

## Conference Paper

# System Engineering for Project Organization

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## Abstract

The theory of systems allows to organize to more efficient management of the development and changes of the project. Classification of M. Jackson for classification of various practices of the systems approach was used for research and analysis.

The paper deals with the use of systematic approach in organization management to enhance efficiency in project progress and change management. Based on the classification of M. Jackson different applications of systematic approach are examined and analyzed. A case study of soft system thinking is described. The goal of ongoing research is development of a method to evaluate the effectiveness of project teams at HES MEPhI. The efforts involved application of soft systems methodology and yielded a unified methodology comprising tools and approaches of more efficient management of project teams. The merger of the soft systems methodology and evolution of developed tools into a combined methodology, its deployment in the practice of managing project teams in the field of education provides the launching site for its further extrapolation to other fields where project teams operate.

**Keywords:** system approach, project teams, education, soft systems thinking, organizational cybernetics, changes, management, efficiency, project, team.

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## 1. Introduction

In a rapidly changing world caused by the progress of technology, the main competitive advantage in the market is the prompt response to changes. The main "change management" approach is being replaced by a new method formulated by E. Edmondson - "changing management", which declares itself in prompt change as a process of "learning". Moreover, the described approach implies joint efforts, decentralized and unstructured processes, fuzzy and difficult to measure results. This approach finds application in new / innovative activities.

It is worth noting that the tasks become uncertain and complex, their performance is beyond the capacities of one person or an information system. There is a need for a project team [1], namely, a group of people interacting to achieve a specific goal, where each participant performs a separate task, but each part is a necessary contribution

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into the implementation of the task. The final result of the team significantly exceeds the total of the work performed by individual participants.

Existing methods for managing project teams concentrate mostly on cooperation; describe the principles of work of team members and their interaction. At the same time, there is no collaborative and activity component, which can lead to a decrease in the quality indicators of product realization.

The systematic approach [2] can become an advanced tool of team management, which facilitates holistic view of the team, enables identification of the links between the team members, reveals specific conflicts. The systematic approach may significantly improve the level of work and the effectiveness of the project teams.

The purpose of the work described herein is to develop an effective method of a project team management using tools of a systematic approach and organizational cybernetics. The subject of the study is the effectiveness of project teams, and the object were the design teams of students at Higher Engineering school MEPhI (HES MEPhI).

## 2. Results and Discussions

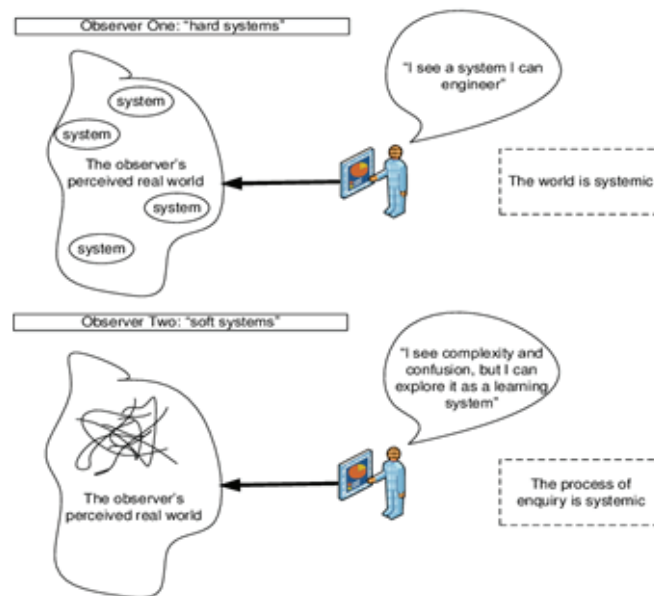
Based on the selected topic, this paper considers the theory of a systematic approach for the management of organizations and the collective solution of complex problem situations [3], which will allow manage the development and changes more efficiently.

TABLE 1: The matrix of problem situations by M. Jackson

Systems	Unitary (Monosubjective)	Pluralistic ("free" subjects)	Coercive (polysubjective with duress)
Simple	Hard system thinking	Soft system thinking	Releasing System Thinking
Difficult	System dynamics Organizational Cybernetics Complexity theory	Soft system thinking	Postmodern System Thinking

In Jackson's book [4], the System of Systems Methodologies (SOSM) is a typology of not only systemic methodologies, but also system thinking (Table 1). One should point out that the first two columns of SOSM distinguish between systemic thinking as "hard" - it deals with systems described by means of natural sciences and mathematical modeling and "soft" - working with systems described on the basis of qualitative criteria. This separation was proposed by P. Chekland [5, 6] in 1981, considering the problems

of management methodology (Figure 1). From the classification in Table 1, as well as the separation according to Chekland, it follows that for the chosen research object the pluralistic relations are characteristic - linked by the common goals of the project team and the customer company, but having different goals for each specific stakeholder.



