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A TRIZ-based Trimming method for Patent design around

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HIGHLIGHTS

- Establish an integrated TRIZ-based framework for Trimming strategy to design around competitive patent.
- Present a step by step Trimming Technical Features process to generate Trimming scenarios and Trimming problems for innovation inspiration.
- Generate two Trimming scenarios for Core Ejector System improvement.

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ABSTRACT

Patent design around is an effective way to walk around competitive patents and avoid patent infringement. This paper proposes a TRIZ-based Trimming method for Patent design around. The 4 stages of Patent design around include design around target definition, design around problem identification, problem solving, and solution evaluation. In the 4 stages, Technical Features (TF) are identified to define design around target based on patent claim decomposition. In order to avoid literal infringement and doctrine of equivalents, the design around problem identification process of Trimming one or more patent Technical Features is developed. Then, the problem solving tools based on Modern TRIZ tools (such as Physical Contradiction resolution, and Function-Oriented Search) are introduced to solve the design around problem. Two Trimming scenarios of Core Ejector System is investigated to illustrate the method. The project successfully circumvents target patent and generates several new granted patents in China.

1. Introduction

In the global businesses market, patents are used as a weapon to achieve competitive advantages [1]. However, existing patents often form a high barrier against other competitors [2]. In fiercely competitive market, a low cost and less time-consuming way is to imitate and copy competitors' products technology to develop identical or similar products [3]. Besides, the design problem constantly facing across industries may not be innovative design during product development [2–4]. Therefore, when imitating products or solving problem, it is necessary to adopt competitors' products technology while avoiding infringement risk.

In order to avoid infringing risk, Patent design around (also called as "Patent Circumvention") is used for designing similar solution based on competitive patent but not equivalent to the existing patents [3,5,6]. It can be achieved in the following ways: Trimming (Eliminating) one or more technical feature(s) (TF) claimed in the claims, substituting one or more technical features of the claims or using evolution trends of technical features to achieve same or better function. TRIZ (Theory of Inventive Problem Solving), developed by Genrikh Altshuller, is a problem-solving, analysis and forecasting tool derived from the study of patterns of invention in the patent literature [7,8]. TRIZ helps to systematically solve product design problems and develop next-generation technologies and products with less risk [9,10]. There are some key concepts which make TRIZ very valuable for innovative design: Ideality (the sum of desirable functions over the sum of undesirable functions and cost) [11], which describes the technical system development direction. Resources, which inspires us to use existing resources (Internal and External, Readily-available and Derived, etc.) and to turn harm into help [12,13]. Contradiction, which helps to eliminate the contradiction and avoid the conventional trade-offs [14–16]. Trends of Engineering System Evolution (TESE) (also can be called as Laws of technological system evolution), which provides a means to reveal how systems evolve, predict the direc-

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tions of evolve, and ultimately control the evolution [9,17]. For the purpose of design around Patent, TRIZ is one effective way.

However, TRIZ has some deficiencies in solving problem. Firstly, TRIZ is a very complex system that contains numerous problem analysis and concept generation tools, and few researches presented a structured way step by step to guide innovative design process using these numerous tools. For example, many Modern TRIZ tools, like methods of Physical Contradiction resolution in Modern TRIZ and Function-Oriented Search (FOS), etc., are developed after Classic TRIZ tools. Classic TRIZ is the tools and work developed or supervised by Altshuller [18], such as Contradictions (Engineering Contradictions and Physical Contradictions), Su-field Analysis, and Algorithm for Inventive Problems Solving (ARIZ). Secondly, TRIZ solutions are stated in terms of general principles and does not provide with an innovative concrete structural design [19,20]. When applying the principles to search for concrete solutions, designers' knowledge level and ability still need to be depended on. For example, when inventive principles or standard solution in TRIZ are suggested, the designer will have to understand and apply general principles for the specific problems. Besides, some tools used in TRIZ are not adequate and need to be improved or integrated with other effective tools for different problem situation. When identifying the opportunities of system evolution, voice of customer and voice of manufacturing process, etc. should also be considered. In order to evaluate the feasibility of solution, TRIZ need to be integrated with Design of Experiment (DOE), Robust Design, Reliability Design, or Design for Six Sigma (DFSS), etc.

Patents contain valuable information (such as creative design solutions) for engineering design [21]. Patent design around is designed for walking around a competitive patent and develop substantial difference design in the scope of patent claims but not infringing the original patent [2,5,22,23]. It provides generally two advantages. Firstly, it could adopt technology of competitive patent to reduce R&D cost. Secondly, companies could use the technique to enhance their own patent protection strategy and avoid designed around by other competitors.

