Implementing the Theory of Problem Solving Methodology in Developing Innovative Products

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ABSTRACT

An account of innovative products, processes and services is a tough process which is possessed of approaches that have modern designs and structure. Nowadays, companies want to be more productive and more efficient. However, sudden and large changes have happened in competitive conditions and to prevail in this competitive and rapidly changing and expanding world, scientific developments had to be followed. To gain competitiveness, the companies need to procreate new products or removing the existing contradictory states. In these cases, TRIZ (Theory and Innovative Problem Solving) methodolgy is one of the most competent scientific approaches, used by managers or inventors. In this study, TRIZ methodolgy was explained in detail with innovation concepts. At the end, an example about TRIZ application has been explained.

Keywords*: Approach, Contradictory, Innovation, Scientific, Triz.*

1. INTRODUCTION

Today's businesses have faced with significant challenges such as rapid changes in customer expectations, global competition, rapid technological inventive, shortening product life cycle and the socio-economic environment. The most important way of providing supremacy is undergoing a change in the race conditions. Undergoing a change is possible with creativity and inventive that was realized for processes, products and strategies. Companies must create dissimilarity to take a necessary and different place into the global markets that have very sharp competitive factors. Dissimilarity and favorite differences can be earned by gaining competition power with creative solutions.

Creativity can be defined as follows: Creativity is to find astonishing solutions for problems, to gather together in harmony original or called incompatible with each other designs or to reveal new and useful product. In 1946 G.Altshuller a Soviet Scientist flourish a technique known as TRIZ for which the technique and applications are easy to follow and to learn. However, being a systematic device, TRIZ can be used as a useful method in new product development process to generate alternatives. In this course, the methods of TRIZ's characteristics and devices will be defined and their use will be illustrated [1].

2. LITERATURE REVIEW

2.1 Creative Performance

Creativity is the strength to make new, innovative products; creative performance can be analyzed and accessed by process and result (Kassim, Nicholas, & Ng, 2014). Creative thinking is the most important part of the creative process (i.e., the action of an activity or thinking). The creative outcome has to do with the innovativeness of a creative product.

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2.2 Creative Process

Most of the relevant literature has defined creativity as the process of bringing into being something that is both new and effective (Amabile, 1996; Ritter, van Baaren, & Dijksterhuis, 2012; Sternberg & O'Hara, 1999). It is also the process of solving complications (Amabile, 1996; Ritter et al., 2012; Hammershøj, 2014), which consists of the following basic stages: arrangement, incubation, illumination, and verification (Wallas, 1926; Hammershøj, 2014). Further analyses of inventive achievements show that the way in which a problem is initially defined determines the extent to which it will be solved in an inventive manner. Problems must be reconstructed and redefined according to context (Isaksen & Treffinger, 2004; Kuo, Chen, & Hwang, 2014). Therefore, we must first identify facts and problems, and then creatively define problems (Kandemir & Gur, 2009; Cybulski, Keller, Nguyen, & Saundage, 2015; Kuo et al., 2014; Huang & Chen, 2004).

During the initial state of an ill-defined problem, goal state or action (Chrysikou & Weisberg, 2005; Jauk, Benedek, & Neubauer, 2014; Benedek, Jauk, Sommer, Arendasy, & Neubauer, 2014), the basis dynamic of the creative process is obtaining novel and useful results by fully applying the powers of divergent and convergent thinking (Isaksen & Treffinger, 2004).

The present study proposes that the imaginative process involves five stages: identifying problems, analyzing problems, and identifying, selecting, and executing a strategy.

2.3 Creative Products

Creativity is the capability to create something useful and innovative, and the ultimate goal of a creative performance is to goods creative or innovative goods. A creative product analysis matrix (CPAM) is a common tool for assessing innovative products based on three causes: novelty (e.g., originality, being the first), resolution (logic, usefulness, appropriateness, the solvability of any difficulties), and amplification and synthesis (esthetic considerations, beauty). In the field of engineering design, however, creative fruit must be novel, inventive, and valuable [2].

3. TRIZ

TRIZ is a knowledge-based organized methodology for inventive problem solving (Gadd, 2011), which offers a systematic approach to finding technical explanation and increasing the innovativeness of technical systems (Ilevbare et al., 2013).

