

Cognitive approach to IT project management: The impact of cognitive biases on decision-making

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Abstract

In recent years, decision making in projects, including digital product creation projects, has increasingly become a subject of study in the research and scientific community. Despite the improving project management frameworks, the success of projects and the quality of decisions made in them are far from ideal. In the article, the authors highlight IT-project stages, to which it is proposed to apply a cognitive approach. Implementation tasks that might be solved by the method of cognitive analysis are specified. The article examines the impact of cognitive biases on decision making in digital projects compared to “classical” project success factors. In our work, we used sequential testing methods: regression analysis, vignette experiment, and field experiment. The results demonstrate that cognitive biases have a significant impact on decisions made and, as a result, on the success of projects. They also emphasize the importance of further studying cognitive biases and their impact on decisions made, including in digital projects.

Keywords

cognitive approach, project management, cognitive biases, group cognitive biases, individual cognitive biases, the impact of cognitive biases to decision-making

1. Introduction

In the 21st century, the development of information technologies introduced the IT industry as one of the fast-changing areas of human activities. The initial period of implementing corporate information systems at various enterprises can be characterized as trials to automate the chaos. Regardless the availability of standards, projects encountered the production not being ready for IT implementation, as well as the gaps between the existing possibilities of information systems. This stage of IT projects implementation theoretically allowed for business processes optimization and detecting the points of growth. However, it was frequently concluded just with simple and formal description of certain operations or of its groups [1]. It was ascertained that poorly formalized problems could not be solved with standard project methods, especially in the situation of opposition or inactivity of project groups inside the customer company. Therefore, IT projects received the place and the reason for using a subjective and empiric approach referring to refined knowledge of an expert and avoiding labor-intensive methods. It is worth mentioning that the cognitive approach, which saves your time and respectively your budget, may increase the project risks in general. Thus, its application is to be extremely reasonable and moderate. This paper emphasizes those stages to which it makes sense to apply the cognitive approach. The common feature of these stages consists in the need to analyze the poorly structured data, interaction of experts or expert groups, working in a quickly changing environment [2].

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Talking about the economic efficiency of activities, we can say that the companies face a big challenge of a prompt response to the changes taking place in the today's world and in the market, and, as a consequence, the issue of proposing the best solution of current requests and problems existing for consumers and clients.

The activities undertaken at a company can be divided into two categories: project activity (a project) and operation activity (a process). The project creates a unique product, service or result and is deemed fulfilled when the set objectives and tasks have been achieved and executed, and approved by the project stakeholders engaged [4]. The operation activity is continuous and recurrent. It consists of works without a certain completion date, and you often repeat the same processes and receive the same results. Based on the above definitions of the project and operation activities, projects are the very tool utilized by companies for achieving the objectives mentioned above. The project implementation process provides for solving every time unique tasks corresponding to a certain set of environmental factors throughout the project existence. The objective of this paper consists in determining the effect of cognitive biases upon decision making in the IT project management.

2. Cognitive approach to IT projects and features of successful projects

Under conditions of a high level of uncertainty inevitably appearing with the existing living tempo and social development, increasing the degree of success for the projects implemented and, as a consequence, increasing the economic efficiency of a company activities becomes vitally important.

Among the project stages for which, in our opinion, it makes sense to apply the cognitive analysis tools, the first one to be mentioned is the direct decision making on launching an informatization project. The idea as to the potential possibility of an IT project appears based on requirements of the business and supervising authorities.

The task of management consists in approving a decision on the need to launch, as well as on what efforts to be put in development. If the efforts are to be put outside, it is reasonable to find a contractor and an information system. As a rule, the situation is least formalized at the project beginning decision making stage, which is directly indicative for applying the cognitive analysis tools. The expert team is to include the company top management, as well as the IT department and the automated division heads.

Let us select the requirements gathering as the next stage analyzed. The real life shows that the gathered requirements are most frequently contradictive and incomplete. There are pretty many cases of incorrect evaluation of the significance of a particular wish within the general project structure. As practical examples, it is worth mentioning irreconcilable contradictions often appearing among process holders at sales and production departments, quality vs sales and production, as well as procurement vs production divisions (Table 1).

