TOOL TO SUPPORT THE DESIGN AND IMPLEMENTATION OF INNOVATIVE SOLUTIONS

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Abstract: This article indicates the need to create innovation in the economy. The innovative process is closely related to creative management, including methods of creative problem solving. The presented tool to support the use of creative problem-solving methods (in particular inventive creation methods) is aimed to design and implement innovative solutions. The described tool supports the selection process of methods and enables fast application of the method. The tool was designed based on literature research and a repeated case study. A case study consisted of 3 stages: creativity research, creative sessions using the inventive methods, and development of guidelines for the construction of the tool to support the design and implementation of innovative solutions. The study included manufacturing and service companies in southern Poland. The tool (in the form of a database of inventive methods) has been positively verified. The conducted verification was held according to the adopted scheme in the repeated case study. However, the methods used to generate innovation have been selected by using the application process of the tool supporting selection of inventive methods.

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Introduction

Reality is a world of turbulent changes. These changes continuously bring chances and threats to enterprises. The industry intensively evolves, and incessantly develops innovative technologies, and hence in consequence management and supervision methods. Yet, the routine analytical approach used to solve newly appearing problems does not show the expected results.

The result of the traditional approach to management is a low degree of innovation in Polish enterprises (Kowalski and Nasierowski, 2007; Franken, 2010; Patalas-Maliszewska 2012; Baruk, 2002). This fact is confirmed by numerous reports including the Innovation Union Scoreboard, among others. Poland is characterized by a lower level of the Summary Innovation Index – SII than the average for all other countries of the European Union (Polish Agency for Enterprise Development report, 2015). At the same time, Poland is in one of the last places in the ranking of EU countries with regard to participation of enterprises conducting innovation activities, 25th place out of 27 (report of the Ministry of Economy, 2015).

The methods and techniques for the creative solving of problems may turn out to be the support that is needed. It is used to solve problems in a creative way, to create innovation or to support creativity in the organization while at the same time positively affecting the widely comprehended sphere of economics of work, and supporting efficiency, performance, and functionality in achieving results. The results of their application are visible not only for the person who uses them, but for the entire organization; they affect management, philosophy of thinking, and social relations in the company.

The systematic development of the creativity of employees in enterprises, by applying methods of creative problem solving, will positively affect innovative potential. New solutions – innovations can contribute to the increase of competitiveness of the enterprise.

However, there is difficulty in applying creative methods. Their limited description in the literature, small number of experts, or their focus on only the psychological aspect of discussed methods (rather than also on results), hinders their use in enterprises. Therefore, a simple tool for the selection of methods of creative problem solving was proposed (in particular inventive creation methods), with regard to problems of the enterprise. The tool (in the form of a database of inventive methods) is supposed to provide information, which method should be applied in the given conditions (situation), and provide a comprehensible, synthetic description that enables its immediate application.

Research methodology

Empirical research were conducted, based on the literature analysis concerning the innovation level of Polish enterprises (in particular from the SMEs sector) and with methods of creative problem solving, in the enterprises of Opole and Silesian Voivodeships in the form of a repeated case study. Procedure

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compliant with an indication o in Yin's textbook (1984), early stage of knowledge development in the given area of research, identification of current phenomenon in real conditions, vague boundaries between phenomenon and circumstances of its occurrence). The procedure of conducting the case study proposed by Czakon (2013) was adopted, the diagram presents Figure 1.

Studies were carried out in the enterprises of Opole and Silesian Voivodeship (Poland) in the years 2013-2016. The scientific basis included:

- quantitative methods (creativity test) – which provide information on the creativity level of employees,
- quality methods (in-depth interview) – used in the study of creativity of the organization
- methods of creative problem solving,
- techniques to support the development of creativity,
- methods of decision making based on many evaluation criteria.

These studies included the following stages (according to Figure 2):

1. Preliminary studies – creativity tests were conducted in enterprises, which enabled us to measure the creativity of employees in the given enterprise. Tests were drawn up based on specialist psychological tests. Tests enabled us to assign employees of the given enterprise to one of three groups: innovators, persons not fully using their creative abilities, and persons whose creativity is “dormant.” Moreover, barriers limiting the individual and collective creativity were identified in surveyed enterprises using an in-depth interview.
2. Basic empirical research – in analyzed enterprises, the employees participated in creative sessions in which inventive creative methods were used in order to design innovative solutions. An expert was responsible for the selection of methods and carrying out the creative session. Innovative organizational, procedural, product solutions were designed. Employees positively used the process of the creative sessions and the application of inventive creation methods to solve problems.
3. Development of a tool supporting the selection of inventive creative methods to the problem. Conclusions from conducted basic empirical research, preliminary studies, and literature analysis were used to build a tool supporting the selection of inventive creative methods to the problem (situation) of enterprises. One by one the base of inventive methods 1 was verified in enterprises. Verification was based on the assumption that in the creative session there would be the use of methods indicated by the selection tool, the expert will only carry out an open observation.

