CONCEPTUAL APPROACH TO THE CREATION OF IT-PROJECT-MANAGEMENT SIMULATION MODEL

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Abstract. *In conditions of transformation economy the issue of effective management of economic systems, including IT projects, becomes more important. Tools and techniques which were used earlier cannot be applied in the new realities. In order to improve the quality of IT project, the authors proposed to create an agent-dynamic model of IT project management as a complementary tool in decision-making, planning, monitoring and controlling of the project. It is based on the project life cycle stages of international project management standard PMBoK by Project Management Institute. As a tool for formalizing of IT project processes were used UML diagrams. Thus, as a result of this research, the conceptual basis for the creation of agent-dynamic model of IT project was formed, which reveals the principles of modeling of agents in system-dynamic environment as a complex interaction of internal and external actors of IT project, due to the rules defined in project management plan, at different stages of the project life cycle, taking into account the system development life cycle.*

Key words. *Agents, Agent-Dynamic Model, quality of IT project, IT Project management, IT Project life cycle.*

1. INTRODUCTION

In conditions of transformation economy the issue of effective management of economic systems, including IT projects, becomes more important. Mistaken managerial decisions can cost a lot of money for company and sometimes even endanger its existence. Identification of incorrect decisions at early stages, as well as the ability to assess the consequences of various decision making options could allow to save significantly and also to reduce the percentage of failed IT projects. Such an analysis of scenarios of event development, that are difficult to predict and assess analytically, can be carried out using simulation, namely through the creation of agent-dynamic model of IT project management.

Problems of integration of system dynamics and agent-based modeling were discussed in the works of Eamonn L. [8], Lektauers A., Trusins J. [9], Schieritz N., Milling P. [11], Tian Y. [13], Größler A., Borshchev A. [4], Wakeland W., Figueredo G., Aickelin U., etc. Main features of IT project management were considered by Schwalbe K. [12], Sodhi J., McLeod R., Jordan E. [10], Turban E,. Volonino L, as well as by McKinsey&Company. To issues of project life cycle and system development life cycle were dedicated works of H. Kerzner, J. Rothman and R. D. Archibald. The research is based on the stages of project life cycle of international project management standard PMBoK by Project Management Institute [1].

At the same time, these studies did not consider a number of methodological problems, which reflect the specific behavior of agents within the complex environment of IT project. Also there is insufficient study of issues of applied nature for system modeling in the field of project management.
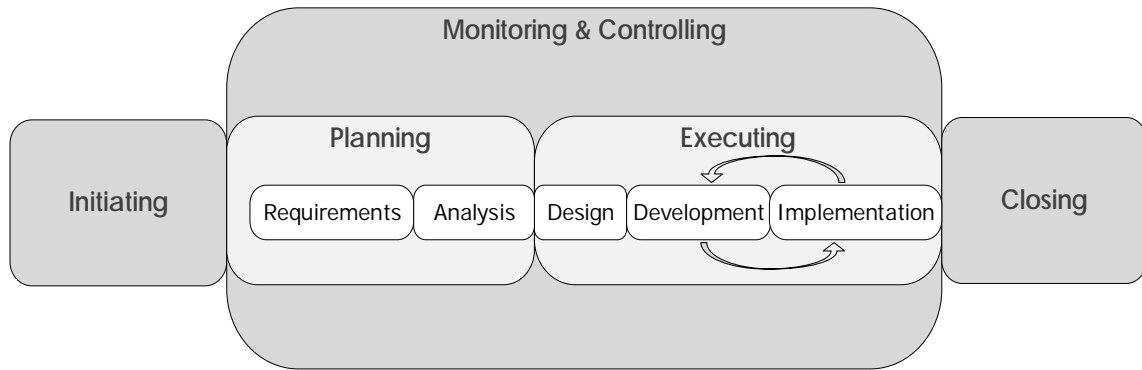
2. PURPOSE

On this basis was defined the goal of the work, which is to form the conceptual basis for creating of agent-dynamic model of IT project. To achieve this goal it is necessary: to determine the general life cycle of IT project, to identify the agents and the nature of their relationship in the context of project life-cycle phases and to identify the main simulating processes at the each stage of IT project life cycle.

