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The potential of creative methods for IT project management

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Abstract. IT support is now one of the key elements in the competitive advantage of almost every organization. Hence, the IT project management has started to play an increasingly important role. Therefore of concern is the observed low percentage of successful IT projects and use of IT systems functionality in organizations. Business expects more and more flexibility and innovation from the IT sector. Solutions not supported by creative techniques will not be satisfactory for the recipient. Although there is a proven positive correlation of creativity with effective project management, overall organization performance and client satisfaction, there is no detailed research in the literature on the actual use of creative methods by IT teams in project management. The research undertaken combines the area of IT project management with creative methods. The article presents the results of the study of IT teams in the Polish SME sector in the field of their knowledge and experience in the application of creative methods in IT project management. Experimental research allows an assessment of the potential and effectiveness of selected creative methods in the IT project management and an indication of the areas of their application in the project life cycle.

Keyword. IT project management; creativity; TRIZ; problem solving; innovation

1 Introduction

The current twenty-first century has changed the role of creativity to the dominant one, making it sometimes more important than the technical knowledge [1]. Creativity has become an important factor in all team work, including projects. Creativity finds its application more and more often in organizations implementing long-term large-scale projects related to complex products. Multifunctional teams created for such projects often experience a crisis in communication as early as at the stage of designing. At the same time, this crisis is often transformed into a chance to stimulate different creativity techniques and generate new technical knowledge, thus enabling implementation of the main goal of the project [2].

On the other hand, in the IT environment, there is a constant focus on technical aspects and the methodology of project implementation [3]. Project management standards are improved, but they do not relate in any way to creative methods. Meanwhile, there is still a low percentage of IT projects completed successfully with additional problem of alignment IT - business and low percentage of functional IT systems use [4-6].

Although a positive correlation between creativity and effective project management has been proved [7], there is no detailed research in the literature on the actual use of creative methods by IT teams in project management. Therefore, it was considered reasonable to undertake research and determine how various aspects of creativity are perceived by IT teams themselves. The research was supposed to answer the following questions:

1. Do IT teams know and use creative methods in IT project management?
2. Do creative methods have potential for IT project management and, if they have, in what areas?

The structure of the article is as follows. In the next section, the research background is presented. In the third section, there is the subject literature review, which allowed for the identification of research gaps. Next, attention has been focused on creative methods. In the next section, the research purposes are presented. Then, the research method and process are described. As a next step, the basic research results are disclosed and referred to a comparative research with the discussion. The article ends with conclusions and suggestions referring to the role and potential of creative methods in IT projects management.

2 Research Background

Project management in an enterprise using creative methods aimed at improving the competitiveness of enterprises is becoming a fact. This has been confirmed by the results of the research done by Plotnikova and Romanenko [8], based on which the reasons for implementing the innovative enterprise development model, as well as innovative project management and creative technologies to manage projects in modern conditions were identified. The results of research encourage a conscious, systemic and targeted impact on the creative process and activities of creative employees as a basis for project management.

In the era of high competition, companies are still looking for ways to introduce technological innovations. More and more emphasis is placed on the process of IT project management improvement. Often the question arises as to how projects can be implemented better and faster than the projects of the competitors. IT project management requires the use of various skills. These are purely IT skills but also the skills from the area of project activities. Studies conducted among software development specialists by Chan, Jiang and Klein confirm the model, which indicates that basic teamwork skills improve other specialist skills contributing to the achievement of better project results. These software developer skills are the subject of research into software development, but it turns out that in practice inadequate resources of programming staff and narrow specialist skills are one of the main reasons responsible for the failure of software development projects [9].

Studies carried out by Belski and Belski [10], who write about the harmful influence of expertise on creativity, also confirm the above statement. This harmful effect is a natural consequence of extensive professional experience and profound knowledge in a given area. A psychological barrier is formed that blocks flexibility and creative thinking. It is called "psychological inertia" or "vector of psychological inertia" and consists in the fact that previous professional experience is preferred in the process of solving problems. Psychological inertia is such a powerful mechanism that without proper techniques one cannot overcome certain patterns and habits of thought. Experts in projects quickly find solutions to problems without a great cognitive and time-consuming effort. On the one hand, it is beneficial, but on the other hand it has negative consequences. In this way, expert solutions are usually limited to knowledge specific to a given field and with no use of new ideas.

Cheng, studying the cultures and systems of East and West, developed "C theory" [11], where "C" means creativity. In this theory he included all valuable East and West management practices in the form of five mutually supporting elements, which include control, creativity, adaptability, personnel, and decision-making. Then I-Chan investigated the use of "C theory" in project management [7]. Research has shown that the higher is the use of "C theory" in project management, the better is the organizational efficiency. Additionally, among all the factors of "C theory", the creativity factor was characterized by the highest positive correlation in project management with three of the four dimensions of the Balanced Score Card, i.e. internal process, client satisfaction, finance control.

The results of the above studies have demonstrated a significant impact of creativity on project management and organizational efficiency, which can translate into an increased probability of project success. It should also be remembered that client satisfaction is one of the main elements of the modern definition of the success of an IT project. And here creativity has also demonstrated the highest positive correlation and the greatest predictive power (the influence of creativity on client satisfaction is the biggest).

Interestingly, research shows that engaging people with the use of their creativity is motivating. By encouraging people to think creatively, the leader creates at the same time an internal motivation. This also shows the importance of the project team leader, who can either effectively encourage or block the creative activities of his subordinates. This has been confirmed by research involving owners of companies [12]. In the study, three variables were used, i.e. the owner's experience in a given field, the personality of the owner and the style of leadership. From the results of the research it follows that the personality of the owner and his style of leadership have a significant correlation with the degree of creativity in the organization.

