

Strategic Patent Development Using TRIZ and Patent Information in Industry

Sehoon CHO¹[82-10-2712-7560] and Kyeongwon LEE²[82-10-2369-8226]

¹ Hanwha Precision Machinery, Seongnam-Si, Gyeong-Do, South Korea
Ph.D. student at Korea Polytechnic University
sehoon.cho@hanwha.com

² Department of Mechanical Design Engineering, Korea Polytechnic University,
Siheung City, Gyeonggi-Do, South Korea
lkw@kpu.ac.kr

Abstract. Companies need patents that are prepared for the past, present and future. How should we make the countermeasures against current or future problems due to patents that we have not prepared in the past? How should we secure the necessary patents for the upcoming future? TRIZ is a very useful and excellent tool as a practical tool for realizing the patents required by company. TRIZ Process also provides a good methodology for developing patents.

First, we use patent information and market needs in the process of determining the topic or target we want. You can create a list of patent candidates by analyzing the competitors' patents. And extracts specific analytical products from the business areas that require price or technology competitiveness in the market.

Organizations are organized according to each theme. Then, a schedule is scheduled for each topic and a periodic meeting is held. The patent expert conducts a patent search for candidate ideas. The expert evaluates the results of the analysis and selects ideas to be patented. Meeting leaders can plan and lead the development of patents that companies need through the TRIZ expert and facilitator role. This verification was experimentally conducted at Samsung for more than 5 years.

Keywords: Patent Search & Generation, TRIZ, Strategy, Facilitator, Cross Functional Team

1 Introduction

1.1 Initial Problem Situation

Every company has a variety of purposes. However, all companies must be sustainable. In particular, a typical company must do activities to obtain ongoing profit to exist. The company generates sales by creating a product or service and finally making a purchase by the customer. The company must keep the market and customers made by the products. If a company loses its customers or markets, its sales and profits are lost. Patents

are reasonable and good safeguards to protect individuals, companies, their customers or markets.

Many patents have been filed and registered in each country's patent office even now. Unfortunately, most patents do not reach the company's expectations. Sometimes they act against expectations.

What are the characteristics of a patent that reaches the company's expectations? Companies need patents for past, present and future. How should patents that have not been prepared in the past address current or future issues? How do you get the patents you need for the upcoming future? How should we create a patent that protects our competitiveness?

Then, by whom are the patents that the company needs? Who can make such a patent? In general, patents are the result of R & D and are created by research developers. So far most companies are thinking that way. The patent department awaits calls from research developers.

1.2 Issue Given to Patent Department

New managers give us new task. Executives with experience paying a large amount of royalty have an active attitude toward patents. Most companies pay a lot of money for making patents. It requires a lot of money to create new patents and hold patents. In general, managers want to get back if money is invested.

The patent department was given a new problem. What is the patent department doing? Where is the money invested to make a patent? When and how can we get back the money we invested?

2 Redefining the Problem

2.1 Situation of Problem

We have so many patents following the usual methods and procedures. However, from the manager's point of view, they no longer recognized their value. Only very few patents were returning for the investment. Most patents did not reach the expectations of the executives. Almost all patents have begun to be created from developers. Inventions come when developers solve problems in the development of new products. This is the normal flow. The quantity and quality of patents depend on the R & D department.

Sometimes we try to generate ideas. There are different types of ideas and concepts. However, it was judged to be meaningless from the manager's point of view. It has not been applied to our products, and it is less likely to be applied to new products.

2.2 New Approach

TRIZ is generally known as a method or tool for solving engineering problems. By looking at TRIZ we realize that it does not refer to any particular formal procedure. It

is constantly being developed and changing. It is said in numerous conferences and papers.

We redefined the process of making patents. Did the interactions of the components lead to the creation of bad patents? What was lacking and what was the useful function? What are environmental causes? We defined the researcher and the developer as one component and analyzed their characteristics. It was in a state where it was possible to analyze the cause along with the function analysis.