3. BASED RESEARCH

According to international project management standard PMBoK [1, pp. 19], the life cycle of the project can be divided into five phases: initiating, planning, executing, monitoring and controlling, and closing.

However, apart from the standard phase separation, there must be taken into account specific stages of the product life cycle, depending on the product type. Since the object of this study is IT project, it is advisable to consider system development life cycle. For convenience of simulation there were set out five key stages in the system development life cycle: requirements definition, analysis, design, development and implementation. In turn, the implementation includes testing, deployment and user training. When combining the project life cycle and IT product life-cycle, the overlapping of phases takes place (Fig.1).
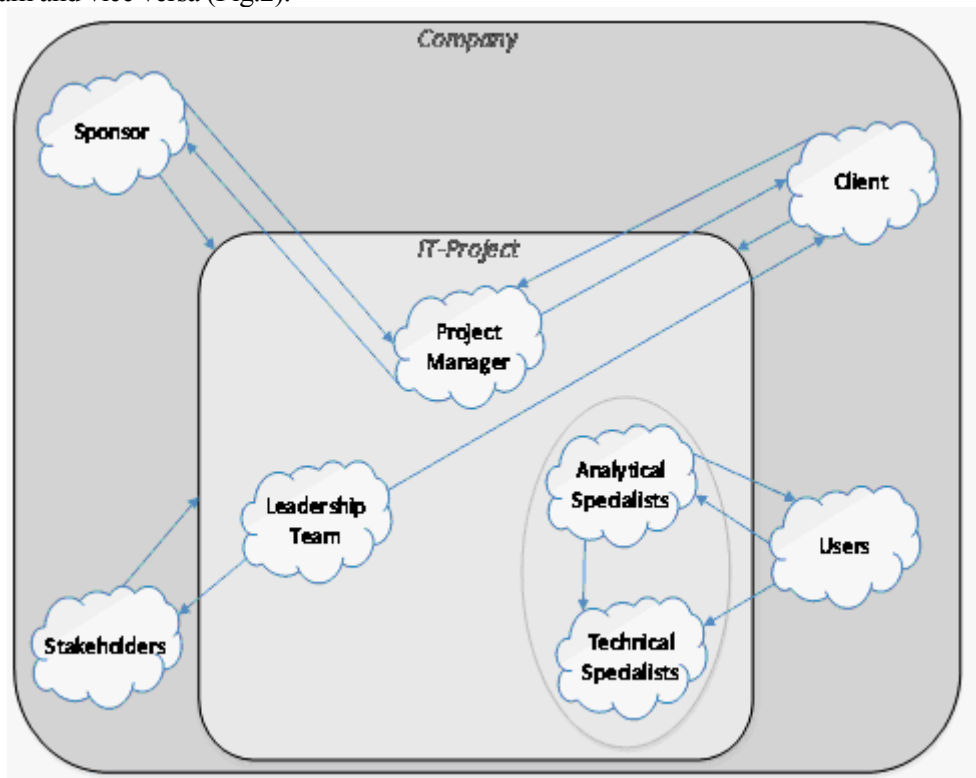
Figure 1. It project life cycle

Within the simulation, the agent is an "autonomous entity, that purposefully operates in a particular environment according to a certain set of rules, interacts with other agents and adapts during its functioning" [14, pp. 37]. All agents that refer to the project can be divided into two groups: IT project team and external agents. IT project team, led by project manager, provides execution of the project. In turn, the external agents may in some way affect the project, but are not included to the project team.

For creation of simulation model it is appropriate to model IT project team that consists of the following agents: project manager, leadership team (the administrative group that helps the project manager), analytical and technical specialists. Analytical specialists include business analysts and system analysts. Technical specialists unite developers, programmers, testers, etc. This grouping was done for the convenience of modeling of project participants and may not involve the combination of the roles of participants.

To external agents could be added: a sponsor, top management of the company, functional managers, CIOs, specialists from other departments, consultants, business associates, etc. However, for simulation will be allocated only four replicated agents: sponsor, customers, users and stakeholders, which can include all the other participants. During IT project implementation external agents actively interact with the IT project team and vice versa (Fig.2).

