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UNCERTAINTY AS THE KEY FACTOR TO SELECT PROJECT MANAGEMENT TOOLS

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ABSTRACT

The paper details the research aimed at determining an effective problem solving algorithmfor development and implementation ofsearch-type projects where the result originally has noterminal parameters and is achieved with an iterative-incremental methodunder resource constraints. The paper studies practical use and applied relevance of a Cynefin concept model with respect tonon-traditional projects implementedunder varying degrees of uncertainty. It definesthe concept model domainshaving different solution algorithms andmeant for various types of projects. The paper also examines application of diverse sets of rules (standards), regulations, and concept modelsto manage different types of projects. It analyzes andsubstantiates dissimilarity of theCynefin concept model that has no distinct classification features fromthe traditional modelsthat can be classified according to certain criteria and bases. The paper provides classification of projectsby their complexity and uncertainty. It presents areas of application both ofagile project management methodsandcreative technologies and approaches to complex organizational and technical, innovative, andresearch problems.

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INTRODUCTION

In terms of traditional approaches, project implementation is known to relate to the perennial problem to achieve a high-quality result under resource constraints. This problem has been addressed and is still addressed by

applying the relevant standards to project management which constitute a systemic aggregate of knowledge and good practiceaccumulated from the successful project experience. 1970s of the XX century mark thebeginning of active formation of project management body of knowledge (standards).
The primary standards such as GOST R ISO 21500:2014, GOST R 54871-2011, GOST R 54869-2011, GOST R 54870-2011, PMBOK, ICB proposestep-by-step project implementationthrough the waterfall methodwhich implies that basic project constraints must be specified at its outset. These areproject product and its quality, budget andtimeline. But the operating standards do not meet management needsof the diversity of projects found in practice.

In particular, these are the projects that do not initially allowspecifying basic resource constraints anddefining project outcome parameters since they are implemented under a high degree of uncertainty. They include innovative and research projects, experimental developments implemented by means of a design approach. Specificity and complexity of such projectsrequire searching for and applying the approaches that will ensure the intended results as against traditional approaches. Foreign andnational project practiceis increasingly using theagile management methods: Agile, Scrum, Kanban, Kaizen, Lean. [14, 17, 22]

The purpose of this paper is to find an effective algorithmfor the application of various management approaches and methods for non-traditional projects.

METHODS

To study the indicated problemit is necessary to refer to theso-called quantum entanglement theory, two concepts of which were first elaborated by N. Bohr andA. Einstein in 1927[3, pp. 744-747]. Thequantum entanglement theory was addressed by other scientists as well. With the practical application of the theoryin mind, we shall turn to the works of the knowledge management practitioners who transformedabstract theories to practice-orientedones.

KM (knowledge management) is the activityaimed atupgrading efficiency of business processes of an organization by way of identification, distribution anduse of valuable experience and knowledge. In this context, KM is an intelligent knowledge management system which application enablesto define criteria and place restrictions providingnecessary and sufficient conditions to obtain a reliable result. [15, 16]

One of the most remarkable contributors tothe practical application of the quantum entanglement theory was Dave Snowden, a KM expert and practitionerwho proposed the methodological system Cynefin Framework in 2003. Cynefin (/ˈkʌnɪvɪn/) is a Welsh word for habitat, areal or location. The Framework is generally understood as a supporting structurein the environment of application.But since there is no common interpretation of the term, the authors offer to read itas a concept model within the given context. Therefore, in line with the objective, the Cynefin Frameworkcan be translated as a concept model of dynamic systems environment[13]. The author himself calls his approach a complexity theory and depicts it as follows (Fig. 1.):