The degree to which a company needs creativity and discipline - the main elements of creative tension - depends on the speed with which the industry changes. To a certain extent, freedom of thought and flexibility are essential for productive innovation teams. The management faces the challenge of developing control mechanisms that will guide projects in the right strategic direction and monitor companies progress towards their organizational and project-related goals. Brem in his research work discusses various creativity techniques and proposes a procedure for implementing a creativity workshop and a time plan. He also discusses typical mental barriers for decision-makers to be considered when planning such workshops [13].

It has been observed that creativity workshops are slowly becoming a common way to engage employees in innovative undertakings. Nevertheless, it is difficult to find examples in the literature on the implementation of creative techniques in organizations in the IT industry. Perhaps this is due to the fact that the creative techniques are underappreciated, and if they are used by IT teams, it is only the widely known Brainstorming method [14].

3 Literature review

The third section is the result of an earlier literature analysis, and its aim is to present the current publications on the research on the application and potential of creative methods in the field of IT project management.

The selected set of keywords included three main domains: "Creativity", "IT project" and "Software". Synonyms were identified for the domain "Creativity". The selected keywords have been connected with logical operators and a search query was created as follows: ("IT project" AND (creativity OR creative OR innovative) AND "software"). The Scopus database was chosen for the selection of publications, as the most voluminous database of reviewed scientific literature, including a wide variety of data in each publication, useful for the analysis process. By applying the above-mentioned search query, 59 results were obtained.

After analyzing 59 studies, 15 publications were qualified for detailed analysis. They discussed the importance and use of creative methods in IT projects in the era of innovative technological development and social progress. Most of the other studies concern only the issues of IT projects and software. Despite including the keywords creativity / creative / innovative in the search query, they do not refer to creative techniques and do not raise the issue of creativity. Nevertheless, their analysis allowed to identify the following contexts in which the "Creativity" domain is contained:

- innovative project,
- innovation knowledge,
- creative design task,
- creative processes,
- human creativity and innovation,
- individual creativity in virtual worlds,
- Scrum as an incentive for creativity,
- creative information systems,
- innovative cross border IT platforms.

In IT project management, rigid software development rules and attachment to processes and tools are applied, which according to Borucki "kills" creativity [15]. The current market situation is difficult and uncertain at the same time and therefore stressful. This reduces the efficiency of employees in terms of IT projects that do not fully meet client expectations. An additional aspect that IT specialists must pay attention to is ubiquitous innovation, the basis of which is thorough research and understanding of client needs [16]. Stamelos, Settas and Mallini see the need for effective and innovative education of IT specialists and IT managers in the field of various creative techniques. In their article, they proposed the use of the so-called Management Antipatterns, which consists of rediscovering bad patterns (Smoke and mirrors, Software bloat, Bullshit

Management, etc) [17]. Similar conclusions regarding the need for education in the field of creativity were presented in the study aimed at checking the effects of introducing the creative method Design Thinking and Smart education to the subject of "IT project management" during undergraduate studies. Intelligent education along with the Design Thinking method gave positive results in teaching business students how to manage IT projects successfully [18]. Some studies indicate that some IT companies also see the importance of using creative techniques in IT projects and focus on developing the creative potential of their employees [19].

Often, IT projects are called "black swans" because of the high degree of difficulty and uncertainty, and the highly innovative ones differ so much that standard ways of managing them and developing systems cannot be successful [20]. Research confirming the validity of using creative techniques in managing uncertainty in IT projects was presented by Marinho, Lima, Sampaio and Moura. They developed a project uncertainty management guide in which they proposed the use of brainstorming and teamwork in multidisciplinary teams [21].

Other authors emphasize the understanding of techniques used in IT projects, which should improve the existing project management processes used in most software development works, as well as take into account unusual problems and creative ways of solving them [20].

It turns out that most companies have IT specialists with the much-needed creative potential and knowledge necessary to implement innovative solutions. This is important due to the need to go beyond certain rigid patterns (so-called "out of the box") in IT project management, creating teams with creative IT specialists, in order to collaborate and understand what the users really require. Simonette claims in her article that it is the attitude of the management that creates an atmosphere in the team for the emergence of creative ideas and innovative solutions to current problems. He proved in his research that promoting such an approach will ensure greater efficiency and innovation in IT processes [16].

Very interesting conclusions were presented in the study by Wu, Rose and Lyytinen using the Delphi method. During sessions with panel groups of IT managers, it proved justified to use out-of-the-box thinking due to a large number of technical problems. So-called innovation points have been established as a result of this study, which are key problem areas that required innovative, unconventional solutions. Each point required a different problem solving approach and creative methods for finding a solution. According to the project managers, who are the experts, "the adoption of such practices is novel and adds value to both practice and future research". [20]

In the literature on the subject, there are studies in which the authors analyze SCRUM as a method supporting creativity by dividing a project or large tasks into smaller parts carried out incrementally. This approach stimulates the activity of the "amygdala" in the brain, activating the creative thinking of the project team members. [22]

The above literature review points out research gaps in the following areas:

- the shortage of studies showing the use of creative techniques in IT projects,
- the shortage of studies on the ways and places of applying creative methods in IT projects,
- the best creative techniques recommended at each project stages or in specific problem areas (so-called innovation points) have not been identified.

