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Improving the TRIZ Creative Engineering Methodology to Take into Account the Notion of the Value of the Idea

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Abstract. Most of the time, the notion of the value of an idea, if not ignored by the company, seems to be established toward the end of the technical development of the idea during the resolution of a problem or in the final stages of the innovation management process for the development of products or services. Generally speaking, the birth of ideas with or without the use of creativity methods consists in the resolution of a technical problem, i.e., the technical aspect of the idea. This paper proposes an experiment using a creative process integrating a TRIZ approach and seeking to demonstrate that taking into account the notion of value, expressed by value proposition statements, in the evaluation of ideas for selection purposes influences the selection of the best idea that satisfies the client's needs, i.e., the value aspect, but neglects the technical aspect that the client expects. Currently, the TRIZ creative engineering methodology is used to solve mainly the technical aspect of a problem, among others the technical and physical contradictions of technological processes and technical systems. When using a TRIZ approach to find and discover solutions to a problem, it is proposed to associate the value aspect with the technical aspect of the ideas or solutions generated. Thus, in parallel to the search for solutions, be able to associate a set of value proposition statements also generated during the process.

Keywords: TRIZ, Problem solving, Notion of the value, Idea selection, Decision-making.

1 Introduction

1.1 Formulating the Problem

Context. The concept of value appears in many fields, such as the arts, philosophy, and linguistics. It can also be found in various scientific fields, such as engineering science. In this last field, the focus is placed on the technical systems and technological processes for things like artificial or natural objects and activities required or desired by individuals [1].

Most often, if a company does not entirely overlook an idea, its value is perceived toward the end of the technical development phase. Accordingly, to develop the best idea, the notion of value should be determined prior to the development stages, i.e., in the area of the idea (idea generation, idea development, idea selection process [2]).

Gap Statement. When developing new products (or services), a company is faced with solving technical problems regarding the product's design. Currently, the TRIZ creative engineering methodology is mostly used to resolve the technical aspects [1]. The method does not address the notion of value which could determine the choice of the best idea from among a number of generated ideas. The technical aspects of a problem are expressed, in part, by the technical and physical contradictions of technological processes and technical systems [1].

The following observation is essential: the difficulty with this research stems from the value or value aspect of the idea, the definition of which is non-existent or inadequate.

Objectives. The primary purpose of this article is to illustrate the possibility of influencing the decision support process when selecting an idea by considering the notion of value, i.e., by associating the value aspect with the technical aspect of an idea or solution. When an adapted TRIZ method is used to search for and identify solutions to a problem, it is then that a set of value proposition statements [3, 4] are linked to the technical aspect. These proposition statements are identified in conjunction with the problem-solving process.

1.2 Creating Value in Innovation

Creating Value and the Concept of Innovation

Authors Carlson, Polizzotto, and Gaudette [5] contend that the survival and growth of a company tend to be influenced by its ability to create value. They point out that a company that fails to create value is experiencing difficulties. For authors, value creation is described as a process enabling a company to meet its customers' needs and thereby encourage innovation.

They complete by describing two critical elements of the value creation process: "Important customer and market opportunities, to create a significant market impact"; and "Value propositions, as the starting point for all value creation activities." [5]

The second key element seems to be the means of expressing value creation.

Lindic and da Silva [4] define the value proposition as follows: "A value proposition describes how a company's offer differs from its competitors and explains why customers buy from the company." [4]

In this way, value creation is shown to be closely linked to the concept of innovation. The Oslo Manual version 2018 [6] defines two critical components in the concept of

innovation, namely "the role of knowledge as a basis for innovation, novelty, and utility, and value creation or preservation as the presumed goal of innovation." [6]

The Customer's Needs

To successfully meet the customer's needs, it appears necessary to gain an understanding of how they perceive value.

The overall value is an aggregate approach that combines the perceived benefits and sacrifices to obtain the client's perceived value. In other words, it represents the contrast between various elements used to evaluate the benefits and those used to evaluate the sacrifices. Together, these evaluations assess the overall value of a product when it is purchased. [7-13].