The Theory of Inventive Problem Solving, known by the acronym "TRIZ, is a problem-solving methodology tailored to provide innovative explanations for scientific and engineering problems. Genrich Altshuller, a Russian inventor, developed TRIZ in the late 1940s and 1950s. After World War II, Altshuller worked on design problems in the Soviet Navy. Altshuller was convinced that he could improve the creativity of design engineers. He began by looking into Synectics but was not impressed with the method. So in 1946 Altshuller started his work to create a new science of invention [3] Altshuller and a few colleagues began by studying author certificates, the Soviet Union's equivalent to patents. The basic premise of TRIZ is that the solution principles borrowed from studying novel inventions can be codified and applied to related design problems to profit inventive solutions. Altshuller and colleagues constructed their methodology for generating inventive solutions to design and published the first article on TRIZ in 1956.TRIZ offers four different strategies for generating an innovative solution to a design problem. They are:

1. Increase the ideality of a product or system.
2. Analyze the product's place in its evolution to ideality and force the next step.

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3. Analyze key physical or technological contradictions in the product and revise the design to overcome them uses inventive principles.
4. Model a product or system using substance-field (Su-Field) analysis and apply can Didate modifications.

Altshuller developed a step-by-step agenda for applying strategies of inventive problem solving and called it ARIZ. Space considerations allow us to introduce only the idea of contradictions and to give a brief introduction to ARIZ. While this is just a beginning introduction to TRIZ, it can serve as a significant stimulation to creativity in design and to further study of the subject. Note that this section follows the TRIZ conventions in using the term system to mean the product, device, or artifact that is invented or improved.

The benefit of TRIZ is understanding that contradictions can be methodically solved with application of innovative solutions.

Three fundamental principles of TRIZ accepted as follows:

1. The ideal design is goal.
2. Contradictions help to solve the problems.
3. Innovation process can be configured as systematic.

The main goal of TRIZ method is to find the ideal solution or perfection. TRIZ methodology depends on four elemental paradigms;

1. Contradictions
2. Perfection
3. Functionality
4. Using resourcess

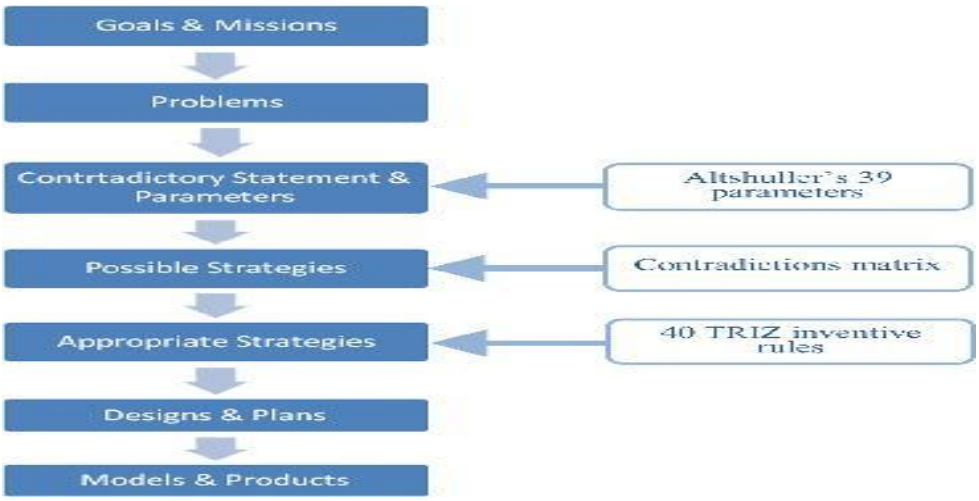

Fig.1. The TRIZ Approach

4. BASIC STRUCTURE OF TRIZ

TRIZ is a structure that has initial inventive philosophy, methods and tools. The philosophy of TRIZ displays excellence, resources, and contradictions. The better important tool of TRIZ is ARIZ. ARIZ is an innovative problem-solving algorithm. The better used tool of TRIZ is Contradictions Matrix.

Fig. 2. Basic Structure of TRIZ

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The philosophy of TRIZ:

1. It is to estimate creative problem resolution and designed product development. It is to create principles that are accepted for all fields of technology.
2. It is to eliminate contradictions.
3. It is to use effectively materials, energy and awareness for creating the beneficial effects.