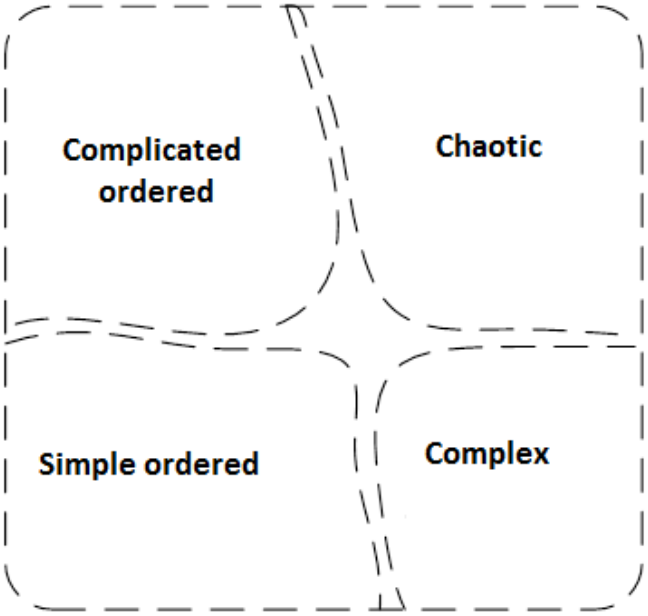

Fig.1. Concept Model of Dynamic Systems Environment (Cynefin)

As shown in the figure, the graphic of D. Snowden's concept model consists of four domainsof individual experience and knowledge, each of which is immanent toappropriatetype of a dynamic system (type of a project). The model is peculiar for the absence of clear boundaries between the domains, which distinguishes a concept model froma classification one since classificationsupposes the existence of logic relations betweenhomogeneous conceptsformed by some criteria (bases). The model under consideration can thus rightly be seen as a concept model because it does not reflectthe possibility to use the classification approach.

Here is a more detailed review of each domain presented in Fig. 1 in the context of project management.

Simpleordered systems

This is the domain ofsimple ordered systemswhere events and phenomenaarise from cause-and-effect relationships thatinevitably have certain consequences. Such relationships are predictable and repeatable and allow anticipating events with a high probability and predictable result. With regard to these systems, D. Snowden offers the following decision-making algorithm: sensecategorize – apply an action algorithm, leading to the only right result. [25]

It is appropriate and sufficient to apply a package of regulatory documents (instructions, rules, orders, etc.) to manage the dynamic systems of this sort. With regard to project activities, such approach entails the application of best practice obtained duringthe implementation ofsimilar projects.But nonetheless, such practice is not universaland cannot be spread to other systems. To manage simple ordered projects, we consider it reasonable to apply the classical waterfall model with pre-determined final result, well-structured processes, and action algorithms in the form of matrices, plans, andnetwork diagrams.

The simple ordered systemsare generally typical for operating activities having rather simple and repeatable processes. As a rule, however,project environment is a unique set of non-recurring events with unique result and cannot beregarded as the simple ordered system.

Complicated ordered systems

Complicated ordered systemsare also characterized by cause-and-effect relationships except that they are not as evident. Such relationships are usuallyvariable due to their primary dependence on time and the environment in which these events are taking place. For instance, a water bridge structure is largely influencedby the geological conditions of an area, and its erectiontechnology depends on time of year. Besides, the relationships in the complicated ordered systemare of multifactorial nature as a rule.

Such problems can be solved in a variety of ways as there is no one-for-all approach. Therefore,this kind of projects must be developed and implemented with the participation of professionals possessing relevant expertise. Since knowledge and experience are individual, one should select acomplex problem solving algorithm subject to the expertise level of those professionals.
The complicated ordered systemshave the following sequence of decision making: sense – categorize – select an action algorithm, leading to expected result.[18]

The domain of the complicated ordered systems covers everything that is logical and analyzable withevidence-based methods. A case in point is constructionof the Kerch Strait Bridge.

Whilebest practice is applied to the simple ordered systems in the form ofregulatory documents, good practice is usually applied to the projects relating to the complicated ordered systems since best practicecannot be identified in those cases. The difference is thatgood practicesuggestsseveralsolution algorithms, and it is incumbent on the professionals to choose the optimal one. Moreover, such project management problems are complex and require involvement of relevant professionals. Classical approaches are the most appropriate to manage the complicated ordered systems.They include well-knownandquite common sets of project management rulessuch as ISO 21500: 2012, PMBoK, Prince2, etc.