Rivière and Mencarelli [16] point out that most authors recognize the existence of a number of different characteristics of value. They suggest the following criteria :

- Value stems from making a comparative judgment: it is the result of a relative judgment made by a consumer about an object [14, 16, 17];
- Value is personal: it is commonly recognized in literature on the topic that value is subjective and personal as opposed to being objectively determined by vendors [11, 16-20];
- Value is both contextual and dynamic: many authors share the opinion that perceived value would vary based on the type of product being purchased and the type of usage the individual has in mind for the product [11, 14-16, 21, 22].

Therefore, to meet the customer's needs and address these criteria, it is essential to focus on the value aspect when developing a product or service, i.e., the customer's perception of value. These criteria also reveal the extent of the options available when developing attractive offers.

Problem and Problem Solving

Now, it is worth defining the notion of a problem allowing to meet the customer's needs.

A problem is a gap between existing and desired situations [1]. This gap provides many opportunities to solve the customer's problem. Of course, the gap can also be filled by adding, changing, or removing certain functions carried out by technological processes and technical systems [1], and by adding, changing, or removing "potential applications" that make up the value proposition [23]. In terms of value and from a technical point of view, the customer's problem is solved as the actions have turned the initial situation into a desired situation or closer to the one desired through desired potential applications. As a result, the customer perceives the offering's value and learns of the solutions provided by the functions [1, 23].

Problem-solving by identifying both the desired functions and the desired potential applications [1, 23] is closely tied to a company's ability to understand the customer's point of view [4].

The Notion of the Idea

The notion of the idea embodies more than its definition. It involves both the creativity behind the idea and how it is expressed.

There are two definitions of the word idea. The first is from the dictionary: “Someone’s opinion or belief about something.” [24] and the second by authors Koen, Bertels, and Kleinschmidt [25]: “An idea is the most embryonic form of the new product or service.” [25]

As such, the expression of an idea will be regulated by the area of the idea. The latter then organizes the exitance of the idea, from its birth to when it is selected [2]. If selected as the most promising solution, the idea will be developed into a concept and eventually materialize and lead to a unique result.

Accurately determining the value of an idea without further study of its potential and impact remains highly challenging. The perceived value of an idea can only be perfected during the development of the concept, thereby eliminating or reducing uncertainties, ambiguities, and risks.

As mentioned, ideas tend to be fragile. Besides this, another feature of a new idea is amazement. This suggests a certain strength and boldness to an idea capable of driving change. The opposing notions of fragility and amazement suggest a connection between ideas and change. Without the notion of amazement, the relationship between these two things is not functional. [26]

Decision Support and Selection of the Idea

Ultimately, there remains only to select a single idea from among the set that best solves the problem. The best idea is selected based on the technical aspect of the problem (product or service). However, if the value aspect of the selected idea is overlooked the client may be dissatisfied. The customer expects a solution to the technical problem and, more importantly, expects the idea to add value.

The selection process occurs toward the end of the creative process, where there is not enough time between the conception and selection of the idea [27]. The idea selection process aims to identify one or more ideas that have the most potential according to a set of specifications (identification, description, business values, features, feasibility, etc.) and eventually be developed to perform specific tasks [2].

Developing the Technique

Savransky [1] states that “Any application of TRIZ starts with understanding of the technical system or technological process and the situation in which the problem appears.” [1]

In order to accomplish the project and its primary function, both the process of developing the technique and the description of the parts of the technique involve identifying and describing the technological process(es), technical systems, functions, subsystems and super-systems, attributes, etc. [1]

The application of the TRIZ method makes it possible to find solutions to problems involving technological processes and technical systems, i.e., the technical aspect of the problem. Therefore, each part of the technique constitutes the technical aspect.

The Notion of Value

Next, let us examine another component supporting the goals of the research problem, i.e., the notion of value. To begin, we must first define the meaning of “value”: “The regard that something is held to deserve; the importance, worth, or usefulness of something.” [30]

This definition introduces an important point supporting the notion of value: “The regard that something is held to deserve” [30] establishes a connection between someone and something. While the “something” may appear relatively straightforward and unchanging, the complex nature of this relationship becomes apparent when we examine the “someone,” namely due to the breadth of their perception of value and their judgement of its significance.

