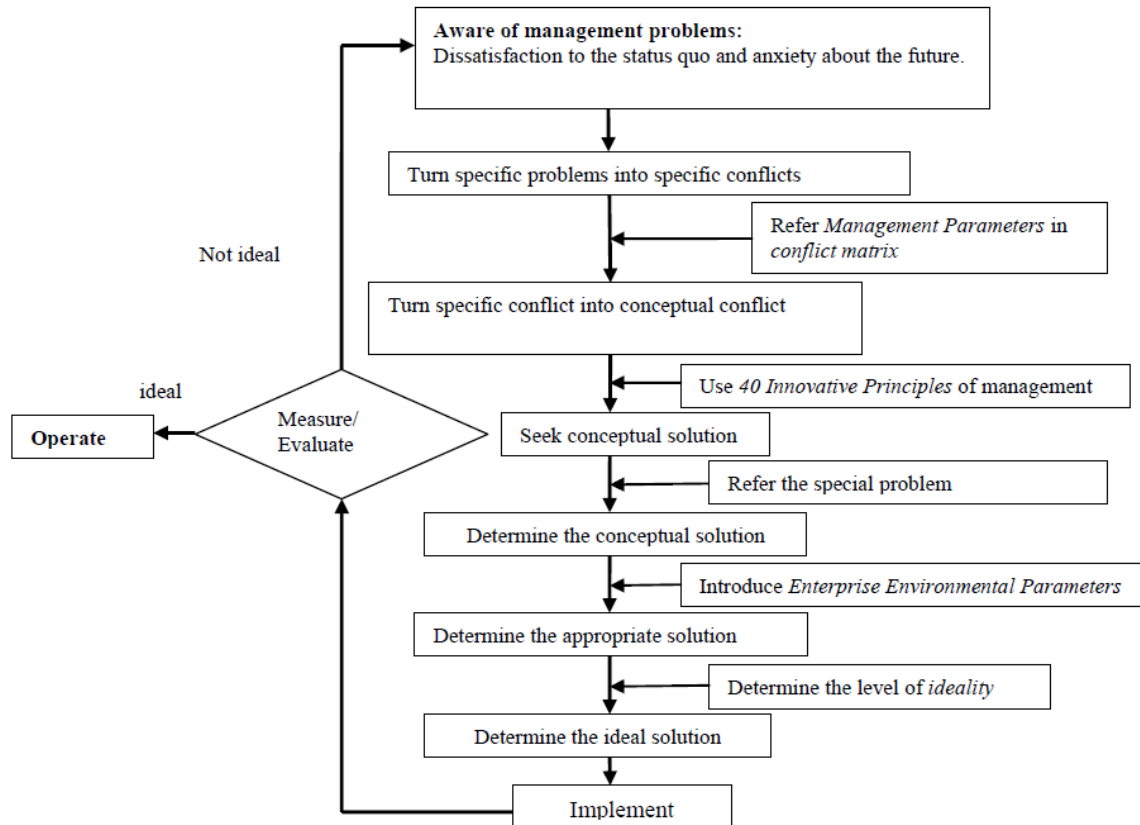


Figure 2 the process model of management innovation based on TRIZ

The process model in Figure 2 was consisted by eight steps: (1) Be aware of management problems. In the start of innovation, if the manager dissatisfied with the status quo, he or she will need management innovation. Dissatisfaction to the status quo may come from the performance of management that did not achieve the desired goal of managers and fail for commercial competence. (2) Turn specific problems into specific conflicts. This step turns the factual innovation problems into one or several specific conflicts of an enterprise, and adds the conflicts into in general *Conflict Matrix*. (3) Turn specific conflict into conceptual conflict. The process required to refer the *Management Parameters* as seen in Table 2 into the *Conflict Matrix*. (4) Seek the conceptual solution. The conceptual solution can be solved based on the *40 Inventive Principles*. The conceptual solution can solve the conceptual conflict based on the existing knowledge and experience of enterprise manager. The number of solution should be more than one in order to give options for the manager to choose according to the practical situation. Too much general solutions should be avoided. (5) Determine the specific solution. Conceptual solution offers a wide range of most likely solution. For a specific business, it is not easy to determine the specific solution from the conceptual solution. Feasible conceptual solutions should be obtained by gradually narrowing the scope of available conceptual solutions. (6) Determine the appropriate solution. Specific conceptual solution is only for a specific conceptual conflict, without considering the actual situation of enterprises. The *Enterprise Environmental Parameters* can be applied to explain the effect of actual situations. (7) Determine the ideal solution. In *TRIZ*, the ideal solution means that one can achieve the least investment and stack effects. In reality, such ideal solution does not exist. However, the near-ideal solution can be pursued

instead. The index of ideality can be applied to quantify the level that close to the ideal. (8) Implement. As soon as the ideal solution was determined, it is necessary to implement the solution to deal with the factual problem. One thing important is to measure the *ideality* of the ideal solutions as feedback in order to determine if the loop should be continue or not.

