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## TRIZ as an enabler for intellectual property protection during product development

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### Abstract

In Europe and the United States a switch to a knowledge intensive production industry is actively pursued. Especially in these knowledge intensive branches of industry proper protection of IP is of utmost importance to get and maintain a profit-making advantage over competitors. These companies define patenting strategy's that go beyond the patent of just single products or processes. The decisions on these patenting strategies are made by specific IP departments after the development process. The main question to be answered is if a company's patent strategy is better served if the product designer can take this strategy into account during the concept development stage. This paper looks at the possibility of TRIZ as means of supporting the product designer in acquiring patent strategy data. It does so by linking a design model to TRIZ tools and methods and patenting strategies. Furthermore TRIZ is compared to generic strategies for developing a (design around) patent. It is concluded that all information is available to define the data for the patenting strategies during concept development, but that the available tools and methods are too slow. Furthermore, two important strategies for defining patents, combination and decomposition, are not properly supported by TRIZ.

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### 1. Introduction

Due to globalization, increasing development speed and growing competition between companies, designers are faced with new challenges concerning the protection and distribution of various types of Intellectual Property (IP). An increasing number of products are developed in global networks with multiple stakeholders like suppliers, customers, research facilities and other external subcontractor. In Europe and the United states a switch to a knowledge intensive production industry is actively pursued.

Especially in these knowledge intensive branches of industry proper protection of IP is of utmost importance to get and maintain a profit-making advantage over competitors.

Collaboration and communication is becoming more important in these development processes, and is even further facilitated by the digitalization of information and the increasing availability of digital development and communication tools [1]. During the entire design cycle the choice of which type of IP protection is relevant should be observed. This has to be done in line with the phase of the project and the corresponding requirements of the protection. To execute this IP-strategy to its fullest extent, designers should be supported and guided in the use of the strategy. This paper will investigate the opportunities of using TRIZ as a support methodology for the development of IP information by the product developer during the early stages of product development.

## 2. Types of Intellectual Property

Different types of IP are protected by law. Some types are automatically protected upon creation, other types need to be submitted and be approved of before legal protection is granted. The IP law may differ from one region to another and different types of IP are recognized and legally enforced. The most common IP types are listed and explained below.

- Trademark: A Trademark is a distinctive mark or feature used to identify a product or service in a specific market. Most countries require registration of Trademarks before it is legally protected.
- Trade secret: A Trade secret is information about a design, system or process of sorts that is valuable to a company for economic benefits. The information is not commonly known and can be protected through contracts with the employees of the company. The information is then confidential and thereby protected by the law of protection of confidential information.
- Copyright: Copyright is the exclusive legal right to reproduce, publish, sell, or distribute literary, musical or artistic work. In most countries this right exists automatically after the work is created.
- Design right: The Design right gives exclusive legal rights to the owner of a design of sorts. Shape, pattern and configuration are some of the designs that can be protected. The design right is not globally valid, regulations differ from region to region.
- Patents: The patent grants a set of exclusive rights to the inventor for a limited period of time in exchange for the public disclosure of an invention. A patent has to be granted after an application has been filed. The patent system consists globally, but regulations vary in different countries. The inventor can file patents for one or more countries.

The above mentioned IP types are all protected and regulated by law. Besides these we can also identify protection types initiated by the public (like Creative Commons, BSD licenses, etc.). What the rules are to apply for these kinds of IP protection differ per country. Also the applicability of the different types of IP differ per area of expertise. Patents have become the most applicable form of IP protection for technical innovations. Larger technical companies often create patent profiles and strategies that adhere to their corporate policy to ensure their future commercial market share. For the product designer the patent is also the most important form of IP. This is why we will focus on/limit ourselves to patents as means of IP protection in the rest of this paper.

### 1. Patents

A patent is an official document, issued by a government, that allows the creator of an invention the sole right to make, use, and sell that invention for a predefined period of time. In order for a patent to be granted the invention has to incorporate some specific characteristics. For example the European Patent Office uses the definition that only those products are patentable that are *new, industrially applicable and involve an inventive step*. For the product designer the term inventive step is of key importance. The inventive step is defined as being *non-obvious to someone skilled in the art* [2]. If a patent is filed the newness/inventiveness is checked using two important infringement rules. These two rules check if the new patent would impinge on earlier patent claims [3].

#### 1. The all elements rule

This is a principle applicable to patents, according to which each element of a patent claim must be present in an allegedly infringing device (patent) in order to establish literal infringement.