2.3 Definition of the Real Task

The general characteristics of a patent that can be returned for the money invested are known. Patented technology, solution must be applied to any product. Or that the technology has an essential reason to apply to future products. From the standpoint of the company, the company has the technology that solves the important problems that the product or service currently has. And the function or performance that the consumer expects of the product they intend to sell within one to two years. There is also a need for a solution to patents owned by competitors who are likely to potentially infringe on the company's products or services. Patent disputes are a great risk to the management of the company in the past, present or future. If there is a current patent dispute, it is essential to resolve the problem patent.

So the real task is when someone gets these patents in some way

3 Analysis of the Problems

3.1 Resource Analysis of Developers and Researchers

Products are getting easier for users. However, technologies for implementing functions and performance are becoming more complex and sophisticated. Different technologies and different functions are merging. Therefore, complexity is increasing in the process of making products and problems. This shows that there are limits to the creation of good patents by some researchers or developers in the process of making existing patents.

Each researcher and developer has limitations in their major, experience, knowledge, and skill. Occasionally, inventions begin with new ideas or concepts using personal experience or knowledge. Rarely, such attempts have good results. However, most of the product planning results are not made as good products, and various difficulties are encountered in the development process and discontinued. As a result, such patents also lose their meaning.

In the course of making Idea a product, developers get help from TRIZ experts. The TRIZ expert analyzes the problem, identifies the characteristics of the problem, and suggests ways to resolve the contradiction. However, there are often other problems encountered in the actual production process, whether individual concept proposals or solutions by TRIZ experts. In many cases, the problem cannot be solved and commercialization stops.

3.2 Analysis of Decision-making and Procedures

It is important that the patent is filed with the Patent Office sooner. We know that patents that are filed late will become meaningless if only a day is late. The ideas received in the patent department are reviewed by patent experts for several weeks. Once the technology is understood, it will investigate existing patents. Patent filing date is important, but usually takes several months. Also, it takes time to examine whether the proposed concept or idea is applied to the product and there are no other problems. In other words, a review of optimization is needed. The literal meaning of optimization is "the act of making something as good as possible" (Cambridge University Press). Optimization refers to a solution that overcomes various constraints such as environment, material characteristics, cost, etc. that contain negative factors of interaction between potential components in problem solving process.

3.3 Analysis of Patent Subject Selection Process

In general, the R & D process consists of solving many problems. If the developer thinks he has solved a new problem, he will consult with the patent department. That is, most of the topics of the patent are selected within the current development project. The subject of invention is set first and research is not started. Patents are created during the development of new products or services or to enhance the functionality or performance of the product. In the end, there is a difference between the value of patents expected by managers and the value of actual patents.

3.4 Results of Analysis

In the process of filing a patent, it took place sequentially and took a lot of time. The reason for this was the lack of continuous communication and information exchange in the review process in each order. In addition, as a result of investigation of prior art patents, time was wasted as the initial idea or concept was constantly modified in the optimization review stage. The reason is that most of them have suggested inventions or solutions depending on their personal knowledge, experience, and skill. So there are many things missing in the process of reviewing the processes, materials, technologies, devices, etc. necessary for actual commercialization. Also, most of the patent themes were current standards and the possibility of future value was low.

4 Modeling Contradictions in Problem Situations

4.1 Flow Chart of Initial Problem and Contradiction

A flow chart can be drawn as shown in Fig. 1 with the problem situation and analysis. The flow chart easily shows the contradictory situation occurring at the intermediate stage from the end point of view in problem situations [15, 17]. It does not define the

kind of contradiction. It also makes it easy to see where contradictions arise and, as a result, how they affect the end goal.

The flow chart shows that there are two contradictory situations. Researchers and developers are making good patents. At the same time, they are making bad patents. To solve this problem, various experts are required to review it. But it delays the patent application date by a lot of time and procedures.