Having defined the word value in itself, we recall the value proposition definition. Lindic and da Silva [4] define the value proposition as follows: “A value proposition describes how a company's offer differs from its competitors and explains why customers buy from the company.” [4]

It is important to remember that the value proposition is an expression of value creation. For Osterwalder and Pigneur [3], “The value proposition is the reason why customers turn to one company over another. It solves a customer problem or satisfies a customer need.” [3] The authors add: “In this sense, the value proposition is an aggregation, or bundle, of benefits that a company offers customers.” [3]

The customer purchases a product or service from a company because it meets their needs. They recognize that the company has provided them with value to influence their purchasing decisions. As such, value creation is expressed by developing text-based statements that form the value proposition. Together, these statements constitute the value aspect.

1.3 Considering the Notion of Value

The Adapted TRIZ Method

Here, Cavallucci's [28] TRIZ method, is adapted to include the notion of value. There are only two possible spheres in the initial problem-solving approach [1, 29], namely that of initial or specific realities and abstraction or generic realities. The author's approach includes a middle sphere, that of technological realities [28]. Figure 1 illustrates a flow

beginning at the “Initial situation” box and then flowing to the following boxes: “Well-defined problem,” “Problem model,” “Solution model,” “Solution concept” and “Detailed solution.” For the flow to move vertically upwards and downwards, certain steps such as formulation, modeling, interpretation, and construction are necessary to process the information from the previous box and enable the flow from one sphere to the next. The creative space is the mind’s ability to generate ideas or solutions with the help of creative tools.

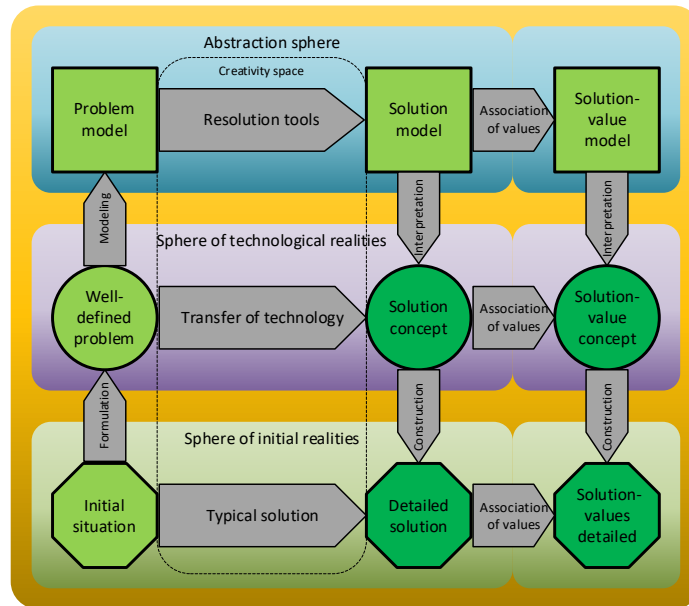


Fig 1. TRIZ creative problem-solving adapted method

In order to demonstrate how the notion of value is considered, the vertical downward boxes are duplicated to form a new section of downward vertical boxes parallel to the original boxes respecting the three spheres. Each box is renamed to reflect a solution-value pairing, i.e., “Solution-value model,” "Solution-value concept," and "Solution-values detailed.”

Progression of the method by the participants in the creative process

The participants in the group will follow the method to solve a problem. The left side of the method (Fig. 1), the upward vertical boxes, is used to identify and state the problem, while the right side is used to capture and process ideas or solutions, as well as value proposition statements.

The process begins at the "Initial Solution" box. Participants take note of the problem and its scope, developing an initial understanding. They can generate ideas using trial-and-error methods [1] from the creative space of the initial realities sphere.