## 2. The doctrine of equivalents

If the new patent makes only a minor departure from the original patent claim and, therefore, does not literally infringe, the new patent may nevertheless be held to be an infringer if the new patent

- achieves substantially the same function
- in substantially the same way
- to obtain substantially the same result.

Based on these two definitions [4] has investigated the patent strategies used within companies and categorized them into 3 generic strategies for defining a portfolio of patents.

1. Proprietary Strategies: A proprietary strategy is defined as using patents as a mechanism that shield the firm's key competitive advantages from imitation. Firms applying a proprietary strategy will protect individual patent by building overlapping and complementary patent rights to minimize the chances that the set of patents can be invented around or overturned.
2. Defensive Strategy: While a proprietary patent strategy protects a company's patents, a defensive strategy focusses on ensuring that a company is not put at a competitive disadvantage because of patents held by others. Firms may need to have a strategy for defending against patents owned by others, for example by claiming patents themselves.
3. Leveraging Strategy: Both previous strategies are labor intensive and are often only applied by larger companies with specific departments dealing with patents. When it is not possible to protect a company's own patents by defining layers of supporting or blocking patents, profits with patents can still be made by selling or renting of patent rights. For example development end subsequent selling a new technology that is protected by patents can give the buying company a decisive head start when trying to conquer a new market.

Especially based on the first two generic patent strategies described above and focusing of the all element rule and the doctrine of elements Liu [5] has identified 4 basic concepts for dealing with patent protection of individual patents (not patent portfolios) or for designing around patents. If the original design as described in the patent consists of elements A,B,C and D then new patents do not infringe on the original patent if the new product consist of

- A,B,C Elimination strategy;  
not all elements are present in the new patent and only infringement rule 1 applies.
- A,B,C,D<sup>1</sup>. Replacement strategy;  
Add a new element D<sup>1</sup> to the patent; D<sup>1</sup> must not basically fulfill the same function in the same way as D (Infringement rule 1 and 2 apply).
- A,B,E Combination strategy;  
Add a new combined element E; E may not basically fulfill the same function in the same way as C+D (Infringement rules 1 and 2 apply).
- A,B,C,E,F Decomposition strategy;  
Element D is replaced by elements E and F (Infringement rules 1 and 2 apply).

## 2. Patent protection and TRIZ

Based on the last section of the previous paragraph it can be stated that the general goals of patent protection of individual patents are closely related to some of the tools and methods of TRIZ. For example trimming can be used to remove an element of the product, while the lines of evolution may lead to addition of an extra functional element. Furthermore the database of effects may be used to find alternative ways to deliver the same function in another way (to overcome the doctrine of equivalents). This section depicts a short overview on previous research that focusses on TRIZ based patent research.

Xiaotian [6] uses the patterns and lines of technology evolution to define radar plots and compare the innovation against patents from possible competitors. By comparing the radar plots a competitive advantage might become

recognizable. With this competitive advantage in mind new innovative product ideas are generated. These new patents should be in line with the patents strategy of the company (for example proprietary or defensive). Verhaegen [7],[8] also investigate the evolutionary potential of products. An algorithm has been developed that through patent analysis extracts information concerning product properties and functions, which are then related to trend phases. The goal of this algorithm is to reliably automate the identification of the evolutionary potential of products and with this open up the possibility to improve product patenting.

Regazzoni [9] states that the importance of intellectually property management is often neglected within SME's. The paper proposes 3 organizational models to improve the support for IP management within SME's with the goal of increasing levels of company internal IP management. Furthermore a model is proposed that links IP related tasks (to inform, to manage IP, to monitor and analyze the state of the art regarding patents) to known TRIZ methods (functional analysis, contradictions, inventive principles, trends of evolutions). In this paper functional analysis is seen as the major TRIZ method for IP protection.

In the work of Schuh [10],[11] the original contradiction matrix used within TRIZ was used as inspiration to define a new matrix that can support companies to counteract the effects of product piracy. Within the paper it is noted that the original matrix, containing only technical innovative principles, might help in some cases, whilst other piracy related problems require non-technical solutions. A total of 26 inventive principles have been defined to counteract product piracy, divided over 3 categories (technical, organizational, management).

Sheu [12] uses trimming to improve a process-machine conflict. The result of a TRIZ-trimming process directly relates to the first infringement rule. After the trimming process not all elements will be present in the product/process so a new patents may be applicable.

Eleven specific patent strategies have been suggested by Ikovenko [13],[14]. Based on these specific strategy definitions he was able to link known TRIZ tools and methods to six of these strategies.

