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IMPLEMENTATION OF THE TRIZ INNOVATION METHODOLOGY: EXPERIENCE FROM A MECHANICAL ENGINEERING COMPANY

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INTRODUCTION

The importance of innovation for an organisation' sustainable development is acknowledged both in academic (e.g., Tidd and Bessant, 2009) and business worlds (e.g., Koetzier and Alon, 2010; Von Stamm and Trifilova, 2009). In the modern business environment shaped by increasing global competition and shortening product life cycles, innovation is becoming more than just a driver of competitive advantage. It instead ensures an organisations' long-term survival.

Pressing against the need for ever faster and more complex innovations (necessary to keep up with the innovation pace of competitors), growing costs and demands for the development of new solutions pose a very difficult situation for organisations. There is no longer time, finances and human resources for unconstrained research and development. Therefore, it is not sufficient just to come up with a certain quantity and quality for innovations, it is necessary to deliver them in an efficient innovation process.

A basic innovation process could be described as the linear funnel-shaped move of innovations in an organisation. Importantly, these innovations go through several stages with distinctive characteristics. Davila, Epstein and Shelton (2006) identify four of them:

1. the generation of innovative ideas,
2. the selection of the most promising ideas,
3. the implementation of selected ideas,
4. and value creation from these innovations.

In order to deliver innovation with the required effectiveness, the stages of an innovation process have to be both efficient in themselves and well aligned with each other. For this purpose, countless innovation (and other) methodologies have been developed, including TRIZ.

TRIZ (as customarily abbreviated from its original name Teoriya Resheniya Izobretatelskikh Zadatch – the Theory of Inventive Problem Solving) is a collection of related methods used mostly for the generation and selection of innovative ideas.

A case study presented in this article aims to address the question of the usability of TRIZ in a chosen company, and follows the methodology's initial implementation process in the company that took place at the beginning of 2015.

The company researched, in this case, is a Czech subsidiary of a global electro technical concern that operates in the mechanical engineering industry. As a reaction to competitive pressure and complex and highly advanced production, the company is searching for efficient methods to deliver further innovations of its sophisticated product.

1 THE TRIZ INNOVATION METHODOLOGY

The TRIZ innovation methodology was identified as one of the possible solutions for addressing this problem due to its structured approach to delivering innovations. Gadd (2011, p. xvi) defines TRIZ as "…an engineering problem solving toolkit which successfully summarizes past solutions and successes to show us how to systematically solve future problems".

What is particularly relevant for using TRIZ in technological industries is that the methodology is based on the extensive research of patent databases made by its author, Genrich Altshuller, and his successors. Studying thousands of patents, Altshuller identified 40

underlying principles that could explain almost any of these patented innovations. These principles now form the core of the methodology and, although they are abstract, they are linked to real life solutions though the inductive process of their creation.

Gadd (2011) states that TRIZ is particularly useful in situations in which brainstorming, as the most common method for problem solving, does not work. Altshuller himself (Altshuller and Shulyak, 2002) describe his methodology as the opposite to a trial-and-error procedure. Although creative methods are still important for generating innovative ideas, the sequence of steps for problem solving used by TRIZ could be highly algorithmised.

The main theme of TRIZ is the solving of contradictions, i.e. demands on a subject (or situation) that seemingly cannot be satisfied because they counter each other. One of the most common examples of contradiction uses bus design – a bus needs to be big enough to carry a large amount of passengers comfortably and, at the same time, small enough to be driven safely through a city. Usually, such situations are solved by using a trade-off between the demands, which results in designing a medium sized bus. Contrary to this approach, TRIZ proposes (and leads to) solutions that can satisfy both demands, e.g., making an articulated bus comprising two rigid sections (small enough) connected by a pivoting joint (big enough).

For its structured innovation approach, TRIZ uses a number of related methods. Even though the methods could be deployed in an algorithmised and defined sequence, it is possible to use them separately as well; it depends on the innovator from which the extensive collection will be used.

The high number of distinctive methods and their complex system of interaction is one of the most notable weaknesses of the methodology, which is very difficult to handle by an inexperienced user. Yet, although not widespread, TRIZ is used by numerous innovative organisations, such as NASA, Boeing, Procter & Gamble, BMW, Motorola, etc. (TRIZ Canada Team, 2014). However, as was pointed out by Moehrle (2005) in his meta-analysis of 43 case studies dealing with the use of TRIZ, none of the studied companies uses all of the basic methods of TRIZ, which points to probable opportunistic approach in using TRIZ.

2 METHODOLOGY

The aim of the case study is to provide an assessment of the suitability of the TRIZ innovation methodology for the company and an assessment of the initial implementation process.