Moreover, when referring to project management standards promoted by the two most important associations, PMI and IPMA, the practices of using creative methods are not taken into account, although they are important for highly innovative projects, which include IT projects. In these projects, standard project management and systems development pathways are not sufficient for full success. Therefore, it is necessary to develop this research area not only for practice but also for supplementing and developing the theory in the IT project management field.

For this reason, the authors of the article have attempted to fill the above-mentioned gaps in the area of IT project management in the software development category.

4 Inventive methods

The science of inventive creation is a methodology of searching for creative solutions, stimulating creative thinking in various fields. When there is a problem in the organization for which no ready solution is available, and the traditional methods and techniques used so far are not fully operative, then the situation can be solved by using inventive (creative) methods.

In the modern literature on the subject, many different divisions of the inventive methods can be found. One of the divisions proposed by Koch [23] divides the methods of creative problem solving into:

- intuitive and creative methods, involving the generation of new ideas through subconsciousness, logic is not involved in this process but rather intuition, the solution comes by launching the imagination,
- systematic and analytical methods based on logic, accompanied by a conscious process,
- mixed methods - a combination of both categories, aimed at supporting the logical method with intuitive and creative methods.

The most common intuitive and creative method, often used in companies, is Brainstorming. This is a typical quantitative method. It is presented in detail in a monograph written by its creator Alex Osborn [24]. The essence of this technique is searching for problems and solving problems in groups diverse in many respects. The method was developed by the advertising industry in the 1950s and remained popular in this industry. Group Brainstorming can be an effective technique for generating creative ideas. According to many researchers, Brainstorming helps to develop and support creative thinking, which gives grounds for the statement that it is useful as a tool to stimulate the team to think creatively in many areas [25, 26].

The second method included in the same group is Six Thinking Hats de Bono. Established in 1985, it is still being modified and refined. The leading idea in this method is a systematic group search for solutions to a given problem. The method shows 6 different viewpoints - hats marked with six different colours, which define the area of individual thinking with artificially adopted attitudes [27]. The method allows generating a larger number of ideas of better quality for given problems compared to the usual online discussion. Serrat's [28] experience allowed him to formulate the conclusion that "The difference between weak and effective teams lies not so much in their collective potential as in how well they use their ability to think together. The Six Thinking Hats technique helps to raise the team's thinking potential".

Creative methods are constantly evolving as a result of changing external conditions and the need to solve problems on time. Part of this evolution is a more flexible understanding of the process related to creative problem solving. This evolution also includes an emerging understanding of the construction of the problem solving style and the impact that the construct has on creative productivity [29].

The most powerful tool, the evolution of which began in the fifties of the last century, is the Theory of Inventive Problem Solving (abbreviated as TRIZ). It belongs to the group of systematic and analytical methods. TRIZ offers a systematic approach to problem solving, but requires creative ability to translate the recommendations proposed by the inventive principles and standard inventive solutions into a specific area of the problem [30].

The so-called System Operator, often called Nine Screens or System Analysis, was listed as the first tool in the TRIZ methodology. At the same time, it is one of the best tools for systematizing the thinking process in the category of time and space. Effective, strong thinking is primarily systemic, block thinking that allows looking at the problem as a whole. When analysing the problem in a company, it is necessary to look more broadly, not only on the problem (system), but also on its environment (supersystem system) and on the components of the problem (subsystem). Additionally, the whole is analysed in a time perspective, i.e. past, present and future. System Analysis is used in almost every problem area, from the initial definition of the problem to the assessment of the best solutions, and for all types of situations, both technical and non-technical. This method helps managers to identify basic technologies, develop product/service, adopt proper business strategy, make objective decisions, and analyse technical and organizational strategies. Owing to the use of this method, the objective decision-making process can make companies focus on the right technological strategy and take the right innovation strategy [31]. Altshuller [32] - the creator of the method - has claimed that the problem can be more effectively solved by changing the supersystem, i.e. the environment of the problem to which the given system (problem) belongs, or its components, i.e. the elements that make up the system. Thus, the qualitative difference of this method lies in the ability to see not only the system that means problem, but also the supersystem and its components in time perspective (past, present and future).

One of the recently developed TRIZ tools is the method proposed by Altshuller's student - Valerie Souchkov (TRIZ Master) - RCA + (Root Conflict Analysis +). This is a combination of a typical cause-and-effect analysis, otherwise called 5 x Why, with a matrix of contradictions. The chain analysis leads to the main cause of the undesirable effect, while the use of matrix allows finding solutions to the problem. The method allows solving both technical and management problems from identification of the problem and its causes to finding solutions and evaluating them. RCA + allows isolating and mapping contradictions that appear in technical or business systems and their environment, and which are the main cause of problems [33]. It often plays a major role in patent solutions, because the revealed root causes can directly suggest directions for innovative solutions.

5 Research purposes

In the light of the above described issues of IT project management and the potential of creative methods, it has been considered reasonable to conduct research combining both these areas. Therefore the main goal of the present study is to examine if and in what areas creative methods have the potential for IT project management. The implementation of the main objective consists of the following partial objectives:

1. Evaluation of the creativity factor in IT project management in the surveyed IT teams, broken down into:
 - a) knowledge and application of creative methods in IT project management,
 - b) effect of psychological inertia,
 - c) the potential of the proposed creative methods for IT project management.
2. Selection of application areas of the proposed creative methods in the IT project management.
3. Verification of the impact of the order in which creative methods are applied on their assessment.