**Figure 1:** Hard and soft positions in a systems approach

Given the specifics of the object under study, we can conclude that the best solution to the application of the system methodology is the soft system methodology of P. Chekland. This choice is explained by the following set of advantages, in comparison with other methodologies [7, 8]:

- P. Chekland's systematic approach is the result of the evolution of the approach associated with the increasing complexity of the technical system and the related human aspects throughout the entire life cycle of the system. In this regard, MSM will enable linking of project teams with systems engineering;

- According to Jackson's matrix (Table 1), Chekland's MSM is characterized by work with human activity systems. The design teams of HES MEPhI fit the organizational-activity [9] and design relationship, the implementation of which is ensured by "soft system thinking".

In this connection, P. Chekland's SSM approach was applied to the HES MEPhI project teams [10], which consists of the following stages:

- 1 - collection of unstructured information;

- 2 - a real model (rich picture), structuring of information, definition of problems, current solutions and required systems;

- 3 - root definitions - formulating the basic characteristics of systems to solve problems;
- 4 - creation of an ideal model (structured and logically connected set of activities), which will allow to achieve transformation;
- 5 - comparison of the ideal (4) and real (2) models in order to conduct a discussion with participants in “problem situations” to determine the necessary changes;
- 6 - identification of feasible changes;
- 7 – action.

The final formulation of the problem situation is as follows: “Annually, about 40% of the design teams of HES MEPHl break up or demonstrate low efficiency of project work.”

Based on the analysis of the problem situation, as well as the roles of people in the project team and the characteristics of their behavior and relationships with other stakeholders, a “rich picture” was developed (Figure 2), which shows the main conflict points for each stakeholder.

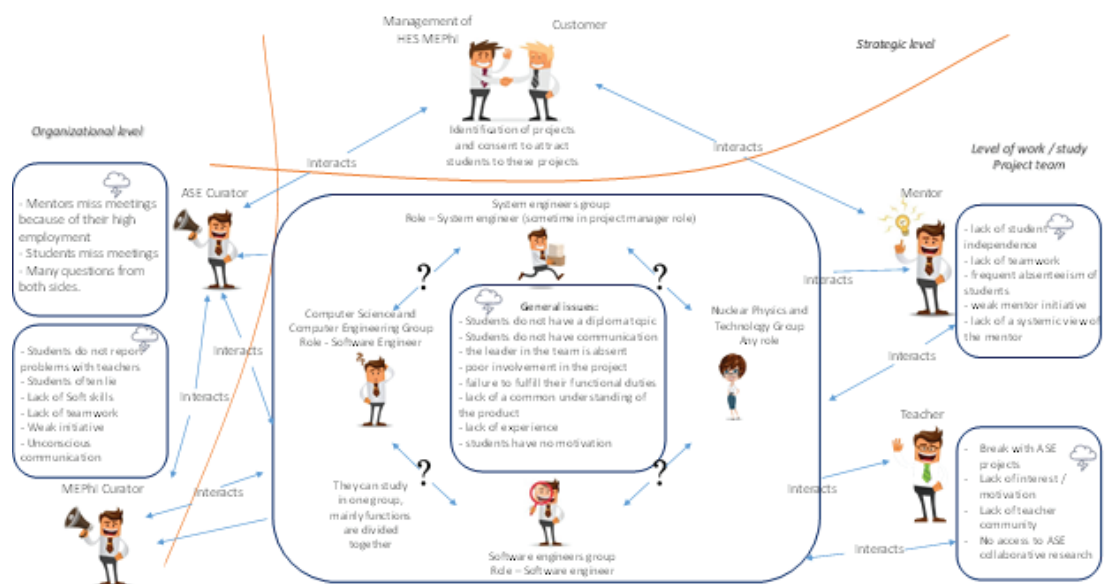
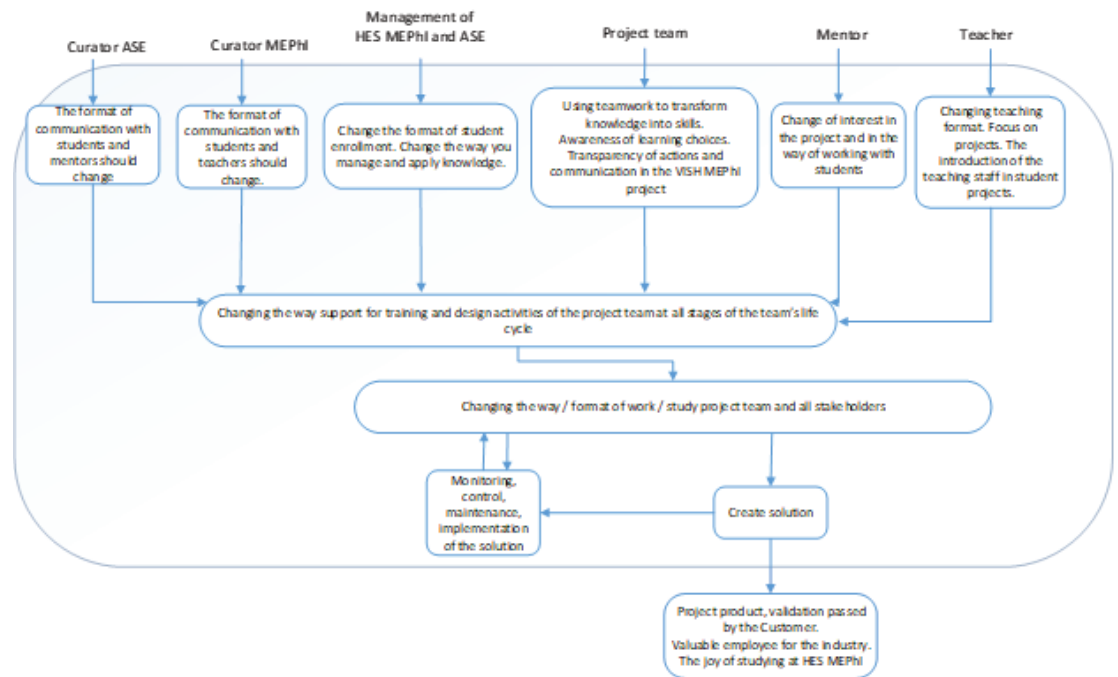