It is important to understand which departments have the right to raise blocking requirements. There is a common situation when the requirements raised by users to the information system do not correspond to the project objectives set by the management. The stage described defines the whole further progress of works, that is why it is important to select a pool of tasks that would really bring to successful project implementation [5]. It is necessary to evaluate the requirements for compliance with a huge number of criteria, inter alia not being always reasonable, towards defining whether there are any blocking and mutually exclusive ones.

After making the list of project tasks, it makes sense to evaluate the risks. The list of risks can also be reasonably made using the cognitive approach. Most often, the process of such list appearance is a brainstorm during which it makes sense to gather the biggest possible number of expert opinions both from customer and from contractor. After processing the obtained list by cognitive analysis methods, the number of items would drop down to a set of risks to which it is reasonable to apply the known risk analysis and management methods.

Table 1

Cognitive approach to an informatization project

Stage	Tasks	Stakeholders
Taking the project launch decision	Deciding as to: <ul style="list-style-type: none"> the need to launch involvement of third-party experts selecting an information system selecting a contractor 	<ul style="list-style-type: none"> top management IT department heads automated division heads
Gathering the system / change management requirements	<ul style="list-style-type: none"> sorting tasks and requirements detection of blocking factors and mutually exclusive requirements detection of potential stress points 	<ul style="list-style-type: none"> process holders project manager implementation consumers (sales department)
Making a list of project risks	<ul style="list-style-type: none"> detection of risk criteria making a list of risks 	<ul style="list-style-type: none"> top management IT department heads automated division heads process holders project manager implementation contractor's experts customer's experts consumers
Satisfaction assessment	<ul style="list-style-type: none"> detection of satisfaction criteria assessments gathering and analysis 	<ul style="list-style-type: none"> top management IT department heads automated division heads process holders project manager implementation/expert consumers

It makes sense to develop the project parts related to formation of budget, network diagrams, time schedules, resources and direct works management by methods of the classic project management. The only exception, in our opinion, consists in the change management. This case creates a situation similar to the initial requirements gathering needing an analysis of the reasons to fulfill particular tasks. In any analysis, it is sound to follow the principle of reasonable insufficiency without trying to consider any and all user requirements to the functions from the cognitive analysis point of view. The tasks that are definitely worth paying attention to consist in the following: matching the work of several departments or several contractors, data sharing, especially between heteronomous systems.

It also makes sense to analyze the changes for which it is ascertained that they substantially modify the initial system logic or may potentially breach the key business processes with a risk of their dead stop.

It is generally reasonable to apply the cognitive analysis after finishing a project and for analyzing its success and results. As it is entirely possible that the quality satisfaction turns to be different for the project stakeholders on different levels of responsibility and for different departments or branches.

The application of cognitive approach in informatization projects enables:

- substantiating the decision on the need to initiate the project with account taken of informal factors;
- deciding on involvement of third-party experts and selection of an information system;
- reducing the certain tasks evaluation time;
- detecting potential stress points of the project;
- determining blocking factors and mutually excluding requirements;
- analyzing the list of project risks with account taken of informal factors;
- obtaining a substantiated evaluation of the customer satisfaction with the project results.

In the scientific literature, researchers have different opinions to the matter of determining the basic factors having impact on success of projects in the area of information technologies (digital projects), in view of which we can distinguish two principal groups for such projects success factors. For consideration of the first principal group of factors, we refer to the papers [8, 9], where around 250 big IT projects are analyzed to distinguish such six main factors affecting the project success:

- efficient project planning;
- evaluation of expenditures;
- determining the metrics for measurement of intermediate results;
- tracing the intermediate results achievement;
- change management in the project;
- quality control.

For distinguishing the second principal group of factors, we refer to the paper of Nasir M.H.N., Sahibuddin S. [9] presenting a more contemporary view of the project management and distinguishing the following five basic project success factors:

- clear requirements and specifications;
- clear tasks and objectives;
- justified duration;
- efficient approaches/procedures in project management;
- management support.

In our paper, we classify them under group B factors. It is worth mentioning that there is an alternate group of factors as well (we designate it in our paper as group C factors – microenvironment factors). Thus, the factors having impact on the project success are represented by certain cognitive biases attributable to DP (DP – deciding persons). We adhere to the following definition of cognitive biases: “Gaps (appearing as a result of using heuristics) between the normative, reasonable and heuristically determined behavior”. Various cognitive styles attributable to DP are classified herein under the same group of factors as well.