Figure 2. The scheme of interaction of IT project team with other agents

The interaction of IT project team with external agents can also be viewed through the prism of the project life cycle phases (Fig.3).
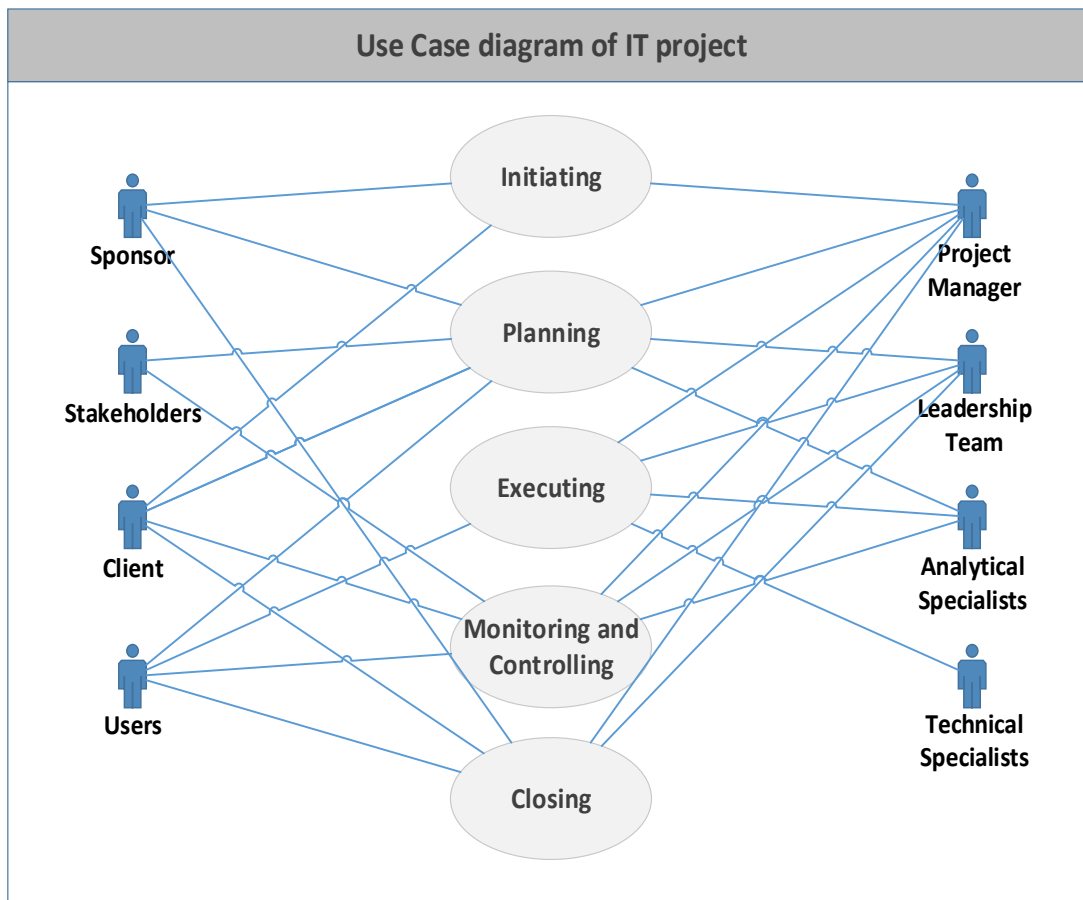

Figure 3. Use Case diagram of IT project

Such a diagram not only displays all agent relationships in the context of the stages, but also is useful during modeling, because it allows to check whether all relations between the agents were reflected in the model.

In order to create an agent-dynamic model of IT project management, which involves the simulation of IT project within project life cycle stages, it is necessary to define the basic processes that must be simulated at each stage.

Initiating. The main activities that take place during the project initiating can be presented at UML activity diagram (Fig.4).

The analysis of the activity diagram shows that the most difficult and time-consuming process is the "Evaluation of the project deliverables". The success or failure of project depends on how the obtained project constraints (Scope, Cost and Time) correspond to reality.

