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USING TRIZ METHOD FOR SUPPORT INNOVATION IN DEVELOPING PLASTIC PARTS

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Abstract: *This paper presents a working methodology based on TRIZ method that can be used in the design of plastic products in an innovative way. The paper presents a type of paper trays that were designed using the presented algorithm. The concept was validated by 3D printing and testing at a 1:3 scale.*
Key words: *TRIZ, innovation support, plastic part design.*

1. INTRODUCTION

TRIZ is a method of problem solving in an innovative and inventive way. The term comes from Russian and stands for Teoriya Resheniya Izobreatatelskikh Zadatch, the English translation being Theory of Inventive Problem Solving. It is a logical method based on data and fundamental research of several authors, beginning with its inventor Genrich Altshuller [1].

Currently TRIZ method is in its third stage of development [2] and even benefits from a series of software solutions that make it easier to use.

In general solving a problem using the TRIZ method is performed following the steps below:

- Identifying and defining the particular problem
- Reformulating the problem using TRIZ philosophy
- Identification of generic solutions based on previously known solutions
- Interpretation of generic solutions and establishing specific solutions

2. WORK METHODOLOGY

For the innovative design of a plastic component/assembly the authors propose a developing algorithm (figure 2) centered on the TRIZ method.

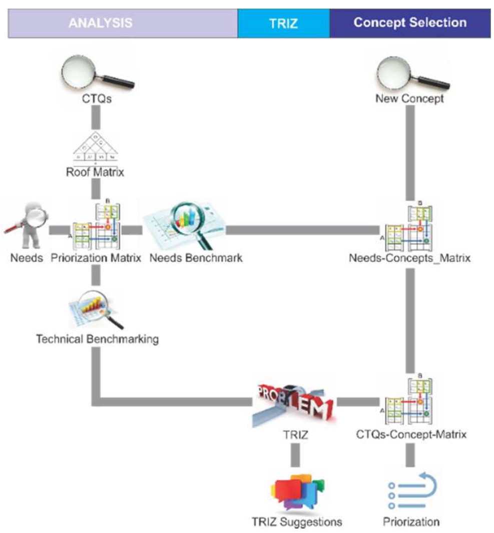

Fig. 1 Development algorithm of plastic paper trays

For the first stage of the TRIZ method (particular problem identification and definition) the authors propose the use of tools to enable identifying requirements of the interested parties and elements of the CTQ (Critical To Quality). To achieve this, the following instruments are used:

- identifying requirements of the interested parties
    - Brainstorming Needs
    - Needs Affinity and Tree Diagram
    - Benchmark Competitors
    - Prioritize Needs (AHP)
    - Technical Benchmarking
- establishing CTQ
    - Brainstorming CTQ

- CTQ Affinity and Tree Diagram
- Quality Function Deployment (QFD)

Based on the developed product's requirements that have been identified and also the CTQ, the specific problem is determined as a set of specifications for the new product.

In the second stage of the TRIZ methodology (redrafting the problem using TRIZ philosophy) the specific problem is transformed into an abstract problem [6] – figure 2, by assigning each element identified in the first phase (requirement and CTQ) a TRIZ parameter.

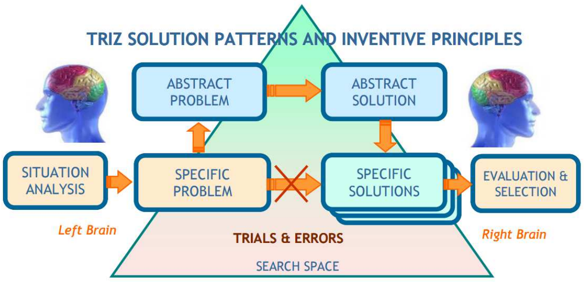

Fig. 2 Problem solving with TRIZ [6]

According to TRIZ methodology three types of conflicts can arise between the parameters describing the problem to solve:

- Administrative – it refers to items that are found in the general description of a system, product;
- Technical – it refers to situations in which an improvement of a feature of the system/product leads to worsening (low performance) other characteristics /properties;
- Physical – refers to situations where two conflicting requirements are set upon the same component of a system/product.

Once the three types of conflicts are identified (using the matrix of contradictions) we can move into the third stage of TRIZ – identifying generic solutions based on previously known solutions.

In this stage for the abstracted shape of the problem to be solved, one or more existing known analogue solutions are being identified.

In the final stage, based on the identified generic solutions specific solutions that are applicable on the problem to be solved are sought out.

3. RESULTS

The problem to be solved is a competitive design of support tray for paper.

In the brainstorming stage were collected 42 ideas that were later refined using the affinity diagram, some of which are listed below:

- to be storable
- to have a modern design
- to be light
- to be used in combination with existing models
- to be easy to clean
- can be quickly removed from the stack
- different color palette
- to have elements that will provide marketing advantages
- can be protected with a cover

The identified CTQs are:

- to be made of plastic
- to incorporate innovative elements
- to be compatible with existing models
- to have a short manufacturing time
- can be made from recycled materials
- cost-efficient

In Needs benchmarking requirements identified are analyzed in relation with the market competitors. The two most important elements are: to have elements to give it marketing advantages and to be easily arranged in a stack.