Based on three Patent design strategies (Trimming, Substitution, and Evolution) in our prior work [6], this paper mainly focuses on the Trimming strategies and proposes TRIZ-based Trimming approach for Patent design around to walk around existing patents that are in period of protection. In particular, we additionally consider (1) An integrated TRIZ-based framework for Trimming strategy. (2) A detailed Function Model process including function levels and function rank for Trimming Technical Features priority ranking. (3) A step by step Trimming Technical Features process to generate Trimming scenarios and Trimming problems for innovation inspiration. (4) A structured infringement evaluation process based on literal infringement, doctrine of equivalents, and patent prosecution history estoppel analysis. (5) Two Trimming scenarios for Core Ejector System improvement, and more detailed step by step Trimming process form Trimming scenario generating to inventive principles suggesting.

The rest of the paper is organized as follows. In Section 2, we give a brief review of related works about TRIZ and Patent design around. Section 3 describes the framework, detailed step by step Trimming process and problem solving of our approach. In Section 4, two scenarios of Core Ejector System of Injection Mold improvement design is investigated. Finally, Section 5 concludes this paper and discusses our future work.

2. State of the art

TRIZ discovered patterns of technological systems' evolution and way to invention based on numerous patent analysis, therefore the creativity can be managed and many fruitless trials and errors can be avoided [11,15]. TRIZ provides tools of problem analysis and problem solving, which can effectively help to adopt ideas from other domains and apply them to new domains. Many literatures present TRIZ theories and successful applications [9,14,15,24–26]. These literatures seldom effectively utilize patent knowledge and provide general roadmap for innovation. TRIZ is still in developing stage. The research of TRIZ for innovative design generally focuses on the following aspects:

- Problem Identification. The initial problems are often superficial or complex, and it does not mean that this particular problem should be dealt with. Constructing, growing, and building absolutely new types of problems are one more promising directions in TRIZ development. There are two subgroups to generate new problems. The first subgroup is to identify root cause of the initial and target problem [27]. For example, it is a critical problem for air conditioning industry that maximum reduce the noise of air conditioning. In order to solve this problem, Function analysis and Cause–Effect Chain Analysis can be used to identify the root cause of the noise problem. However, it may lead to time-consuming technology development. The second is to construct problems that would improve a required characteristic or parameter of the initial Engineering System (ES) [27]. If we change the initial problem above to "how to make people not hearing the noise of air conditioning". Many innovative and less cost solution can be found. For example, the component that generate noise can be placed far away from people (like outside the room). Therefore, the initial problem is transformed to a new type problem and achieve the same or better goal. Solving these different problems may help to get innovative design that never thought before. The following TRIZ tools are helping to generate new types of problems, such as Value Engineering Analysis (VEA), Flow Analysis, Cause–Effect Chain Analysis, Feature Transfer, Super-Effect, and Trends of Engineering System Evolution [18,27].
- Opportunity Identification. These researches generally focus on identifying opportunities from technology and market aspects. More concrete sub-trends in TRIZ are developed to guide the evolution of Engineering System [17,28,29]. Function-Oriented Search (FOS) provides more concrete and feasibility solutions based on the same or similar functions analogy that adopts an already existing technology from remote technology area to the initial problem area [30]. Main Parameters of Value (MPV) are the critical features and functionality that differentiate products and drive customer purchasing decisions, which help to identify the most significant parameters for customers [27].
- Integrated with other innovative methods, like Design for Six Sigma (DFSS) [31], Theory of Constrains (TOC) [11] and Quality Function Deployment (QFD) [32].
- Utilizing TRIZ in new application, like Patent strategies [3,33,34], Technology Forecasting [35,36], and Service Design.
- Computer-aided innovation (CAI). Combined TRIZ with various computer technologies (such as Ontology, Text Mining and Natural Language Processing) to support computer-aided inventive problem solving [21,37,38].

Using TRIZ for patent circumvention was first published by Dr. S. Ikovenko in 1991 [39]. There were major aspects of the patent circumvention using Function Analysis and Trimming. Due to various reasons (for instance, time and protection of intellectual property), few successful cases and detailed researches are published for now. Combined with TRIZ, patent provides concrete structural design to generate feasible concrete solution. Patent design around presents effective means to walk around competitive patent solution without infringing. It is one approach that improve innovation capability with low cost