Table 1 Patent Strategies with corresponding TRIZplus tools, Ikovenko [13]

DETAILED PATENT STRATEGY	TRIZ TOOLS	
The Antidote Strategy	Function Analysis, Cause-effect Chain Analysis, Trimming, Function Oriented Search	Protect your IP
The Submarine Strategy	Trends of Evolution, Function Oriented Search	
The Toll Gate Strategy	S-Curve Analysis, Trends of Evolution, MPV Analysis	
The Picket Fence Strategy	S-Curve Analysis, Trends of Evolution, Function Oriented Search, Reverse Contradiction Analysis	Avoid patented IP
Competitive Patent Strategy, by Trimming Circumvention	Function Analysis, Cause effect Chain Analysis, Trimming	
Competitive Patent Circumvention Strategy, by History Estoppel Research	Function Analysis, Function Oriented Search	

### 3. Patent data investigation and definition during the design process

The goal of this paper is to investigate if it is possible to define an integrated method or tool for a holistic IP protection within the early stages of product development, encompassing the complete development cycle. This is done by investigating what the added benefits are of having the product designer define IP-data, defining when what data can be generated and finally what the demand are from a product developer in regard to a method supporting him in developing IP-related data. During the product development process the designer has to make many important decision. In a standard development process these choices are mainly dealing with the functionality of the product/process; in many cases also checks are executed to see if there is no direct patent infringement. Patentability of a concept design in the light of a company's patent strategy is not taken into account. The ultimate goal of this

research will be if it is possible to define products that better adhere to patent protection strategies if the designer has insight into the patentability of his many product concepts during the development process.

A first step was taken by investigating when a product/process developer would have the opportunity to influence the IP-data investigation and definition. This was done by linking a (rather arbitrarily chosen) model of a design process [15] for new products with TRIZ tools and methods. The links within this model are based on the data typically generated in project phases and the applicability of this data as input for TRIZ tools. In a next step the TRIZ tools are linked to patent strategies. It was chosen to use the link between TRIZ tools and patents strategies as defined by Ikonen [13],[14], but any of the approaches described in section 1.3 could be incorporated. This results in an elaborate interconnected scheme of process development steps, project information and data, TRIZ tools and databases and patent strategies. A graphical representation of this model can be found at the end of this paper (fig 1).

Analyzing the model and the observations from the previous sections of this papers lead to some new insights.

- In the case of protection of new products by patents the steps to protect the product are typically executed during or after the detailing stage. But the TRIZ tools needed to do so are already available during the prototyping stage. When one of the patent protection strategies is used, many product variants have to be generated and evaluated during the concept stage. Although TRIZ tools allow for the generation of these alternatives, the lack of development and analysis speed is a problem for thorough investigation of best patentable product alternatives during concept development. Developments of computer support for both the development and analysis steps needed for patent generation, like for example depicted in [7],[8], might turn out to be the solution.
- When a defensive strategy is used to ensure that a company's development is not blocked by competitors, a more detailed description of the product/patent is available. This implies that other tools become available like value conflict mapping and lines of evolution. Depending on the detailed strategy chosen the number of product alternatives to be developed may be limited.
- As for a leveraging strategy only one patent could be enough this strategy is for now adequately served by the existing support supplied by TRIZ
- When looking at the 4 basic concepts for dealing with the development of patents the first two have direct links to TRIZ.

- Elimination strategy -> Trimming

- Replacement Strategy -> 40 inventive principles, 76 inventive standards, evolutionary trends etc.

The two other basic concepts are less prominently present in the TRIZ toolkit. Where the elimination and replacement strategy are supported by TRIZ methods (that thus propose ways to find an innovative solution), the combination and decomposition strategy cannot be directly linked to such methods. Only the innovative principles proposed by some of the TRIZ methods can be linked to the strategy, but thus do not generate new innovative insight.

- Combination Strategy; this can be directly linked to inventive principle 5 (merge) which according to [14] can be linked to inventive standards 1.1.2-1.1.5 and 3.1.4

- Decomposition strategy; no direct link is present in the contradiction matrix although some principles are related; for example inventive principle 1 and 3 (segmentation, local quality) which according to [14] is linked to 7 other inventive standards.

#### 4. Conclusions and outlook

In this paper a preliminary investigation is described into the TRIZ based support of product designers during the concept development stage. Ultimately the research should answer the question if, to a certain extent, the designer can incorporate a company's patenting strategy into his/her concept development stage. Based on the observations presented in this paper it is concluded that all data and information needed to create patents (strategies) is available but lack development and analysis speed (especially for proprietary and defensive strategies) to be practically applicable. When we more directly compare TRIZ to strategies to develop individual patents, it appears that both the combination and the decomposition strategy are not supported by TRIZ tools and methods.

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