6 Research method and process

This study is an experimental study conducted in 2018-2021. Basic research was carried out on IT teams from 52 IT organizations from the SME sector within the same category of IT projects - developing dedicated software for organizations. Then a comparative study was conducted involving another 30 IT organizations from the SME sector. Due to voices questioning the validity of the use of student samples in applied research [34], it was decided to experimental research on real IT teams in natural conditions - in their organizations while working on IT projects.

The study assumes the following stages:

- selection of IT teams involved in the comparable IT projects, the subject of which is the development of software dedicated to the organization,
- assessment of psychological inertia during the work of IT teams on problem tasks,
- lecture and workshop training on selected creative methods,
- experimental research using creative methods in natural conditions - in companies on real IT project.

IT teams were selected as a result of announcing the recruitment of IT companies for research. From among the applying organizations, the ones that met all the criteria assumed important for the study were selected:

- implementation of IT projects where the object is to develop dedicated software for organizations,
- stability of the IT team - the team has worked in the same composition at least in one project,
- the team did not specialize in the creative methods proposed in the study.

These criteria were to ensure the homogeneity of the research objects.

Before using creative methods, the effects of psychological inertia during the work of teams in IT projects were assessed. The teams were asked to solve 3 problem tasks related to IT project management in the category of custom software. All teams were given the same tasks. These tasks required, in particular, the design of new solutions and the planning of new activities. During their resolution, the work of the teams was subjected to observation. Researchers assessed in which processes and areas inertia works most strongly when solving problem tasks. The teams were then interviewed and confirmed these assessments. These interviews also made it possible to identify the most common effects of psychological inertia in IT projects.

The next stage of the research project was to introduce IT teams to the subject of inventive creation through a lecture and workshop training on selected methods. Printed methods guidelines were provided to each member of the IT team. Then IT teams went through the process of solving problem cases related to IT project management with the use of the proposed creative methods. Teams used creative methods in a specific order proposed by the researchers, i.e. Brainstorming, Six Thinking Hats, System Analysis (TRIZ), Root Conflict Analysis RCA + (TRIZ).

One of the most important problem areas in the management of IT projects related to custom software is well-defined and organized cooperation with the client for whom the project is implemented. All IT teams have the biggest problems in this area. Therefore, working with creative methods was expected to find improvements in this area. Researchers had access to documentation from each team's previous similar project. It was used to select problem points in the above-selected area and to identify how the team dealt with them.

The problem points were repeated in most projects. Therefore, it is possible to list the problems that the teams dealt with:

- low client awareness of their IT needs,
- unspecified, generally formulated client requirements,
- lack of consistency in business expectations and needs,
- delegating incompetent people to the project by the client,
- the contractor's lack of knowledge of the client's industry specifics,
- lack of client involvement and direct users of solutions and functionalities in design works,
- lack of the project support by the client's senior management,
- lack or inadequate communication with the client,
- extensive decision path at the client,
- underestimating the duration of project tasks.

During the experiment, it was compared what new solutions the team generates for these problem points using the indicated creative methods. Both the problem solving process and the generated solutions were assessed. The method evaluation criteria were as follows: degree of difficulty, number of solutions, time to find a solution, innovation of solutions, quality of solutions. During the experiment, the researchers coded the scores in the established criteria on a 10-point scale (from 1 - lowest to 10 - highest).

In the final stage of the research, IT teams were asked to give an overall assessment of the creative methods used in the experiment in terms of the possibility of producing the best results in IT project management. Additionally, IT teams indicated in which IT project management processes the application of particular methods can be important.

Ultimately, the results of the research described above were grouped into the following areas:

- experience and knowledge of the IT team in the field of creative methods,
- effect of psychological inertia,
- assessment of creative methods,
- application of creative methods in IT project management processes.

The obtained results were subjected to statistical analysis.

In the first half of 2019, a parallel comparative study was undertaken. The aim was to verify the impact of the order in which creative methods are applied on their assessment. The comparative study was conducted on IT teams in 30 organizations from the SME sector. It differed in the order in which creative methods were applied in experimental solving of problem cases related to IT project management. The following sequence of the application of creative methods was adopted: Root Conflict Analysis RCA + (TRIZ), System Analysis (TRIZ), Six Thinking Hats, Brainstorming. The obtained results were subjected to statistical analysis and compared with the results obtained in the basic study.

7 Research results

In this chapter, the results of the basic research carried out on 52 SME organizations (IT teams) are presented. The next step is to compare these results with the results obtained in a comparative study (changing the sequence in which the individual methods are applied).

The aim of the first part of the study was assessment of the knowledge and application of creative methods in IT project management done by IT teams. Of the 52 teams studied, 46 teams were familiar with Brainstorming, only 4 teams were familiar with the Six Thinking Hats method, 3 teams with Design Thinking, and one with Ishikawa Diagram. 6 teams do not know any creative method. However, no team is in the habit of using any creative method in their daily work.

The second stage of the study was an experimental study of psychological inertia. As a result of the experiment, the following processes and areas were identified by observation in which inertia had the strongest effect:

- searching for the causes of problems,
- solving problems,
- designing new solutions,
- planning new activities,
- performing seemingly routine activities,
- human resources management - delegation and verification of performed activities.

Additionally, after explaining the mechanism of psychological inertia, the teams were able to identify the following effects of inertia in their IT projects:

- the habit of carrying out various projects in the same way,
- transfer / copying of solutions,
- duplication of the same schemes.

The next stage of the study was to assess the potential of the proposed creative methods for IT project management. The evaluation was made as a result of experimental studies using the established evaluation criteria. The results are shown in Fig. 1. The following abbreviations were used in the presentation of the results: BS - Brainstorming, 6H - Six Thinking Hats, SA - System Analysis, RCA + - Root Conflict Analysis. The evaluation applied a 10-point scale, where 0 means the lowest, the smallest, the shortest, and 10 - the highest, the largest, the longest.