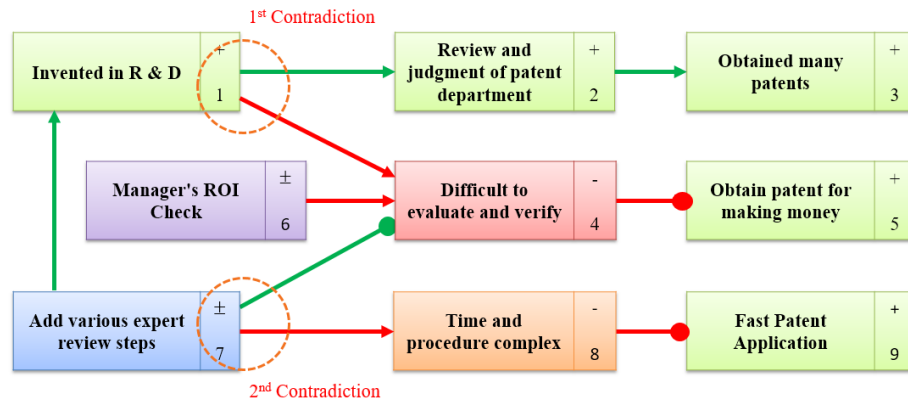


Fig. 1. Flow Chart of initial Problem

4.2 Criteria for Evaluation

There are conditions that are not allowed in the process of resolving the problem situation or in the final result. It is not a real solution if it has new problems or if it is difficult to implement problem solving. It is important to clarify the evaluation criteria of the final solution in advance for the real solution of the problem [15]. In Part 7 (7.2) of ARIZ [3], Altshuller asks whether each solution meets the requirements of IFR-1.

The criteria for evaluation are as follows.

- 1) The annual patent application goal of the division must be achieved.
- 2) Researchers should use minimal time.
- 3) Support organization professionals can only use the time currently allocated.
- 4) There is a possibility that the created patents will be applied to the product.
- 5) The patent application period should be shorter than the present.

5 Generate Solutions

5.1 Cross Functional Team

Cross Functional Team (hereinafter referred to as “CFT”) defines a set of members of various functional departments as a single team that focuses on common goals and problems such as the development of new products [1]. And CFT is the communication and cooperation effect between R & D, production technology, and marketing departments [2]. There is also a study of what characteristics of CFT affect performance [14].

The idea of problem solving was reviewed in terms of time and space. And supplementing the lack of researchers' ability to cause problems. Many researchers and specialists in support organizations solve problems at the same time and place. Support organization experts assist the researcher in the process of gradually embodying the idea. So far, support organization experts have had useful and harmful features. It took a lot of time to get back to the researcher by creating understanding and feedback of the support department's ideas. The key point of the solution is to engage professionals from the beginning in the process of analyzing and re-solving the problem, which are necessary for review and verification. And included facilitators as managers to better manage the team that was composed. Facilitator is the one who controls the process of discussion, involves the participants, and structures the group work. TRIZ facilitation is a professional way to organize the process of group work of client's experts aimed at finding the solutions of unsolvable problems and achieving the goals set to the group [16].

The CFT Organization approaches the Resource concept. This concept can simply be included in the Super system at the stage of finding a traditional resource in problem solving, or it can be defined as an Extended Resource. In all resource analysis, there is a "Require & Delivery" interconnection between each resource or component. Likewise, the members of the CFT pre-detect the interaction of the negative element or condition with the corresponding Goal while solving the given problem through interaction during the meeting time. The main function, mission and qualities of the members of the CFT to solve patent problems in this study are shown in Table 1. Facilitator selects the experts in product planning, R & D, and manufacturing according to the products to be handled through inter-views.

Table 1. Organization of Cross Functional Team.

Section	Mission	Qualification
Facilitation	Situation analysis, Project Direction & Goal define, Meeting Leading, Evaluation, Time keeper	Facilitator, TRIZ Specialist, (IP Expert)
Marketing	PRM Review, Market & Products Trends, VOC& VOB, Sales point, Core Needs, Product Concept	Over 5 years' experience
R&D	Concept design base on Seed & Core Tech, Implementation and verification of function and performance, Simulation, TRM review	At least 3 years' experience, R & D expert
Patent Expert	Prior Art Search, Ideation Support, Patent Review, idea List-up, Application, Claim Optimize & Tuning	Over 5 years' experience
Manufacturing	Mass production verification and review, Drafting Potential Problems, Suggestion of improvement idea	Engineer, Over 5 years' experience
Design*	Visualization of Idea & Concept	At least 3 years' experience

The design department can be excluded depending on the situation of the technical problem.