Three research questions were formulated:

Research question 1: Is the TRIZ innovation methodology suitable for the assessed company?

Research question 2: How do the employees perceive the suitability of the TRIZ innovation methodology for their work?

Research question 3: How do the employees perceive the suitability of the form of the training used for the initial implementation of the TRIZ innovation methodology?

To answer these questions, methods of semi structured interviews (Pawson and Tilley, 1997; Hendl, 2012), participant observation (Spradley, 1980; Švaříček and Šedová, 2007; Hendl, 2012) and secondary data analysis were used. There were three stages of data collection: (i) before the training, (ii) during the training and (iii) after the training.

Initial data were collected during long-term participant observation and non-formal interviews in order to get to know closely the work tasks typically assigned to employees, their attitude towards innovation and the company's organisational culture.

For the period of the implementation, participant observation and semi-structured interviews were selected as the most suitable methods due to the number of employees involved (an expectation of about 15 participants) and their time schedules, which prevented using focus groups. Interviews were conducted one week ahead of the training. As secondary data, a

basic analysis of training evaluation questionnaires, independently created and distributed by a lecturer after the training, was used. These questionnaires contained questions about the quality and the content of the training and the overall usability of the knowledge gained for the participants' work.

A post-implementation assessment was conducted using semi-structured interviews with participants of the training and non-structured interviews with two members of the management of the company one week after the training. The interviews with participants of the training included a verbal assessment of the training's effectiveness using the Kirkpatrick model (Kirkpatrick and Kirkpatrick, 2006).

The interviews were based on realistic evaluation methodology (Pawson and Tilley, 1997). This methodology suggests splitting interviews into two stages – the former serves for the harmonizing of the expectations and terminology between the interviewer and interviewee, the latter for refining concepts developed by the researcher. Data collected from interviews were transcribed and both thematically and analytically coded (Richards, 2009), and then were, together with notes from participant observation and a basic statistic evaluation of the secondary data (questionnaires), used to answer the research questions.

2.1 IMPLEMENTATION PROCESS

For the initial implementation of the methodology, a two-day training format was chosen jointly by the company and the lecturer (who, based on his expertise, initially proposed instead a three-day format). The first day of the training focused on the introduction of the methodology and its basic methods. The second day of the training consisted of a workshop during which participants applied methods learned on a real-life problem area of their work.

The final number of participants was 14 (out of which 12 were interviewed before and after training). The participants were chosen from all over the company (mainly the Engineering department, but from other departments as well) in order to bring in a diversified working group able to assess innovative ideas created during the workshop using their various expertise. The lecturer was an experienced TRIZ user with a strong academic background and long history of TRIZ training given.

3 FINDINGS

Pre-implementation findings based on the interviews and observation pointed out some important facts:

- There was a minimal knowledge of TRIZ among the participants.
- Innovations were seen as being important and needed, however, not always as a part of the work of a given training participant.
- Generally, the participants perceived that they had enough time in their work to innovate.
- As the main constraints for innovation, bureaucratic processes and rigid organisational structure were mentioned.
- A structured, but not rigid, approach to generating innovative ideas was perceived as potentially worthy.

At this point, no evidence was found to counter the possible usability of TRIZ in the company.

The format of the training remained unchanged. The first day was divided into two parts – the former was dedicated to analytical methods useful for preparing an assignment for a TRIZ-based solution (i.e. innovative idea generation and selection), the latter to the solution methods of TRIZ itself. A theoretical lecture was accompanied by a number of simple examples. The second day was designated to the workshop. Initially, the whole group was split into two, which were parallelly trying to analyse a problem area, then the group was reunited and together came up with innovative ideas – out of which 18 were assessed as being potentially feasible, mostly with minor impact on the product (which could, nevertheless, be seen as successful, with regard to the level of advancement of the product).

Despite the quantity and the quality of innovative ideas created, participants were,

based on the interviews and partially participant observation, mostly dissatisfied with both the learning outcome and the process of the workshop. From their reactions, emerged the difference in expectations of the whole training. The majority of the participants expected the training to be very practically oriented towards creating real life innovations, while the lecturer delivered mostly theoretical content and did not focus much on the outcomes of the workshop. Moreover, the outcome oriented participants criticized the lecturer for the workshop facilitation process. However, the dedication of the second day to the workshop was generally appreciated as it allowed trying TRIZ on a real life problem that was necessary to be solved.