Continuing the process, a problem formulation identifies the problem by describing the initial situation, the main useful function, the work of the system, the parts of the technique, the levels of the systems and the ideality. In addition, they can identify known solutions and other relevant information. Being in the sphere of technological realities, they can generate ideas with the help of TRIZ tools such as the 9 boxes, the Size-Time-Cost operators, the operative Zone and Period, the resources, etc. [1, 29]

Continuing the process towards the sphere of abstraction, a model of the defined problem is created. By developing a problems graph and partial solutions, participants construct technical and physical contradictions and substance-field analysis. From these constructs, TRIZ tools such as the 9 boxes, the Contradiction Matrix, the 11 Separation Principles, the 76 Standard Solutions of Invention Problems, the 9 Evolution Laws, etc. [1, 29], are used to generate ideas.

In this process, the creativity space is about generating ideas, but also value proposition statements. Figure 1 has two parallel descending verticals. This depiction involves associating the value aspect identified by value proposition statements with the technical aspect identified by the parts of the technique of the ideas or solutions. These associative processes are depicted by the arrows "Association of values."

Table 1 depicts an example of solutions identified and which value proposition statements are suggested by association.

Table 1. Creative Results Table

No	Solution record	Value proposition
1	Solution 1	Value proposition 3 Value proposition 4
2	Solution 2	Value proposition 1 Value proposition 2 Value proposition 5
3	Solution 3	Value proposition 6
n	Solution n	Value proposition 3 Value proposition 4 Value proposition 6 Value proposition n

This table captures all the ideas and solutions, as well as the value propositions generated in the creativity space and in the three spheres. It remains for the participants to process and select the best idea. Thus, the solution models or solution-value models need to be interpreted by giving them a description and meaning and, if necessary, assigning them viable technologies. Thus, these solution models or solution-value models become solution

concepts or solution-value concepts in the sphere of technological realities. A construction of these concepts allows to complete the association of the value aspect with the technical aspect and to select the best concept (idea, solution). Then, to develop, demonstrate, verify and validate that the solution solves the problem. Thus, a detailed solution or detailed value-solution is available in the sphere of initial realities. All that remains is to implement it. [1, 29]

Influencing the Selection of the Best Idea

As a general rule, selecting the best solution (Table 1, column “Solution record”) to solve the problem is done by evaluating the technique of each solution. The technical resources mostly carry out this assessment during the problem-solving process. This raises the question of whether the technique-based selection of the best solution truly addresses the customer's needs or those of the end-user.

The assessment of the proposed solutions must be based as much on the value aspect as on the technical aspect in order to demonstrate the importance of considering the notion of value. In other words, during the assessment, the value propositions associated with the solutions (Table 1, column “Solution record” and “Value proposition”) ought to influence the assessment with a view to selection.

2 Experimental Methods

2.1 Defining the Problem and the Objective

The experiment's goal is to determine whether the inclusion of value (value proposition statements) impacts the selection of the best idea or solution from among those generated using a creative process that includes an adapted TRIZ method (Fig. 1). The primary focus of the TRIZ method was originally to produce ideas that would solve the technical aspect of the problem since the value aspect of the problem did not exist. Value is not (or rarely) considered in problem-solving. Given that experimentation falls within the area of the idea, the term idea will be used to define the methodology.

2.2 Methodology Design

Applying a creative process integrating an adapted TRIZ method (Fig. 1) involves using a research methodology to explore and confirm its applicability in real-life situations. The selected research class is qualitative descriptive research combined with the qualitative descriptive study [31].

The case study was conducted for a manufacturer of commercial equipment in the food industry. The company wanted to remain ahead of the competition by improving its innovative processes. The company is interested in applying a creative process integrating an

adapted TRIZ method (Fig. 1) to solve problems. They are also looking to create value for their customers.

The company is considered a small business and has an organizational structure consistent with that of a small business.

The study population is composed of at least one manager and employees involved in product and service innovation, development, and design. The company nominated a group of participants to be assigned to the study and considers that they will be able to follow up after the experimental period.

Three operational concepts were selected to measure and collect data [31]. The first concept to measure is the creative process. Participant observation was deemed the most suitable way to measure certain characteristics of the creative process. The second concept to measure is the participants in the group. Participant observation was deemed the most suitable way to measure the participants' interest and involvement. The third concept to measure involves generating ideas and value proposition statements [31]. The ideas generated by the participants are recorded in a Creative Results Table. Non-participant type observations seem to be the correct technique to measure certain aspects of the generated ideas and value proposition statements [31].