5.2 Selection and Procedure of Patent Subject and Problem

Patents that the company wants should ultimately help the management. If a serious technical problem is resolved, it can be a good patent. We need patents that make patents that have potential for patent disputes worthless. The technology that is expected to be used in the near future should be patented by the company. The common features of the above-mentioned patents are all applied or applied regardless of the product.

Fig. 2 is a very simple procedure proposed for solving the problem.

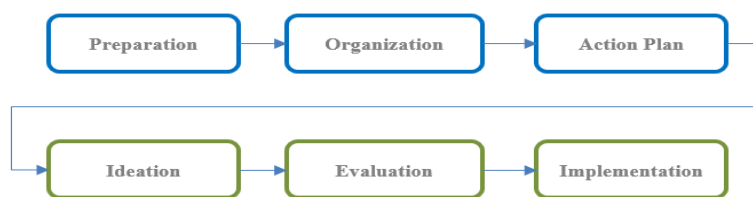


Fig. 2. Approximate patent troubleshooting procedures

Fig. 3 shows the check points of the preparation stage in the proposed procedure. Approximately seven things are checked as listed. Each item must collect and process information in advance.



Fig. 3. Approximate patent troubleshooting procedures

The fourth in Figure 3 uses the patent analysis results of competitors. In the claim chart, the elements belonging to one claim are set as one technology system, and function analysis is performed with each element. Before proceeding, prepare the Tech Tree regardless of the subject matter of the patent or the content of the problem. Most products, regardless of patent design around, product optimization, preempt Future patents, etc., have target functionality and performance. And it is a technical system with interaction with components.

Table 2 shows the elements analyzed by the claim chart and the functions of each element in a table. This is a breakdown of the configuration and functions of competitors' patents. Also, a Claim means one technical system. This allows researchers and developers participating in the CFT to easily think about improving the system's functionality and removing elements at the same time. The final specification can be divided into customer and product requirements.

Table 2. Claim chart based ideation list Table.

E/N	Function	Final Spec.	AS-IS	Issue(Gap)	Cause	Idea	Main Inventor
E1	F 1-1	S1	-	-	-	A1	A
	F 1-2	S2	-	-	-	B1	B
	F 1-3	S3	-	-	-	C1	C
E2	F 2-1	S4	-	-	-	D1	D
	F 2-2	S5	-	-	-	E1	E
	F 2-3	S6	-	-	-	F1	F

Table2 is usually made in Excel format. Here we show it in sample form only. Nowadays, most technology systems can have complex tables because they have various functions. In this case, it is better to define "Target element" first. The target element is usually chosen by analyzing the patent claim chart. Empirically, we choose to have the most complex structure or steps. You can also choose to have the most restrictive conditions

5.3 Patent Generation Process

All troubleshooting procedures require management. Management here is not simply demanding goals. It should be the role or facilitator of the supervisor planning to reach the goal. The facilitator must know the characteristics of the members and know what role they should play at some stage. Currently, the given situation is technical problem solving.

Table 3. Weekly valuation and Process management

Item	Future Tech		Optimization		Patent Issue		Rank				Total
	New Biz	Alter-nate	Next P	Current P	DA	AT	idea	A	B	C	
R			3	1			8	3	1	2	14
V			4				7	4		0	11
G		1	2	2		2	5	6	1	2	14
S			3	2			6	3	2	1	12
H			1	1			2	1	1	7	11
D			6	6			12	3	9	1	25
Total	0	1	28	18	0	2	50	25	24	18	117

In this study, we evaluated the ideas derived from the final goal periodically. It is necessary to manage the progress according to time, rank according to the value, and

manage the follow up work. This study was conducted on a weekly basis. Table 3 is an example of evaluating inventions that are specified on a weekly basis for teams with six different patent themes. And the table shows that three goals are separated into two, and a rank is assigned to each idea. An idea that does not have a concrete and clear function does not define a Rank. Only such ideas can distinguish value. Such ideas are regularly re-evaluated and rank. Each team discusses three types of patent themes for each product at weekly meetings. Individual methods have been used in existing papers or methods. The final evaluation of the invention is periodically evaluated up to the completion stage of the invention and concurrently with the completion of the invention.