In the post-implementation interviews, participants generally agreed that TRIZ could be useful and suitable for their work and company as such. However, as was evident from the interviews, the level of their knowledge of the methodology was very low and virtually prevented them from using TRIZ independently without the guidance of a more experienced user. According to the Kirkpatrick model, the effectiveness of the training was very low as the participants were generally dissatisfied and even the short-time learning outcomes were considerably low. The causes of this situation lay in the exaggerated number of methods taught during the first day and the low level of the practical utilisation of these methods during the workshop, which, in some parts, utilised instead methods methodically opposite to TRIZ, as training lost its focus during the second day.

As the strengths of TRIZ, its structured approach for generating new ideas and its ability to lead users to think out of the box were appreciated by most of the participants. As a weakness, time requirements were mentioned. Contrary to some pre-implementation expectations, the complexity of TRIZ was not perceived as a disadvantage and the methodology was rather described as using "common sense".

Members of the management were, in the interviews conducted after the training, critical of the process, the content and especially of the lecturer, who, in their opinion, did not deliver the outcome they agreed upon. Due to this fact and the poor learning outcomes, despite the innovative ideas generated during the workshop, they questioned the further use of the methodology in the company.

CONCLUSION

In this case study, the possible suitability of the TRIZ innovation methodology for the assessed company operating in the electro-technical industry was recognized. While innovating an already advanced mechanical engineering product, the methodology can assist innovators in finding new innovative ideas using its structured approach based on the general principles found in patent databases.

However, in order to assess the universal usability of TRIZ in this type of company, more research is needed, utilizing a higher number of assessed companies and their long-term observation. Such research would answer other questions associated with the use of TRIZ in practice – e.g., quantification of the benefits connected with its deployment during an innovation process, the practical usability of particular methods or understanding how users are working with the methodology.

Participants perceived TRIZ as potentially useful for their work and, during the workshop, they generated some new ideas that, although having only a minor impact on the product, were described as being out of the box and innovative. Nevertheless, as is encountered in this case study (and which corresponds with, e.g., Gadd, 2011), TRIZ is not an easy subject to master and requires a lot of time to learn and practise. The case study highlights that short training is not sufficient to train participants to use the methodology independently (even limited to the basic knowledge of its methods). In these situations, the selection of only a handful of key methods could lead to better results than trying to teach the whole basic TRIZ utilization process. That is, after all, a situation in which probably most TRIZ using companies operate (Moehrle, 2005). Selecting only a handful of methods enables the hands-on practical utilization of them during training,

which is necessary for their future use by the participants.

Also, the careful selection of the lecturer and an alignment in the outcomes of the training have proven to be extremely important for the overall success of the implementation. In the case study, problems in this area affected the further use of TRIZ in the company despite clear evidence of its utility as a solution for the difficult innovative situation in which the company is. It is noteworthy to point out once more the overall need for training content tailoring by a lecturer according to companies' preferences, and not the opposite. In the observed training, the problems arose from insufficient communication (from both sides) between the lecturer and the company in terms of the training outcomes. Moreover, the lecturer was unable to handle the training in a shortened time frame and to customize its content to participants' needs. Therefore, many crucial aspects recommended for conducting a training (e.g., Salas, Tannenbaum, Kraiger and Smith-Jentsch, 2012) were missing.

For the assessed company, using TRIZ mainly during official innovative workshops is probably the best solution. Due to the inability of the participants to use the methodology independently, it was advised to use an external facilitator (or possibly a company's own trained employee) with knowledge and experience with TRIZ, who can facilitate the idea generation process and lead participants in using the methodology. Due to its methodological and time demands, it was recommended to use TRIZ for the in-depth research of parts of the product or for finding solutions for long-term problems unsolvable by more common methods.

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Abstract:

In the rapidly changing world, an innovation process needs to become an efficient and consistent supply of innovative ideas – functioning despite growing the complexity of the products companies make and the shortening time frame between innovation and its deployment. Creativity and engineering solely are no longer able to handle the just-in-time stream of innovations required to keep the competitive advantage of a particular company, and for this reason, innovative methods structuring the process and bringing new ideas are needed. The TRIZ (the Theory of Inventive Problem Solving) innovation methodology is proposed as a possible solution for the mechanical engineering company researched in this case study. The company manufactures products that have already been developed for decades and, therefore, struggle to bring a sufficient amount of innovations to keep up with the pace of its competitors. TRIZ provides engineers a structured approach to innovations and shows them possible principles used in the past to solve similar innovative problems. The case study follows the initial implementation of the methodology in the company and points out the difficulties faced during a two-day training of employees in using TRIZ. The selection of only some of the basic methods of TRIZ and an emphasis on their practical handling are proposed as a better way to begin the training of the methodology, rather than trying to give a participant a broad view of all the possibilities TRIZ offers.

Keywords: TRIZ; innovation methodology; implementation; case study; training

JEL Classification: M12, M53, O31