Complex systems

D. Snowden’s complex systems are composite, not simple, difficult, and intricate. Experts most often use the lastnotion. Such systems have their causes and effects but many elements andmany moreinteractions between themdo not allowfull employing the classification approaches. It is difficult enough to anticipate development of these dynamic systems with high probabilitybecause of their multiple configurations.

The example projects of the complexsystemscan be research, R&D, innovative projects, etc. One can compile theaction algorithm relyingon the classification approaches and analysis to implement such projects, but it would be difficult

to identify and estimate the whole range of future cause-and-effect relationships. One can only guess project output at its outset. [19]

The complex systems have the following sequence of decision-making: sense – analyze – develop an action algorithm. And if the algorithm applied during project implementation fails, one should develop and apply another algorithm. Such searchapproach to project implementation is callediterative-incremental.

It is worth noting that the algorithmsbringing positive result once do notguarantee the same result in other similar cases. This is the way to create knowledge, methods of solution orcombinations of actions that transform tocontemporary practice. Good practice presented in classical sets of rules can partially be applied to manage such projects. D. Snowden states thatanimplemented projecteventually generates contemporary practice. Given a high degree of uncertainty, such projects require additionalagile management tools. The AgileManifestoprovides the most comprehensive description of the principles and values of agile management [6, p.208], and Prince2, P2M, and Scrum offer systematic knowledge in this field [7, p.544].

Chaoticsystems

Here chaos does not mean a total absence of order, absolute disorder,andrandomness. Chaos and order are often compatible from a mathematical standpoint. The chaotic systems are usuallynonlinear feedback systems which are subject toerratic behavior, unpredictable developments, and sudden breaking of relationships. Such system seems to behave randomly even though a model describing the system is deterministic. The chaotic systems can be regarded as ordered as far as they are deterministic, i.e. follow some patterns.

According to Snowden, deliberate andconsciousentry into such systems canlead to innovationswhile accidental entry requires prompt responseto changes to put the system under control. The chaotic systems have the following sequence of decision making: act – analyze – respond. Under maximum uncertainty and time restriction one must beginto act based on previous experience and knowledge and then set a policy. Many chaotic systems have an infinite number of solutions foundin a confined space.

Yet, any chaotic dynamic system tends towardthe attractor1which is someanticipatedresult reflected in general forms.Any practice will be single and unique in the chaotic systems.

In chaos theory [9, p. 320], the chaotic systemsare extremely dependent on the original conditions of their existence, and minor changesof these conditions can lead to unpredictable results. Such dependenceindicates that even the smallesterrorsinthe parameters of a future project can lead to the results far from those expected. The errorscan most often arise from the ignorance of the whole set of original conditions.It must be remembered that a chaotic dynamic

[1]Attractorisalimited areatowardwhichtime variablesclose tothe system epicentertend.

system does not mean to berandom, although still unpredictable.This circumstance can be considered as uncertainty.

Speaking of dynamic systems consisting of three or more bodies, the renowned mathematician Henri Poincaré [10, p.560] has proved that a slight change in the trajectory initial conditions (positionand speed) of one body canlead to a drastic change in system configuration.

Theiterative-incremental approach can be regarded as the only possible way to manage projects with a high degree of uncertainty i.e. chaotic projects. The examples of chaotic projects are the projects associated with elimination of the consequences of various technological disasters (dam failures, Chernobyl power plant accident, etc.). Meanwhile,the iterative-incremental approachdoes notensure successful implementation of such projects. It seems quite reasonable in this case to complete theiterative-incrementalmethod with TRIZ (Theory of Inventive Problem Solving) [2, p.404].

G. Altshuller, TRIZ author, was able toconstructthe coherenttheory to solve problemswith a high degree of uncertainty,based onthe examination of over 40000patents and certificates of authorship. The author discovered basic laws of inventionand showed that invention process could be controlled. To achieve the desired result, the authorproposed the basic approachesto right thinking, overcoming the psychological inertia, search for a perfect solution, resolution of aconflicthidden in any non-routine problem.