The evaluation of the project constraints is carried by project manager and in some cases by sponsor. But as the future model should become a complementary tool for the project manager, the whole simulation will be carried out from the project manager perspective. Thus, during initiation of the project is appropriate to establish additional simulation model to help the project manager during the evaluation of the project constraints.
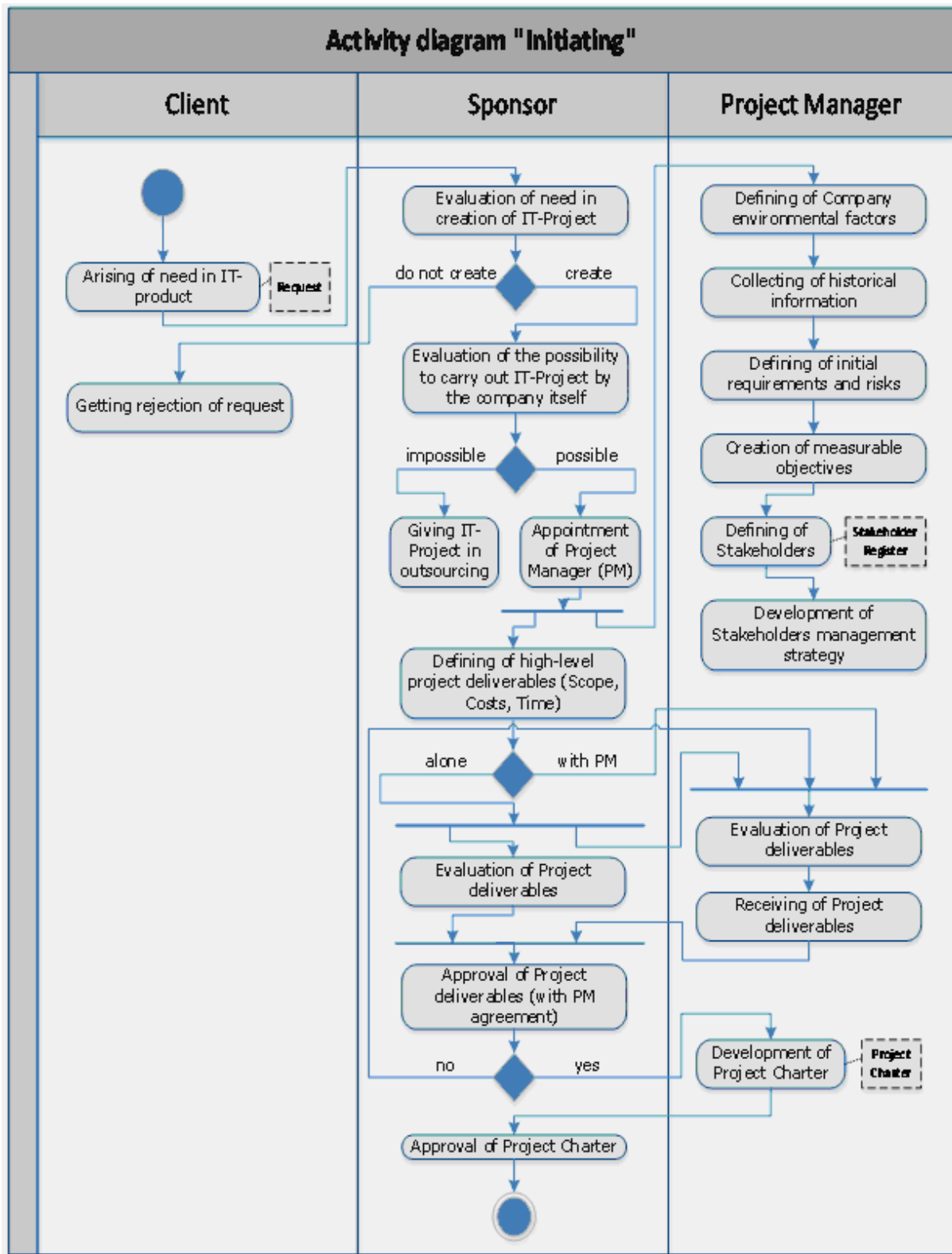
Figure 4. UML Activity Diagram "Initiating"

To solve this problem it was proposed to use an optimization method in AnyLogic software with built-in optimizer OptQuest, which systematically changes the parameters of the model for minimizing or maximizing the value of the target function [2].