Let us emphasize the last group of crucial factors distinguished by some scientists (in our paper, we refer these factors to as group D factors – macroenvironment factors). Under these factors, we understand events being external relative to the project and project team, and the level of uncertainty is, in our opinion, the most representative feature of such events. The lower this level, the more initial input information the project team has in the beginning and in the process of project implementation, and vice-versa.

Regardless of the fact that a certain number of cognitive bias researches has been carried out in general, currently we almost have no works on what impact the cognitive biases have upon projects decision making (including digital projects), and, as a consequence, upon the projects implementation success.

3. Research methods and results obtained

This research has been carried out for achieving the following objective: determining the effect of cognitive biases upon decision making in management of projects on creating digital products under conditions of uncertainty and defining the methods of minimizing the effect of cognitive biases for attaining the maximum projects success. For increasing the significance and applied benefit of the research, it was undertaken in direct cooperation with a national IT company specialized in development and implementation of digital omnichannel solutions.

As per the cooperation terms and conditions agreed upon and for the purpose of keeping the confidential and sensitive information in secret, the persons of the experiment participants and the

company data are not disclosed, and all initial data collected and stored within the framework of conducting research experiments is subject to prior depersonalization procedure.

We have used the following sequential methods of checking:

1. Regression analysis – based on a hybrid dataset including the initial data on the projects implemented for two years (A, B and D group factors), as well as the initial data characterizing the DPs (C group factors collected with the help of questionnaire sheets to get to know the level of cognitive equipment and cognitive styles), applied to define the significance of each group of factors.
2. Vignette experiment – each of the persons under test, being DRs, was given six “vignettes” (situations) with different level of uncertainty and different tools for reducing the number of cognitive mistakes by means of deviating initial formulations in each of which a management decision was to be taken. Based on the results obtained, a summary was derived on which of the offered tools for reducing the number of cognitive mistakes were the most efficient within the proposed conceptualization.
3. Field experiment (case-study) – an online workshop was held with DPs in which various cognitive biases, their essence and principle of function were described and then jointly analyzed on an example of a number of situations incurred to a certain extent in project management. Based on this, with account taken of the expert opinion and DPs’ wishes, recommendations were developed that could be considered by a company for further introducing into the procedure of managing projects on creating digital products for improving the efficiency of projects under implementation. Then the DPs were interrogated with the result consisting in confirmation of the fact that the DPs formerly encountered the impact of cognitive biases while making their decisions in their occupational activities, as well as in obtaining their expert evaluation of the effect of potential implementation of the developed recommendations upon the quality of decisions taken and success of the projects being implemented.

The data on the projects success and A, B and D factors in these projects were obtained in the process of regression analysis as the first step aided by head of the division, in which the project teams operate, and based on this head’s expert opinion and reporting on the projects implemented. For obtaining a part of the initial data left (C group factors – cognitive biases and cognitive styles attributable to the project team members), we referred to the method of Dr. A. Freeman and R. DeWolf – Cognitive Mistakes Questionnaire (CMQ) [11] and to the procedure of S. Epstein – (Rational-Experiential Inventory(REI)) [12]. As per the structure of factors, our paper rendered an analysis and interpretation of the obtained results as a proclivity of each respondent to a certain factor (cognitive mistake).

The REI questionnaire results were interpreted in automatic mode with use of the platform on which the interrogation was held (the conditions of using the “psyttests” platform – psychologic online tests – enable its utilization free of charge for education and research purpose).

Having obtained all the data required, we used Python programming language and a number of specialized libraries (including NumPy, Pandas) to carry out regression analysis of the previously mentioned dataset. In this way, we could calculate the effect of each of the factors included in a certain group of factors upon the project success.

Let us refer to Table 2 to familiarize ourselves in detail with the dataset regression analysis results.

Therefore, the regression analysis results show that the total of factors belonging to C and D groups (0.5 and 0.06 respectively) has a bigger impact upon the projects success than the research and development factors. The methodology of management of portfolios, programs, projects of A and B groups (0.008 and 0.432 respectively). That is true: 0.56 is bigger than 0.44.

In this case, it is not wrong to pay attention to the fact that just one of the three most affecting factors belong to C group when considered individually (cognitive bias “Danger exaggregation”; 0.09), and the second and the third places in the affect are held by “Project management procedure”

(0.135; B group) and “Breach of duration” (0.285; B group) respectively. Under the vignette experiment, the two equally-sized groups composed of the project teams members were proposed to take a certain decision selecting one of several possible reply options in different situations we formulated beforehand, including the situations indirectly related to a digital project management under uncertainty conditions.