He also classified solutions by 5 levelsof invention and offered 40 standard procedures used by researchers. That became the core of TRIZ together with offered Algorithm of Inventive Problem Solving (ARIZ) [8, p.416].

TRIZ is the most popular in the USA and Japan and is now applied to solve creative problems in many fields of human activities beginning with design and engineering and ending withadvertising, PR, management [11, p. 224].

Such trend in the field of knowledge as futurodesign has recently gainedpopularity [4, p.224]. From a practical perspective,the futurodesign can be regarded as forecasting andanticipation as applied to the chaotic projects.

The futurodesign approach is based ontechnology evolution modelling, social and cultural changes in society of the future. It is fairly often likened to innovation activity although the latter is only a particular case of the trend. In fact, it is search for fundamentally new solutions and actions which are nota simple extrapolation of the existing approaches. It is no coincidence thatthe main principle of the trend is the motto "outrun without catching up". The futurodesign can be regarded as logical continuation of TRIZ and ARIZ.

ThoughD. Snowden has stressed that the Cynefin concept model is not a project classifier, in-depth analysis allows identifying someclassification features yet. As previously noted, classification is distributingthe scope of a conceptinto several parts on the selected basis. So, classification supposes existence of an algorithm, criteria, and parameters, and D. Snowden’s model is

undoubtedly an algorithm.Hence it can be considered a classifier in a sense. We propose uncertainty for basis of classification.

RESULTS

In view of the foregoing, here is graphic representation of the classification approach to the concept model upon uncertainty criterion (Fig. 2).

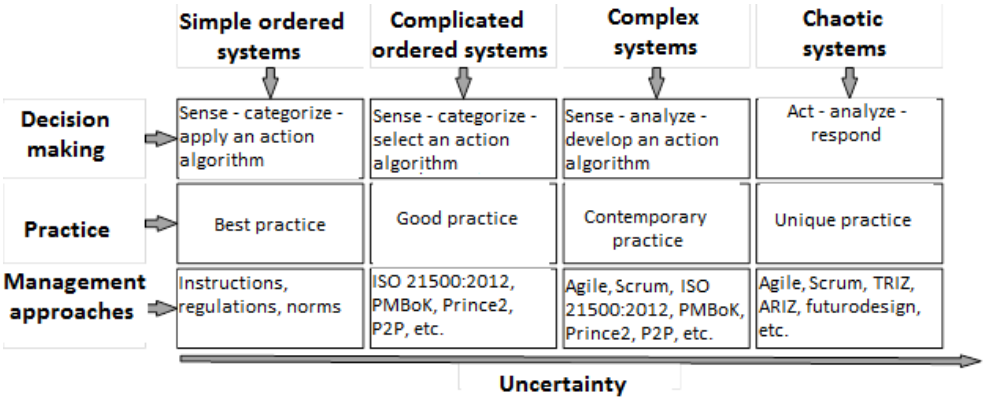

Fig.2. Classification approach to the Cynefin concept model

A dictionary definition of uncertainty is awareness of lack of knowledge about current events or forthcoming opportunities [12]. Let's look at the uncertainty criterion in detail. There are threetypes of uncertainty: uncertainty astotal lack of informationabout the future; uncertainty as doubts about eventsand phenomena of the future; uncertainty as an accident. In the first instancethe only method of solution is partial intervention on the problem (the first step) to elicitbackground information assystem feedback. In the second instanceone can make asubjectiveassessment of an overall situation.In the third instance it is the so-called black swan effect which is unpredictableas a rule. The fact is that uncertainty is associated with externalities normally beyond our control.In all the instances the iterative-incremental methodisthe main problem solutionthat allows generating a project attractor gradually.