There are various examples and studies that TRIZ is very useful as a tool and method for dealing with patent problems [4, 5, 6, 7]. In addition, patent and TRIZ can be combined to infer a potential future technology [9, 10, 11]. Many TRIZ experts have made various attempts to resolve potential infringement patents [8, 12, 13]. These preliminary studies have been done individually. It is not very useful from the perspective of the person who needs to solve the problem in the actual company. Most researchers and engineers, both resources and solvers, have not been trained professionally. It is another problem situation.

5.4 TRIZ Facilitator and Role

Each item-specific CFT has its own collective goal. In the end, to achieve the common goal, teamwork should be made quickly. Facilitation involves a dynamic interaction of the teacher's beliefs, goals, and knowledge [18]. Depending on the facilitator's role, the level of interaction of the members that make up the CFT is different. In TRIZ, the facilitator's role and operation method are suggested [16]. Individuals with high levels of competence have different outcomes depending on the level of interaction. Therefore, in this study, operators of each organization were required to receive professional training (at least 16 hours). Basically, the operator was selected by patent experts. Most of them have worked for more than 5 years. They were additionally trained at TRIZ Level 1.

Therefore, they performed situational analysis, project direction & goal define, meeting leading, evaluation and time keeper at regular meetings. They were patent experts and had basic knowledge of TRIZ.

6 Results of Operations

6.1 Achievement of Goal

According to this study, the analysis and solution of the problem situation started from 2010. CFTs were created for an average of eight items per year. We collected the average of 10 members for one item in product unit. Basically, members were chosen from product planning, R & D, manufacturing technology, patents, and design departments. Each CFT was operated by a facilitator. Most teams were given the same type of goal.

It was to make three types of patents. Three types of patents are required as product units.

Fig. 4 shows the quantitative changes of patents over the past 8 years, including three years before starting the study and five years after the study. A rank is an international patent and B rank is a domestic patent. From 2010, the quantitative change of international patent by this study begins.

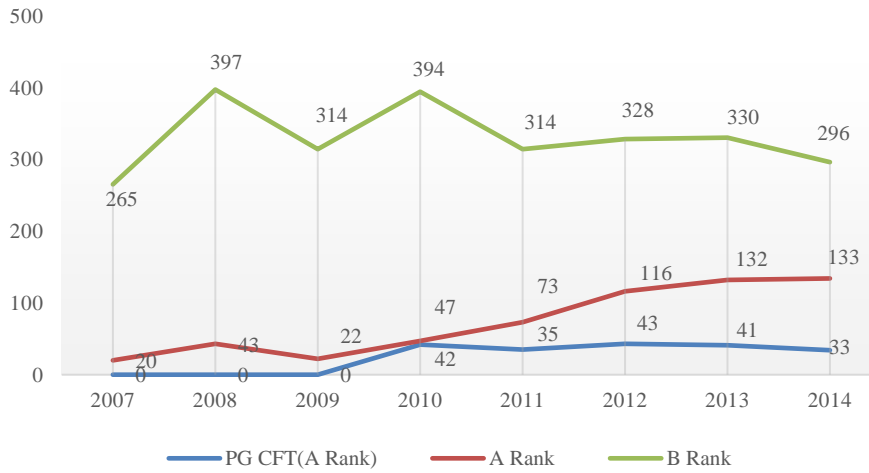


Fig. 4. Changes in quality and quantity of patents over 8 years

Since each task has given the limits of quantitative targets, there is no significant change in five years. However, the quantitative changes in the company's international patents have increased very much each year. On the contrary, the number of domestic patents tended to decrease gradually. The value of domestic patents is relatively low compared to international patents. In the end, it is very good that domestic patents with low value are reduced and international patents increase instead.