Summary

This paper gave an overview of the conflict-solving for the management and technical innovation based on *TRIZ* theory. The *40 Inventive Principles* that commonly applied in technical area is compatible to the management innovation even though several modifications must be made in accord with the enterprise practice. *39 Technical Parameters* can be used to identify the specific problem in the *Conflict Matrix*, however, still require to be modified to suit for the management innovation. It is necessary to reduce the number of *Management Parameters* to get an appropriate solution for the *Conflict Matrix*. In order to eliminate insignificant inventive principles and parameters for the conflict-solving, the practical *Enterprise Environmental Parameters* must be taken into consideration. The *ideality* of the solution should also be measured/evaluated in the process.

Acknowledgement

This research was financially supported by the Hebei Natural Science Foundation Project: Management Innovation based on *TRIZ* theory (grant NO. G2013202184).

References

- [1] I. M. Ilevbare, D. Probert, R. Phaal, A review of *TRIZ* and its benefit and challenges in practice, *Technovation*, (2013) 30-37.
- [2] D. L. Mann. Inventive (business) principles with examples [J]. The *TRIZ Journal*, 1999, 9. Information on <http://www.triz-journal.com>.
- [3] B. Zlotin, A. Zusman. *TRIZ* beyond technology: the theory and practice of applying *TRIZ* to non-technical areas. The *TRIZ Journal*, 2001, 1. Information on <http://www.triz-journal.com>.
- [4] V. R.Fey , E. I.Rivin, The Science of Innovation: A management overview of the *TRIZ* methodology. The *TRIZ* Group, Southfield, Michigan, USA. 1997.
- [5] J. Hipple. The use of *TRIZ* separation principles to resolve the contradictions of innovation practices in organizations, The *TRIZ Journal*, 2004, Information on <http://www.innovation-triz.com>.
- [6] G.Martin, H. Lessing. Profiling technological competencies of companies: a case study based on the theory of inventive problem solving. *Creativity and Innovation Management Journal*, (2004)231-238.
- [7] R. Vries, V. Souchkov, J. Mannak. Remote Team Problem Solving With *TRIZ* [J]. The *TRIZ Journal*, 2008, 7. Information on <http://www.triz-journal.com>.
- [8] G. Altshuller, The innovation algorithm: *TRIZ*, systematic innovation, and technical creativity. Technical Innovation Centre, Originally published in Russian 1969 and 1973, Worcester, Massachusetts, 1999.
- [9] K. Rantanen, E. Domb, Simplified *TRIZ*—new problem solving applications for engineers and manufacturing professionals. Auerbach Publications, New York, 2008.
- [10] B. Ruchti. *TRIZ*-based innovation principles and a process for problem solving in business and management. Proceedings of the European *TRIZ* Association, (2001) 151-158.
- [11] D. Stephen .The Inventive principles of *TRIZ* applied to finance. The *TRIZ Journal*, 2004, 10. Information on <http://www.triz-journal.com>.

- [12] D. L. Mann, The next common sense: philosophy-level integration of *TRIZ* into an integrated business and management innovation process, in the ETRIA TRIZ Future Conference, Italy, 2004.
- [13] O. Farias. The logistic innovation on approach and the theory of problem solving. The *TRIZ* Journal, 2006, 1. Information on <http://www.triz-journal.com>.
- [14] R. Gennady, Inventive principles in marketing, sales and advertising. The *TRIZ* Journal, 2005, 4. Information on <http://www.triz-journal.com>.
- [15] J. Zhang, K-H. Chai, K-C. Tan, Inventive principles with applications in service operations management. The *TRIZ* Journal, 2003, 12. Information on <http://www.triz-journal.com>.
- [16] P-K. Lam, K-S. Chin, Identifying and prioritizing critical success factors for conflict management in collaborative new product development. *Industrial Marketing Management*, (2005) 761-772.