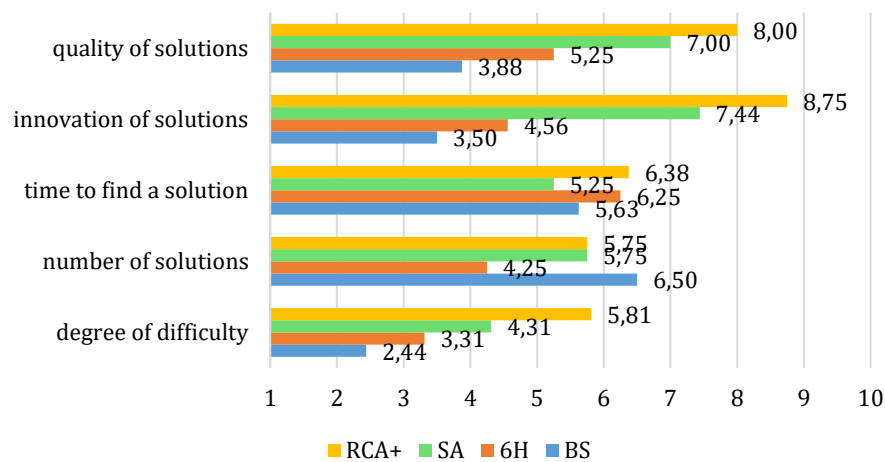


Fig. 1 Ratings of selected creative methods in individual criteria

The most difficult method has turned out to be the RCA + method, and the easiest – the commonly known Brainstorming method. The most numerous solutions are generated by the Brainstorming method, followed by RCA + and System Analysis. The time of finding the solution was the shortest with the use of the System Analysis method, and the longest with the use of RCA +. As for the last two criteria: innovation of solutions and quality of solutions, the highest scores were obtained by the RCA + method, followed by System Analysis – nearly 50% higher compared with the number of scores obtained by Brainstorming. It should be noted that these criteria are the criteria most-valued by IT teams in project management (the highest weights - see Table 1). The Six Thinking Hats method oscillates around the middle of the scale in all criteria.

Teams were asked to assign weights to each of the criteria. Table 1 shows the average results obtained in the study.

Table 1 Average weights assigned to criteria for the evaluation of creative methods.

Criteria	Weights
degree of difficulty	11
number of solutions	11
time to find a solution	14
innovation of solutions	31

quality of solutions	33
Total	100

Then, the assessment of methods in individual criteria could be reduced to a single indicator, allowing for the unambiguous determination of the effectiveness of a given method in IT project management. For this purpose, the grades from individual criteria were recalculated on a 10-point rating scale in terms of 0 - the worst, 10 - the best, and the weights assigned to them were applied. Table 2 presents the effectiveness indicators for individual methods.

Table 2 Weighted effectiveness indicators for individual methods.

Method	Weighted effectiveness indicator
BS	4,57
6H	4,81
AS	6,56
RCA+	6,97

The results presented above clearly indicate that the most effective methods for IT project management from among those used in the study are RCA + and System Analysis.

The final part of the study focused on the evaluation of creative methods by IT teams. Fig. 2 shows an overall evaluation of the methods which concerned the possibility of achieving the best results in the IT project management. The graph presents the percentage of indications to a given method as the most effective in IT project management.

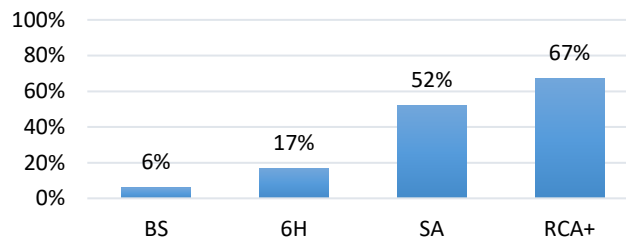


Fig. 2 Evaluation of selected creative methods in terms of the best results in IT project management

Almost half of the IT teams considered the RCA + method as the one that could bring the best results in IT project management. System Analysis was in the second place. Brainstorming, which is the method best-known among IT teams, received the lowest percentage. Twenty two teams indicated more than one method. In most cases it was a combination of the System Analysis and RCA + methods.

In IT project management it is also important when a given method should be used and in which phase of the project life cycle it is useful. To this end, IT teams were asked

to specify in which IT project management processes the use of particular methods may be important. The obtained results are shown in Fig. 3.

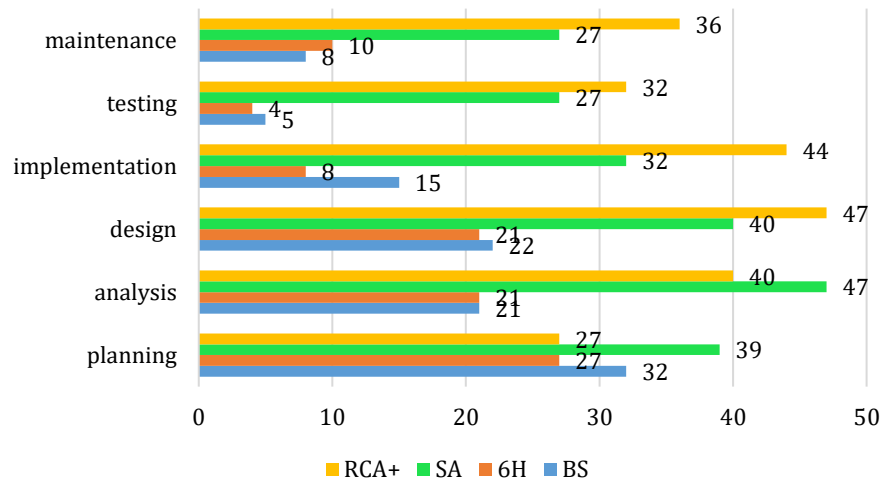


Fig. 3 Application of selected creative methods in IT project management processes.