It should be noted that currently there are longitudinal studies being conducted, and tests assessing the creativity level in enterprises after certain time of applying inventive creation methods are repeated in order to study the changes of this level.

Figure 2: Study scheme

Tool to support the design and implementation of innovative solutions

Participation of the expert and, his knowledge and experience is important for proper and effective application of inventive creation methods. The expert's task is to indicate the method which should be used, and to present its scenario. The group of experts is small, which largely impedes the use of inventive creation methods by a larger group of companies. Therefore, it was reasonable to create a tool supporting the selection of inventive creative methods to the problem. This will facilitate the use of creative problem solving methods by the largest group of recipients. The base of the inventive methods, which is extremely simple, was built in Access program, and this is supposed to also contribute to its popularization. The user of such a database, by answering a few questions about the detected problem and specifics of the given organization, will receive advice in the form of: which method to choose and description of the method for its immediate application.

The first design stage of the tool supporting selection of inventive creation methods was to determine the criteria for the selection of inventive creation methods to the problem. Due to the specificity of solved problems and the practical aspect of applied methods, attention was paid to inventive creation methods.

Criteria for selection of methods based on literature studies, preliminary and basic studies include:

- The number of participants in the creative session (individual or team). There are inventive creation methods, which require one to work in the group. There is also a group of methods, which can be applied to both individuals and to a group.
- Method area (comprehensive or fragmentary). This criterion is aimed to indicate, whether the method is supposed to be applied only to search for solutions or is supposed to be helpful in the entire problem-solving process (from defining the problem to seeking solutions).
- Duration (up to 1 h, up to 1 working days, above 1 day). This criterion is very important for entrepreneurs, because it enables to choose the method to time at its disposal.

- Method nature (based on forced or free associations, analytical methods; lists of test questions, not-systematized).
- Creativity and experience, this criterion is necessary to determine whether the organization's appointed team for creative problem solving is creative. The previously carried out test is supposed to be used for this purpose. It is possible also to be based on previous experience associated with application of inventive creation methods.
- Problem type (technical/technological, organization and management).

The design base of inventive methods supporting the selection of inventive creation methods to the problem in a form of a database of the inventive creation methods is unusually easy to use and transparent, which makes it easier to apply. From the main menu, it is possible to carry out one of four orders: browse the database of inventive creation methods, add a new method, select a method to a determined situation, or close the database. The most important element of the main menu and specific objective of the designed tool that supports the selection of inventive creation methods to the problem is to find a method that will be selected to the following factors: solving entity, duration of creative session, method nature, creativity, and experience in applying inventive creation methods to a problem type. While selecting the method we can define all criteria or those selected. The result of the selection will be shown in table. As a result of the defined criteria, the proposed methods will be indicated along with their description (Jagoda-Sobalak, 2016).

Figure 3: Relationships in the base of inventic methods.

Design stages of database included:

1. Creating tables – 6 tables were created for the selected criteria and for the inventive creative methods.
2. Providing clear values in the table fields (keys) – keys were entered in tables: Id_metody, Id_podmiot, Id_obszar, Id_charakter, Id_rodzaj, Id_czas, Id_kret_dosw.
3. Determining the relation between tables –determined the correct connection of related data in a logical whole.
4. Creating the form – 5 associated and 6 supporting forms were created for communication with the user.
5. Creating queries – in order to enable searching (selecting) methods and displaying search results.
6. Creating reports – created reports display inventive creation methods (that meet the criteria) along with their characteristics and description.

Figure 4: The main menu of the base of inventive methods.

Source: Authors

Tool verification

The last research stage was based on inventive methods verification, which was held among others in the enterprise of construction industry (finishing and decorative elements). Conducted verification was held according to the adopted scheme in the repeated case study. However, methods used to generate innovative solutions have been selected by using the application process of the *tool supporting selection of inventive creation methods* to the problem. Before proceeding with the problem solving, the employees of enterprise filled out the questionnaire, determining their creativity level. The questionnaire showed that the surveyed group has a large creative potential, willingly seek unconventional solutions, and they are open and ready for changes and taking risks. The next research stage in the enterprise was to familiarize employees with the idea of creative organization and with inventive creative methods. Interviews have been conducted with employees, which enabled us to get to know the barriers limiting creativity in the organization. Employees pointed at the following barriers: lack of knowledge, lack of possibilities (place, time, way) of reporting new solutions, and lack of faith in their own abilities. In order to develop creative potential, the management board of the enterprise decided: to create a Research and Technology Development Department, the systematic organization of creative sessions, further supporting employees in personal development and knowledge acquisition by participation in programs of the European Union (Human Capital program), funding trainings, courses, and studies.