Each of the groups under test met each situation just one time but with one key difference: the second group, before describing the situation itself with its initial condition, is given the respective tool as per the situation content to reduce the impact of cognitive mistakes in decision making.

Having analyzed the literature and researches on minimizing the impact of cognitive mistakes upon decision making, we arrived at the conclusion that the most efficient tool for the above purpose currently consists in realization and recognition by human of the presence of cognitive mistakes as the brain functioning features [1,6,7]. Each group was totally given six “vignettes”: the results obtained in five of them showed that the tools we proposed for minimizing the impact of cognitive biases upon decision making really reduce their impact enabling in this way the increase of the quality and efficiency of decisions taken. In this case, in one “vignette” (in which it was proposed to evaluate provability of the event departing from the general sample), the other way round, the group that was not given a tool for reducing the impact of cognitive biases rendered more accurate replies.

However: 46,7% vs 38,9%. We deem this departure to be possibly connected with insufficient understanding of formulation of the described essence and nature of a certain cognitive bias action, and to be corrected during further practical application of this tool due to a more exact formulation.

Table 2

Impact of factors included in A, B, C and D groups of factors upon the project success

Group of factors	Factor	Factor impact	Group impact
A	Labor effort evaluation	0,004	0,008
	Initial project planning	0,002	
	Breach of execution quality	0,001	
	Budget overrun	0,001	
B	Breach of duration (justified duration)	0,285	0,432
	Project management procedure	0,135	
	Requirements and specifications	0,011	
	Management support	0,001	
	Danger exaggregation	0,090	
	Moralization	0,070	
	Hypernormalization	0,065	
	Single-mindedness	0,055	
C	Mind reading	0,050	0,5
	Learned helplessness	0,045	
	Black-or-white thinking	0,035	
	Rationality	0,030	
	Catastrophizing	0,030	
	Personalization	0,020	
D	Intuition	0,010	0,6
	Uncertainty	0,060	

While carrying out the field experiment for the project teams, we arranged an online workshop (with use of the Zoom online conference platform) at which various cognitive biases, along with their essence and action principle, were described and then jointly analyzed with the project teams on the example of a number of situation that may appear to a certain extent in project management activities. Subsequently, the following recommendations were developed with account taken of the

expert opinion and wishes of the project team members, which can be considered for further implementation in the procedure of managing the projects on creating digital products for improving the success of the projects being implemented:

- compiling and further actualization of a pool of knowledge on cognitive biases encountered by project team members in their occupational activities;
- carrying out a retrospective analysis after finishing the projects for the purpose of detecting decisions taken under the impact of cognitive biases, and factors contributing to their manifestation,
- introducing respective corrections into the process of projects management;
- holding regular education workshops / trainings for project teams dedicated to cognitive biases, their essence and functional nature, as well as the situations in which they can show themselves and the ways to minimize their impact;
- formation of project teams with account taken of each respondent's proclivity to certain cognitive biases and the cognitive style possessed by each team member for balanced and maximum objective decision making while working on a project.

As per the results of interrogation held at the end of the meeting, 87% of the total number of interrogated project team members indicated that they previously encountered an impact of cognitive biases while decision making in their occupational activities, and 85% of the total number of interrogated participants have the opinion that the implementation of recommendations developed would enable improving the quality of decisions taken and, as a consequence, increasing the projects success.

4. Conclusions

It is reasonable to apply the cognitive approach at the stages of project definition, initial requirements collection, risks analysis, changes management and satisfaction assessment.

The objective of this research consisted in determining the impact of cognitive biases upon decision making in management of projects on creating digital products under conditions of uncertainty, and defining the ways of minimizing the impact of cognitive biases for achievement of maximum projects success.

Using three different methods of control, we have obtained certain results, which showed that the cognitive biases have an essential impact upon the quality of decisions taken within the projects, and, as a consequence, upon the success of the said projects. These results emphasize the need for continuing the research of the impact of cognitive biases upon decision making in the projects and can finally improve, on the qualitative level, the economic efficiency in the activities of domestic and foreign companies, including those belonging to the IT industry.

Declaration on Generative AI

During the preparation of this work, the authors used Grammarly in order to: Grammar and spelling check. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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