Uncertainty and risk are often equated which is incorrect. Risk is a possibility and probability of any event or phenomenon we can anticipate. Uncertainty is an event or phenomenon we don't know about and therefore cannot assess its probability and consequences.The uncertainty factor relates tohidden variables. The hidden variables can be identified and assessednot directly but through observation and experiment i.e.through the iterative-incremental approach detailed in the Scrum framework.Virtually, we face the perennial problemof contrast(rather than contradiction)of twoworld-views – determinism andagnosticism.

DISCUSSION

The classical approach treats projects as a system of interrelated and interdependentevents and phenomena. In other words, project outcome can be determined if its initial parameters as a system are known. This approach underlies classical project management models often called waterfall models.

The first generation standards such as ISO 21500:2012, PMBoK, Prince2, etc. are based on project deterministic modelling.First, normallyatthe pre-project phase,details of finished product are defined and recorded inTDA. Thenits creation is scheduled. Lateron things are movingin strict adherence tothe specified documents. At that, a project is not very successful if any parameters are inconsistent with the plan andTDA.

The deterministic approachis the most suitable for the projectspertaining tosimple or complicated ordered systems. Nevertheless, all the above standardsdescribe the important process of project change management. The said fact proves thatchanges and variations are inevitable during project implementation due tothe uncertainty factor.

Such approach is ineffective to manage the projects pertaining to complex and especially chaotic systems and can lead to a negative result for ignoring the uncertainty factor. That's why therehave been recently developed agile management approaches and tools for the projects with a high degree of uncertainty. As mentioned above, these are P2M and various frameworks. Besides, updated PMBoK took effect in March 2018. The 6th edition allows applying anagile project management method. Such approaches are substantially different from classical waterfall models.

Agile project management does notprecludeshaping perception of project outcome;onlythe perception is shaped as the attractor, some area toward which all possible project implementation trajectories tend. Agile management does not preclude planningeither,only plans are of indicative nature contrary to directive classical waterfall models and are often calledbacklog (task list) of product creation. This does not prevent the use ofnetwork modelling thougha model is probabilistic. [23].

Human factor comes to the forewhen implementing complex and chaotic projects. The project with a high degree of uncertainty can be implemented only through cooperation and mutual understanding of the key stakeholders. Values and principles of such cooperation are set forth in the well-known Agile Manifesto. In general, it is a subjective procedure to form anoverview of thedomain to which, according to D. Snowden, a project can be attributed. At that,the initialview of the project domaincan change duringits life cycle.[24]

The Agile Manifesto is not a strict set of rules but a framework i.e.generalized representation of agile management. Agile ideas are available in the form of a set of rulesin the Japan standard P2M (Innovative Project and Program Management)focused at product mission and values for external environment rather than its creation. The standard is based on the ideas ofAgile, Kanban, Kaizen, Lean, etc. Unlike other standards, P2M shows a clear correlation between programs and projects, while not denying the application of classical approaches to project management.The key terms of the standard are mission, values, uncertainty, etc. This once again proves the importance of the uncertainty factor under consideration.[20]

CONCLUSION

In summary, the following conclusions may be drawn:

- Cynefin is a concept model permitting to tentatively form an overview of a projectand select appropriate management approachestothe project as a system. Every model domainsupposes that different approaches, modes of thought andactions are applied. Besides, the approaches themselves can vary and combine in a broad range;
- a project can move both from the chaotictocomplex domain and from the complex to complicated domain, etc. within the Cynefin concept model during its implementation. Movementof the project to another domainrequires changing the approach to its implementation. Thus, when the project moves from the chaos tocomplex domain, it is reasonable to incorporate the tools of conventional sets of rules (standards) in its management. When the project moves from the complex to complicated domain, it is reasonable to abandon the iterative-incremental approach;
- at the outset of a project it is important to determine the project domain within the Cynefin concept model. The determination of the project domain is affected by human factors such as preference, knowledge and experience of a decision maker. However, application of the uncertainty criterion facilitatesproject positioning.
- the deterministic approach is found to be the most suitablefor the projects pertaining to simple or complicated ordered systems while agile methods are appropriate for the projects with a high degree of uncertainty.

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