In the planning and analysis process, System Analysis obtained the highest rating. In other processes, i.e. design, implementation, testing and maintenance, RCA + clearly predominated, and System Analysis was in the second place receiving more than half of the scores. Brainstorming was considered among the top two only in the planning process. In the remaining processes, both Brainstorming and Six Thinking Hats were considered less important compared to the RCA + and System Analysis methods.

An important element of the conducted research is verification of the significance of the sequence in which creative methods are applied on their assessment. For this purpose, the presented results will be compared with the results obtained in a comparative study (with the changed order of the application of individual methods).

The group participating in the comparative study had a similar structure in terms of their knowledge of creative methods, the use of these methods in work related to IT projects and the evaluation of psychological inertia. The comparison of results regarding an overall assessment of the methods in terms of the best results in IT project management did not show any significant differences (see Table 3).

Table 3 Comparison of the best results of selected creative methods in the IT project management.

	BS	6H	SA	RCA+
basic study	6%	17%	52%	67%
comparative study	7%	13%	53%	70%
Difference	-1%	4%	-1%	-3%

Table 4 presents the differences in the results of the evaluation of creative methods in terms of the adopted criteria. In this more detailed assessment, the differences are also insignificant and do not exceed 5%.

Table 4 Comparison of the ratings of selected creative methods in individual criteria

Criteria		BS	6H	SA	RCA+
degree of difficulty	basic study	2,42	4,63	4,69	6,52
	comparative study	2,70	4,33	4,67	6,43
	Difference	-2,77%	3,01%	0,26%	0,86%
number of solutions	basic study	7,10	4,46	5,40	5,92
	comparative study	7,07	4,73	5,87	5,80
	Difference	0,29%	-2,72%	-4,63%	1,23%
time to find a solution	basic study	5,56	5,73	5,27	6,42
	comparative study	5,93	5,97	5,43	6,23
	Difference	-3,76%	-2,36%	-1,64%	1,90%
innovation of solutions	basic study	3,44	4,88	7,44	8,63
	comparative study	3,43	4,53	7,70	8,50
	Difference	0,09%	3,51%	-2,58%	1,35%
quality of solutions	basic study	3,85	4,90	7,31	8,35
	comparative study	3,53	4,83	7,57	8,60
	Difference	3,13%	0,71%	-2,59%	-2,54%

The last part of the research was an assessment of the applicability of individual methods in the IT project management processes. Differences in this area are presented in Table 5.

Table 5 Comparison of indications for the use of selected creative methods in IT project management processes.

Processes	BS	6H	SA	RCA+
Planning	1,79%	4,74%	-1,67%	1,41%
Analysis	2,95%	6,28%	6,28%	9,74%
Design	-5,64%	6,28%	6,41%	-0,38%
Implementation	-5,51%	-2,05%	1,79%	-1,28%
Testing	0,38%	2,31%	-1,92%	5,13%
Maintenance	-2,05%	4,10%	1,41%	-2,56%
Average	-1,35%	3,61%	2,05%	2,01%

According to the data presented above, it should be stated that no significant differences were observed in this area of research.

8 Discussion

The research has shown that the knowledge of both creative methods and their use in project management by IT teams is weak. Asked about the reason for this state, IT teams in most cases answered that they could not see any possibility of applying these methods in IT project management, although their assessment of the potential of the creative methods presented to them gave completely different information. Every team has been fully aware of the fact that creative methods are of some use in the IT project management process. Only 7 teams have thought that Brainstorming is not useful in any IT project management process. The same concerned the method of Six Thinking Hats claimed to be rather useless by the 3 teams. This indicates the lack of knowledge of the creative methods and the lack of awareness of their potential among IT teams rather than the impossibility of applying these methods in IT project management. A premise for this supposition is the double number of indications regarding the use of creative methods in IT project management processes given to System Analysis and RCA+ in comparison with Brainstorming and Six Thinking Hats, remembering that, unlike the other two methods, the methods of System Analysis and RCA + were not known to any of the IT teams.

A positive result is the IT teams' awareness of the impact of psychological inertia in their work. The most serious problem, however, is the habit of implementing various projects in the same way, while every project is, by definition, something unique. This also refers to copying ready-made solutions and applying them to situations requiring an individual approach. Creative methods have a potential here, offering the possibility of making project performer free from the psychological inertia in areas in which it interferes.

Considering the sums of applications of particular methods throughout the entire IT project management cycle, the most applications were indicated for RCA + and System Analysis methods, more than 50% more than as for the Brainstorming or Six Thinking Hats methods.

An important element of the study was verification of the impact of the order in which creative methods were applied on their assessment. As shown by the results of the basic research and the results of a comparative study, the differences in all areas of the research were insignificant. This proves that the order in which the creative methods are applied by IT teams does not affect their assessment. This information is very important as in this way it is possible to avoid burdening the results with an error caused by the impact of the sequence in which the methods are recognized and applied on the assessment of their effectiveness and usefulness in a specific areas of IT project management.