Figure 2: Content picture Rich Picture

Taking into account the specific logical structure of the root definition, as well as the “Overlays” of the world model described using the rich picture and forming the ideal target system, actions were identified to implement the changes that would help solve the problem situation (Figure 3):

- Based on the results, a number of tools were proposed:
- Creation of memos for student, mentor, teacher;
  - modified course ”Design Thinking”;



**Figure 3:** Actions for implementing changes

- testing;
- the formation of teams, taking into account functional positions and team roles;
- course "Introduction to project activities";
- Creation of an educational platform.

Using the methodology of soft systems thinking, a detailed analysis of the problem situation was carried out, the ideal target model of the system was determined, and the necessary changes to achieve the target system were identified. Based on the results of the description of the object of study, a number of tools were proposed based on various system methodologies, including a soft system methodology and organizational cybernetics, the results of which resolve problem conflicts identified at the stage of determining the problem situation.

The great practical significance of the work carried out for the implementation of a new type of training through teamwork, obtaining competitive personnel for the industrial partner and the industry as a whole should be pointed out.

## References

- [1] Project management: Fundamentals of professional knowledge, National requirements for the competence of specialists. - M.: Nauka, 2014. - 92 p.

- [2] System Engineering. Principles and Practice. Translated from English Ed. V.K. Batovrina. / Kosyakov A., Sweet W. [et al.]. - M.: DMK Press, 2017. - 624 p.
- [3] Jackson M., Keys P. Towards a System of Systems Methodologies. Journal of the Operational Research Society. January 1984; 35 (6): 473–486.
- [4] Jackson M. Systems Thinking: Creative Holism for Managers. - Chichester: John Wiley & Sons, 2003 <http://uc-crowd.iscte-iul.pt> (accessed April 15, 2017)
- [5] Checkland P.B. Systems Thinking, Systems Practice. - Chichester: John Wiley & Sons, 1981
- [6] Peter Checkland, Systems Research and Behavioral Science - Syst. Res. 17, S11 – S58 (2000)
- [7] Churchman C.W., Ackoff R.L., Arnoff E.L. Introduction to Operations Research. N.Y., 1957
- [8] M. Jackson. Complexity Theory and Systematic Approach. Translated from English. p. 17
- [9] Shchedrovitsky G.P. Selected Works. - M.: Shk. Cult. Polit., 1995.
- [10] Antropov M.S. Management of Development and Change in Multinational Organizations: textbook. allowance / M.S. Antropov, A.N. Chichikin. - M.: RUDN, 2008. - 146s.