The suggested measurement techniques provide a more general and chronological account of the researcher's observations. Field Notes and logbooks are selected as the data collection method [31].

A set of data collection instruments were developed for recording observations.

Observations are listed in a Qualitative Data Collection Table and include boxes for noting observations (observations, impressions, conversations, experiences [31]) and boxes for adding observation points. This table has three groups of observation points concerning the three measurement concepts.

Two interconnected tables were developed to collect data on ideas and value proposition statements: the Creative Results Table and the Results Prioritization Table. The first table is used to collect data during the creative process, and the second is to prioritize the data from the first table after the fact.

During the creative process, the participants generate ideas and value proposition statements. These are listed in the Creative Results Table provided for this purpose. Following this, an assessment of relevance is carried out in the Results Prioritization Table. This enables each idea to be evaluated according to a predefined set of criteria (selected strategically to align with the company's strategy). In order to test whether or not the inclusion of value can truly influence participants' evaluation of ideas, this experiment features a two-phase assessment process: the first phase does not consider the notion of value, and the second phase does.

Based on the set of observations recorded during the creative process, those concerning the participants affect the validity of the creative process and the data collected about the ideas and value proposition statements. The participants' interest and time involvement are taken into account to determine the level of value of the experiment [31].

As stated, the experiment offers a two-part process for evaluating the ideas. A comparative analysis ensures the thoroughness of the two assessment processes. Comparing the evaluation results and prioritization between the two assessment processes completes the analysis.

The interpretation of the results helps to uncover the meanings of the data analysis. As such, the results must present a rationale, a direction, a value, while also providing an explanation [31]. From these interpretations, a conclusion is developed.

2.3 Expected Results

The data collected through observation is used to discuss, confirm and support the analysis results on the impact of the notion of value on the final selection of an idea.

The type of results expected should support the goal of the experiment. The results of the two-part process of evaluating ideas, i.e., the first phase that does not consider the notion of value, and the second phase that does, clearly defines the process of selection. In other words, out of a set number of exercises in the creative problem-solving process, a number of solutions resulted in different choices between the two assessment phases. Using the value proposition to deliver value to the customer may be more interesting when suggesting a less attractive technical solution to the problem.

2.4 Limits of the Methodology

There are limitations to the experiment that can influence its credibility [31]. For example, the company's area of activity may lead to different results for different areas and therefore affect the ability to replicate the experiment [31]. As a result, selecting a field that requires a certain level of technology for product or service development and that requires advanced creative problem-solving methods seems essential.

The second limitation is the completion of a small number of creative processes. The creative process should ideally be carried out several times to solve different problems and ensure that a large amount of data is collected. Collecting a tiny amount of data could create doubt on the influence of the value aspect in selecting the best solution.

Another limitation is the participants' limited or non-existent ability and experience in using a creative process that integrates an adapted TRIZ Method (Fig. 1). The underlying premise for this experiment was that participants had no experience in using the TRIZ method.

Lastly, the creative chaos involved in carrying out a creative process constitutes an important managerial limitation. An overly rigid structure will constrain creativity by confining the participants to the problem space and hampering the discovery of an ideal solution. Creativity requires freedom of action to break through psychological inertia [1].

3 Discussion and Conclusion

By associating the value proposition statements with the ideas, the influence of the former guides the participants involved in the creative process to select the best idea. The significance of the results will reassure the participants that the customer is receiving the best service from the solution that most benefits them. Results should reflect that the customer's point of view and needs occupied a prominent place in the participants' minds during the creative process.

Ultimately, this type of experiment calls for a situation where a creative problem warranting the use of a creative process is solved. In other words, the problem must present the possibility of identifying technical or physical contradictions and have a high difficulty ratio [1]. As a result, considering the notion of value in certain problem-solving situations with lower difficulty ratios appears to be more difficult to apply, even unnecessary. Following this experiment, several possible areas for further research can be explored. A study of the relationship between the combined value aspect and the technical aspect, and the problem's difficulty ratio in order to discover if there is a limit to the application of the notion of value. Lastly, applying the notion of value to other area of activity and to different creative processes to assess the notion of value in the decision support process.

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