9 Conclusions and suggestions

The results of the conducted research suggest that in the IT environment there is a lack of sufficient knowledge about creative methods and their applicability in IT project management. This is in line with the research reports from recent years, in which doubting the potential of creative IT sector becomes more and more apparent (Gartner, 2018, The Standish Group, 2018). Bearing in mind the positive correlation of creativity with

project management and overall organization performance, it should be considered important to undertake and deepen research in this area of the IT environment. Especially as regards the IT project management, very important is the occurrence of a high positive correlation of creativity with client satisfaction - crucial in any assessment of the IT project success [7].

The main potential of creative methods consists in the possibility to overcome psychological inertia, which causes many mistakes in IT project management and misunderstandings in relations with the clients (recipients of the project products). Nevertheless, it should be borne in mind that using creative methods does not generate random solutions but rather the most ideal solutions. This approach may prove to be crucial in the elimination of common weaknesses in IT project management, such as identification of real user needs, creeping scope, unused system functions, technological debt. Here the methods from the TRIZ group can play a special role, because TRIZ and IT projects, the aim of which is to create IT systems dedicated to a given organization, have in their assumptions the same main goal, i.e. to provide a methodology that will allow the creation of technical systems offering the best possible implementation of the functions with the least possible expenditure.

The results of the research indicate the need to build in the IT environment awareness of the role and potential of creative methods in IT project management. It would be a good practice to include workshops on creative methods into the education of IT project management. Further research should aim at locating creative methods in project management standards. This could significantly increase the success rate of IT projects.

References

1. Belski, I., Adunka, R., Mayer, O.: Educating a Creative Engineer: Learning from Engineering Professionals. *Procedia CIRP*, Vol. 39, 79–84 (2016). doi:10.1016/j.procir.2016.01.169.
2. Kazanjian, R. K., Drazin, R., Glynn, M. A.: Creativity and technological learning: the roles of organization architecture and crisis in large-scale projects, *Journal of Engineering and Technology Management*, Vol. 17, No. 3–4, 273–298 (2000). doi: 10.1016/S0923-4748(00)00026-6.
3. Woźniak, M.: Sustainable Approach in IT Project Management—Methodology Choice vs. Client Satisfaction, *Sustainability*, Vol. 13, No. 3, 1466, (2021). doi: 10.3390/su13031466.
4. Gartner Raport. (2018). Gartner, <https://www.gartner.com/jp/products/japan-core-research-advanced/reports-list/2018-reports>.
5. CHAOS Report: Decision Latency Theory, Package - The Standish Group. (2018). <https://www.standishgroup.com/store/services/10-chaos-report-decision-latency-theory-2018-package.html>.
6. PMR, Market analysis and development forecasts for 2018-2023. (2018).
7. I-Chan, K.: The application and practical benefits of “C theory” in project management, In: *MATEC Web of Conferences*, Vol. 1027, No. 119, 1–23, (2017). doi: 10.1051/matec-conf/201711901027.
8. Plotnikova, L. I., Romanenko, M. V.: Creative methods of innovation process management as the law of competitiveness, *Management Science Letters*, Vol. 9, 737–748, (2019). doi: 10.5267/j.msl.2019.1.015.