20 persons, representing all departments, took part in the creative session. Employees of the enterprise already earlier participated in such sessions. They usually used methods of: brainstorming, crumbling, or 5 why. The tool supporting the *selection of inventive creation methods to the problem* was used to select the method of creative problem solving (designing the innovative product). The following selection criteria were adopted:

1. Solving entity – team.
2. Area of action – fragmentary.
3. Duration – up to 1 day.
4. Method nature – not-systematized.
5. Creativity and/or experience – moderate.
6. Problem type – technical and technological.

The defectologist method was indicated to solve the problem, which was applied to generate product innovation. Employees of enterprises had the task to search for as many shortcomings of the products currently offered by the company, as a result the employees on the board one by one wrote out defects in the elevation stage. In the next stage, defects were divided into two groups: defects associated with material, nature, and properties of the product (on which the producer has no impact), and defects possible to remove.

Figure 5: Selection of the inventive method

Dobierz metodę
Metody Inwentyczne

Wybierz kryteria wyszukiwania

Podmiot rozwiązujący: Zespół

Obszar działania: Wycinkowe

Czas trwania: Do 1 godziny

Charakter metody: Nieusystematyzowane

Kreatywność /doświadczenie: Umiarkowana kreatywność i/lub doświadczen

Rodzaj problemu: Problemy techniczne i technologiczne

SZUKAJ (wszystkie kryteria obowiązkowe)

SZUKAJ (dla wybranych kryteriów)

WYCZYŚĆ

Powrót do MENU

Source: Authors

The next step was seeking the solution in order to eliminate defects from the second group. A detailed method was used in order to eliminate defects, which was also indicated by the *tool supporting selection of inventive creation methods to the problem*. Employees using a detailed method pointed to the problem with assembly (necessary good specialists, assembly increases costs, often connections between tiles are visible, assembly requires the time and practice) as the main reason of resignation from the purchase of elevation stone. Therefore, the problem to be solved was defined as follows: “Design tiles of the elevation stone, which will simplify the assembly.” Again, a *tool supporting selection of inventive creation methods to the problem* was applied, changing the nature of the method based on associations in order to stimulate the creativity of employees. Then an analog transmission method was applied to solve the problem. Laying tiles were compared to puzzles, which then indicated the elements which facilitate assembling puzzles. Next an attempt of analogous transferring to the assembly of tiles was made.

The solution generated in the session, and developed in the laboratory of the enterprise is product - brick tile currently available for sale. It is a revolutionary product – tile combined with the groove. Due to the design it is extremely easy to assembly. The tile is in the color white, but it is possible to paint it any color needed. Its texture and special corners cause that the texture of wall does not differ in appearance from real bricks.

The developed *tool supporting selection of inventive creation methods to the problem* has been positively verified. The selected methods enabled the organization to generate the innovative solutions without the participation of the expert. The first indicated method – defectologist, enabled to reveal tiles deficiencies, which affect the customer’s decision, and which are possible to remove. The next method – details, enabled to indicate the major defect from the customer point of view (difficult assembly). The application of the indicated analogy by the database of inventive creation methods contributed to find the solution, which enables simple assembly, hence increasing the attraction of tiles on the market and it became an innovation of the national scale.

Conclusions

Research in a form of a repeated case study indicated that inventive creation methods support the growth of innovation. They enabled to generate innovative solutions: processes, products and organizational innovation. Positive opinions of the employees in relation to creative sessions with inventive creation methods confirmed the benefits from applying inventive creative methods. The conducted studies enabled to build the creative organization, identification, and development of the creativity level of employees, and eliminated barriers limiting their creativity. The applied inventive creation methods extorted on employees a creative way of thinking, and taking brave, unconventional decisions, contributed to integration of employees, created the climate that supports creation of new solutions, which in consequence significantly affected the creativity in individual enterprises.

The designed tool enables to popularize inventive creation methods, and their application without participation of the experts. The process of tool verification has proven the correctness of the criteria selection and assumptions.

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