Table 4. 2013 Total CFT activity results

Item	Member	Meeting Count	A Rank	B Rank	Cancel	Total
R	9	15	6	12	4	22
V	10	11	5	1	5	11
T	14	7	6	9	5	20
G	9	12	8	6	3	17
S	7	12	6	6	6	18
H	7	12	1	1	9	11
P	20	20	4	9	3	17
D	8	16	5	3	17	25
Total	84	105	41	47	52	140

Table 4 provides an example of one of the study periods. For five years, a team of similar size was formed and progressed on a weekly basis in the form of Table 3. Most of the teams had 2 hours of weekly meetings and 7 to 20 meetings.

Table 5. Quantitative and qualitative changes in patent applications

Year	2010	2011	2012	2013	2014	Total
Patent Application	217	354	296	343	327	966
Product Patents	39	106	68	88	100	256
Rate	18%	30%	23%	26%	31%	27%

Table 5 shows the changes in the amount of patent applications and the use of the product during the five years of CFT operations. Before this study began, the ratio was lower than 10%. The goal of the CFT was to create patents that would be applicable or applicable to real products. This study accomplishes what management expects. The five criteria for evaluation were all achieved.

6.2 Implications and Effects of the Results

The quantitative increase in international patents, the quantitative reduction of domestic patents, and the increase in the proportion of patents used in products have some good signals. The changes shown in Fig. 4 and Table 5, together with the results of the pure CFT itself, produce good overall results. The product of the task we want to deal with each year was different. Also, the members who participated in each year were different. It was a process by which company members were trained to produce good patents. During the process of CFT, various tools and methodologies are communicated to the members. This study analyzes that employees who have once participated in CFT have played a positive role in creating good overall patents.

7 Conclusions & Recommendations

This study has been conducted using the results obtained from the participation of most of the team's TRIZ facilitator for 5 years in Samsung since 2010. The author used TRIZ to find out the problem analysis and solution direction to make strategy patents. I started working for Samsung in 1995, I learned TRIZ in 1998, and started using it for patent work. This study aims to solve the non-engineering tasks by combining and analyzing the theories and methods that solve the patent problem using TRIZ. The conclusions of this study are summarized as follows.

First, TRIZ can be used as a good tool to solve the problems that arise from the manager's point of view. TRIZ is a good way to solve most engineering problems or some business problems. Regardless of any problem situation, TRIZ can be used to suggest the direction and method of problem solving by making the problem situation a contradiction model and analyzing the resources affecting the problem situation. TRIZ is practically useful for solving problems or requirements from the management

point of view, including common engineering situations. This can be seen in the background of the problem situation.

Second, in the process of solving complex problems, it is helpful to utilize various methods of operation of TRIZ as role of facilitator rather than solver's role. For a long time, TRIZ has gained a reputation as a good tool to solve various problems. However, there was often a response to a new problem that TRIZ was difficult in the process of learning. Especially in situations dealing with patent issues, facilitators were more effective when they were at least experts on patents and TRIZ. Today, the development of products is increasing in complexity and requires more skills and knowledge. In addition, the problem solving through CFT is effective in situations where various new knowledge and skills are required in the process of solution.

Third, we proposed and verified the problem analysis and solution by redefining the qualities and roles of the members who solve the problem as the concept of resource analysis. Employees of the company are sometimes called Human Recourse. It is the person who recognizes all the problems, and the person who solves it is the person. Finally, the person's abilities, experience, skill, degree, and major are the characteristics of the resource. The key to problem solving is to find and select X-elements from a given resource.

In order to utilize the results of this study more effectively, the follow-up studies are required as follows.

First, the method of judging the value of the created patents needs to be studied more systematically. In this study, the patents made were roughly classified into six value classes by the decision of the team itself. Such classified results were not subsequently revalidated or evaluated in detail. The value of the actual patent is generated according to the scope of the finally registered claim.

Second, it is necessary to study how to reduce rejection ideas from the beginning. Because ideas that are finally rejected are initially judged, the management resources are consumed relatively small. However, the number is over 30%. There is a need to study the operation method to reduce effectively.

Third, it is necessary to study the concept of Human Recourse in more detail in terms of general resource analysis of TRIZ and analyze it systematically. In this study, we selected the members who will participate in the consultation with the facilitator and the owner of the item in the expert group. This implies that the level of the result may vary depending on the level of the facilitator.

Acknowledgement

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