9. Chan, C. L., Jiang, J. J., Klein, G.: Team Task Skills as a Facilitator for Application and Development Skills, *IEEE Transactions on Engineering Management*, Vol. 55, No. 3, 434–441, (2008). doi: [10.1109/TEM.2008.922633](https://doi.org/10.1109/TEM.2008.922633).
10. Belski, I., Belski, I.: Application of TRIZ in improving the creativity of engineering experts, *Procedia Engineering*, Vol. 131, 792–797, (2015). doi: [10.1016/j.proeng.2015.12.379](https://doi.org/10.1016/j.proeng.2015.12.379).
11. Cheng, C. Y.: C Theory - management philosophy of the book of changes, *Journal of Chinese Philosophy*, Vol. 19, No. 2, 125–153, (1992). doi: [10.1111/j.1540-6253.1992.tb00115.x](https://doi.org/10.1111/j.1540-6253.1992.tb00115.x).
12. Indriartiningtias, R., Hartono, B. : The Effect of Owner Creativity on Organizational Creativity: Empirical Evidence from Surakarta Indonesia, In: 2018 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 473–476, (2018). doi: [10.1109/IEEM.2018.8607703](https://doi.org/10.1109/IEEM.2018.8607703).
13. Brem, A.: Creativity on Demand: How to Plan and Execute Successful Innovation Workshops, *IEEE Engineering Management Review*, Vol. 47, No. 1, 94–98, (2019). doi: [10.1109/EMR.2019.2896557](https://doi.org/10.1109/EMR.2019.2896557).
14. Boratyńska-Sala, A., Woźniak, M.: The state of knowledge and the use of creative methods in IT Project Management, In: Kowal, J., Keplinger, A., Klebaniuk, J., Mäkiö, J., Soja, P., Sonntag, R. (eds.), *Proceedings of International Conference on ICT Management for Global Competitiveness and Economic Growth in Emerging Economies*, pp. 40-52. University of Wrocław, Wrocław, Poland (2019).
15. Borucki, A.: Ergonomic Aspects of Software Engineering, In: Stephanidis, C., Antona, M. (eds), *Universal Access in Human-Computer Interaction. Design and Development Methods for Universal Access. UAHCI 2014. Lecture Notes in Computer Science*, Vol. 8513, pp. 95-103. Springer, Cham (2014). doi: [10.1007/978-3-319-07437-5_10](https://doi.org/10.1007/978-3-319-07437-5_10).
16. Simonette, M.J., Spina E.: Enabling IT Innovation through Soft Systems Engineering, In: IGI Global (2014). doi: [10.4018/978-1-4666-4313-0.ch005](https://doi.org/10.4018/978-1-4666-4313-0.ch005).
17. Stamelos, I., Settas, D., Mallini D.: Teaching Software Project Management through Management Antipatterns, In: 2012 16th Panhellenic Conference on Informatics, pp. 8-12. Kastoria, Greece (2011). doi: [10.1109/PCI.2011.21](https://doi.org/10.1109/PCI.2011.21).
18. Strakhovich, E.: Using Smart Education Together with Design Thinking: A Case of IT Product Prototyping by Students Studying Management, In: Uskov, V., Howlett, R., Jain, L. (eds.), *Smart Education and e-Learning. Smart Innovation, Systems and Technologies*, Vol. 188, pp. 245-253. Springer, Singapore (2020). doi: [10.1007/978-981-15-5584-8_21](https://doi.org/10.1007/978-981-15-5584-8_21).
19. Karczmarek, P., Pedrycz, W., Czerwiński, D. Kiersztyn A.: The Assessment of Importance of Selected Issues of Software Engineering, IT Project Management, and Programming Paradigms Based on Graphical AHP and Fuzzy C-Means, In: 2020 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE), pp. 1-7. Glasgow, UK (2020). doi: [10.1109/FUZZ48607.2020.9177591](https://doi.org/10.1109/FUZZ48607.2020.9177591).
20. Wu, W., Rose, G.M., Lyytinen K.: Managing Black Swan Information Technology Projects, *Hawaii International Conference on System Sciences*, Vol. 44, pp. 1-10. Kauai, HI, USA (2011). doi: [10.1109/HICSS.2011.294](https://doi.org/10.1109/HICSS.2011.294).
21. Marinho, M. L., Lima, T., Sampaio, S., Moura, H.: Uncertainty Management in Software Projects - An Action Research, In: *Proceedings of CIBSE 2015 – In XVIII Ibero-American Conference on Software Engineering*, pp. 323–336, (2015).
22. AlMarar, M. S.: EPC Strategies for a Successful Project Execution, In: *SPE Gas & Oil Technology Showcase and Conference*. Dubai, UAE (2019). doi: [10.2118/19878-MS](https://doi.org/10.2118/19878-MS).
23. Koch, J.: O kreatywności [About creativity], *Information Bulletin High-Tech*, Vol. 32, No. 1, pp. 1–2, (2008).
24. Osborn, A. F.: *Applied Imagination*, Oxford, UK (1953).

25. Schawel, C., Billing, F.: Brainstorming, In: Top 100 Management Tools, Wiesbaden: Gabler Verlag, pp. 44–46, (2012). [doi: 10.1007/978-3-8349-4105-3_14](https://doi.org/10.1007/978-3-8349-4105-3_14).
26. Dalton, J.: Brainstorming. In: Great Big Agile, Apress, Berkeley, CA, pp. 139–141. (2019). [doi: 10.1007/978-1-4842-4206-3_18](https://doi.org/10.1007/978-1-4842-4206-3_18).
27. Göçmen, Ö., Coşkun, H.: The effects of the six thinking hats and speed on creativity in brainstorming, *Thinking Skills and Creativity*, Vol. 31, pp. 284–295, (2019). [doi: 10.1016/j.tsc.2019.02.006](https://doi.org/10.1016/j.tsc.2019.02.006).
28. Serrat, O.: Wearing Six Thinking Hats, In: *Knowledge Solutions*, pp. 615–618. Springer, Singapore (2017). [doi: 10.1007/978-981-10-0983-9_67](https://doi.org/10.1007/978-981-10-0983-9_67).
29. Treffinger, D. J., Selby, E. C., Isaksen, S. G.: Understanding individual problem-solving style: A key to learning and applying creative problem solving, *Learning and Individual Differences*, Vol. 18, No. 4, pp. 390–401, (2008). [doi: 10.1016/J.LINDIF.2007.11.007](https://doi.org/10.1016/J.LINDIF.2007.11.007).
30. Bertonecelli, T., Mayer, O., Lynass, M.: Creativity, Learning Techniques and TRIZ, *Procedia CIRP*, Vol. 39, pp. 191–196, (2016). [doi: 10.1016/j.procir.2016.01.187](https://doi.org/10.1016/j.procir.2016.01.187).
31. Zhang, F., Shen, X., He, Q.: Research on New Product Development Planning and Strategy Based on TRIZ Evolution Theory, In: *Global Design to Gain a Competitive Edge*, pp. 825–834. Springer London (2008). doi.org/10.1007/978-1-84800-239-5_81.
32. Altshuller, H. Развитие системного мышления – конечная цель обучения АРИЗу, (1975). from <https://www.altshuller.ru/triz/triz70.asp>, last accessed 2022/03/30.
33. Souchkov, V., Hoeboer, R., Zutphen, M.: TRIZ for Business: Application of RCA+ to Analyze and Solve Business and Management Problems, *The TRIZ Journal*, (2007). January issue, <https://triz-journal.com/application-of-rca-to-solve-business-problems/>.
34. Highhouse, S., Gillespie, J. Z.: Do Samples Really Matter That Much?, In: Lance, C. E., Vandenberg, R. J. (eds.), *Statistical and Methodological Myths and Urban Legends: Doctrine, Verity and Fable in the Organizational and Social Sciences*, pp. 247–265. Routledge, New York, USA (2009).