5. THE 39-ENGINEERING PARAMETERS OF TRIZ METHODOLOGY

2.8 million Patents were being checked and problems have been classified, described and reduced 39 engineering criterion by Altshuller with TRIZ Methodology. These parameters have been defined for Moving and Stationary Objects as follows: Moving Objects: Objects which can comfortably change position in space, either on their own, or as a result of external forces. Stationary Objects: Objects which do not alteration position in space, either on their own, or as a result of external forces

1. Weight of moving object
2. Weight of stationary object
3. Length of moving object
4. Length of stationary object
5. Area of moving object:
6. Area of stationary object
7. Volume of moving object
8. Volume of stationary object
9. Speed
10. Force
11. Stress or pressure
12. Shape: The external contours, appearance of a system.
13. Stability of the object's composition
14. Strength
15. Duration of action by a moving object
16. Duration of action by a stationary object
17. Temperature: The thermal condition of the object or system.
18. Illumination intensity: Light flux per unit area, also any other illumination characteristics of the system
19. Use of energy by moving object
20. Use of energy by stationary object
21. Power: The time rate at which work is performed. The rate of use of energy.
22. Loss of Energy
23. Loss of substance
24. Loss of Information
25. Loss of Time
26. Quantity of substance/the matter
27. Reliability: A system's ability to perform its intended functions in predictable ways and conditions
28. Measurement accuracy
29. Manufacturing precision
30. External harm affects the object: Susceptibility of a system to externally generated harmful effects.
31. Object-generated harmful factors
32. Ease of manufacture

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33. Ease of operation: Simplicity
34. Ease of repair
35. Adaptability or versatility
36. Device complexity
37. Difficulty of detecting and measuring
38. Extent of automation
39. Productivity

6. THE 40 – INVENTION PRINCIPLES

Altshuller also current 40-Invention Principles after placing 39-Engineering Parameters to find inventive solution for the problem after investigating definite patent solutions and these principles can be explained as follows:

1. Segmentation
2. Taking out
3. Local quality.
4. Asymmetry
5. Merging
6. Universality
7. "Nested doll"
8. Anti-weight
9. Preliminary anti-action
10. Preliminary action
11. Beforehand cushioning
12. Equipotentiality
13. 'The other way round'
14. Spheroidality - Curvature
15. Dynamics
16. Partial or excessive actions
17. Another dimension
18. Mechanical vibration
19. Periodic action
20. Continuity of useful action
21. Skipping
22. "Blessing in disguise" or "Turn Lemons into Lemonade"
23. Feedback
24. 'Intermediary
25. Self-service
26. Copying
27. Cheap short-living objects
28 Mechanics substitution
29. Pneumatics and hydraulics
30. Flexible shells and thin films
31. Porous materials
32. Color changes
33. Homogeneity
34. Discarding and recovering
35. Parameter changes
36. Phase transitions

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37. Thermal expansion
38. Strong oxidants
39. Inert atmosphere
40. Composite materials

7. APPLICATION EXAMPLE OF TRIZ

As the global temperature goes on increasing day by day it is important to keep ourselves cool. So air coolers are becoming an important aspect of our daily routine. In this work a simple model of air cooler is developed. The 39 engineering parameters mentioned in the triz methodology along with the 40 basic principles is taken into consideration for the work. Using this methodology simple and energy efficient air cooler was developed. In the working, the electrical energy is used upon by the fan motor and water pump motor. Fan motor provides high sped air and the water pump motor circulates the water stored in the tank through the porous material. When the speedily moving air collides with the cold porous material, the humidity of the air increases and there by we will get cold air as output.

Table.1. TRIZ Principles Applied in Problem Solving

Principle Number	Description	Implementation
1	Segmentation	Divided as defend parts and circuits
6	Universality	Motor used have multi purposes
8	Antiweight	Weight reducing materials is used
31	Porous material	Porous clothe is used for absorbing the water
36	Phase transition	Water changer to water vapor
25	Self service	Waste resources is used
27	Cheap and short living material	Cheap material used for construction
29	Pneumatics and hydraulics	Hydraulic motion is used

Advantages

The product developed using the triz methodology is cheap and simple to manufacture. It only need less energy for complete working.

8. CONCLUSION

From this work a brief understanding about TRIZ can be known. TRIZ is a knowledge-based organized methodology for inventive problem solving which uses 40 principles to develop inventive products. In this paper we discussed about the creation of an air cooler using triz methodology. The developed product can be made at low cost and it is energy efficient. Triz methodology is an important tool for designing new products. It increases the creativity of the students in developing new innovative products.

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