The goal of optimization is to find the optimal strategy for the IT project for implementing of a definite scope during a certain time with a minimal costs, in order to satisfy the client. For configuring of the optimization functional there must be used a minimizing option, since the objective is to minimize the

costs and time. The amount of costs per month (InitialMonthlyCost) and the amount of time per month (InitialMonthlyTime) perform the minimized target functional variables, under which a project scope (InitialScope) could be fulfilled. As a limitation of optimization parameters that are checked before starting of the experiment serves the scope of the project. The customer satisfaction is an additional requirement that must be met after the running of an experiment.

Planning. During the planning there are created plans of managing of different project fields, in order to determine the methods and techniques of project management for the phases of executing as well as monitoring and controlling. Such general project management plan include: scope management plan, schedule management plan, cost management plan, quality management plan, human resource management plan, communications plan, risk management plan, procurement management plan and change management plan [5, pp. 125]. Each management plan contains rules regarding the required values of key indicators, as well as alternative variants of model behavior in case of changing of values of these key indicators. Consequently, the rules of agent interactions in a system-dynamic environment must be entered into the agent-dynamic model, according to the project management plans.

As a result of integration of all management plans into one model, a general project management plan is formed. Such an integrated model of project management plan is able to take into account the impact of alternative scenarios of different plans on each other and, as a result, on the whole progress of the project.

Executing. At this stage takes place the actual executing of the project and associated processes that ensure quality of project work. Simulation of execution phase of IT project involves the modeling of such stages as design, development and implementation of the required system and related processes.

Monitoring and controlling.. This phase include monitoring and controlling of the project work through the scope management, cost management, quality management, risk management, procurement management and change management, according to previously developed management plans.

In the simulation model the monitoring processes can be represented in the form of key indicators that show the state of the project during simulation run. The possibility to manage the project work can be modeled with the help of special leverages that can influence the model during simulation run.

Closing. Closing of the project involves completion of all transactions for the formal closure of the project. Also it involves the analysis of knowledge accumulated during project implementation, documentation and archiving of important information [6, pp. 250]. Since these actions are carried out only for the formal project completion, this phase will not be presented in simulation model.

4. CONCLUSIONS

Thus, as a result of this research, the conceptual basis for the creation of agent-dynamic model of IT project was formed, which reveals the principles of modeling of agents in system-dynamic environment as a complex interaction of internal and external actors of IT project, due to the rules defined in project management plan, at different stages of the project life cycle, taking into account the system development life cycle.

For achieving of the goal there was established general IT project life cycle from project life cycle stages and specific IT product life cycle phases. Agents and the nature of their relationships have been identified in order to create a simulation model. The interaction of IT project team with external agents was examined through the prism of the project life cycle phases with the usage of UML use case diagrams [7, pp.57]. The main processes that must be modelled were identified in such stages as initiating, planning, executing, monitoring and controlling, and closing of the project. To assess the project constraints during initiating it was proposed to use the optimization experiment with minimizing target function.

Agent-dynamic model will improve the understanding of how the structure of the simulated system and its dynamic processes and principles of interaction of the elements in the complex. As a result, may not only improve the quality of management decisions, but also significantly reduce costs. Also, agent-dynamic model will play different variants of the project, change the main limitations of the project, leverage and see how it will affect the project. Using this model, the Project Manager will review the project prior to its implementation, to compare the predicted results of the project alternatives with each other or with the results of similar projects and to choose the best of them.

The future work include creation of two simulation models within the AnyLogic software [3]. The first one (preliminary), optimization model of the project constraints, has the aim to help the project manager during the initiating phase. The second one (main), agent-dynamic model of IT project management, is a complementary tool for the project manager that simulates the planning, executing,

monitoring and controlling. Such a model will include agents that interact in a system-dynamic environment in accordance with the rules developed during the planning stage. Also the modeling of system development on the phase of executing, as well as displaying of key indicators and leverages as monitoring and controlling stage will be performed.

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