With help from the priority matrix (fig. 4) a correlation is established between the identified needs and CTQs. Then each CTQ is assigned a TRIZ parameter (fig 4) which allows the abstraction of the problem and searching for generic solutions.

The main innovation incorporated into the paper tray design is the result of solving the conflict between the parameters Shape and Waste of energy. The conflict was solved using the generic solution Spheroidality. This solution states the following: „*Replace linear parts or flat surfaces with curved ones; replace cubical shapes with spherical shapes. Use rollers, balls, spirals. Replace a linear motion with rotating movement; utilize a centrifugal force*” [7]

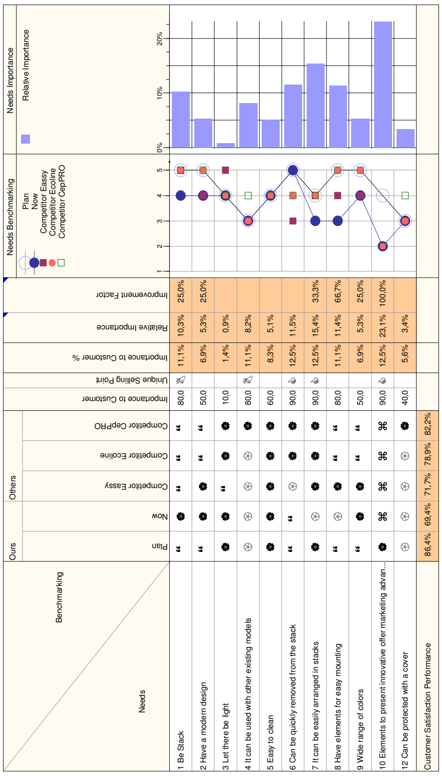

Fig. 3 Prioritization Matrix

TRIZ CTQs / TRIZ Classification	TRIZ Parameter	Conflicts	Optimization
1 Made of plastic	Amount of substance		
2 It can be produced in a single mould	Shape	1	
3 It can incorporate innovative elements	Waste of energy	1	
4 It can be compatible with existing models	Convenience of use	2	
5 It can be manufactured from recycled materials	Reliability	2	
6 It can have a short production cycle	Manufacturability		
7 Cost-efficient	Productivity		

Fig. 4 TRIZ Classification

In order to translate this general solution into one applicable to the paper tray two swivel systems were taken into account, which are presented in figures 5 and 6.

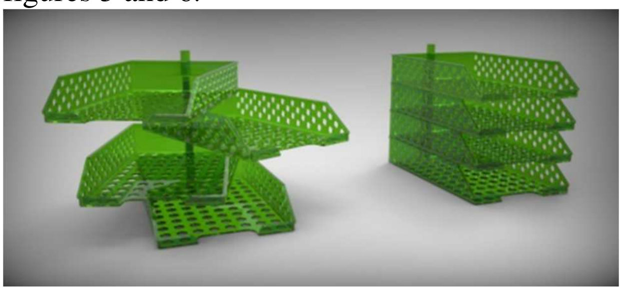

Fig. 5 First version

For the first tray version a swivel system was designed that allows rotating the trays around a centered shaft. After a careful analysis of the system it was concluded that this system is not in line with one of the needs identified at the beginning of the method, namely to be used with existing models.

Fig. 6 Second version

A second swivel system has been designed (Figure 7) that will allow the trays to pivot around an axis and also to be used with existing models.

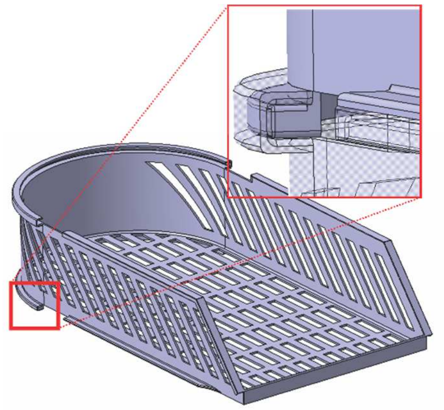

Fig. 7 The second swivel system

In order to validate the methodology two tray models were printed. In order to validate the functionality of the models a 3D printer was used in order to manufacture and then test the two tray models (Fig.8).

Fig. 8 Printed Models

4. CONCLUSION

Using the development model based on the TRIZ method proposed in the paper, the authors have managed to develop a new concept paper tray. It has a swivel system that enables the removal of trays from the stack without the need for disassembling them. The methodology can be used to develop other products, the result obtained when redesigning a simple component is eloquent.

5. ACKNOWLEDGEMENT AND DISCLAIMER

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UTILIZAREA METODEI TRIZ PENTRU A STIMULA INOVATIA IN DEZVOLTAREA PRODUSELOR DIN PLASTIC

Rezumat: Lucrarea prezinta o metodologie de lucru bazata pe metoda TRIZ care poate fi utilizata in proiectarea produselor din plastic in mod inovativ. In lucrare este prezentat un model de tăvițe pentru hârtie a cărui design a fost obținut utilizând algoritmul prezentat. Conceptul a fost validat prin printare 3D si testarea lui la scara 1:3.

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