PROJECT MANAGEMENT CYCLE IN THE CONSTRUCTION INDUSTRY AUGMENTED BY COLLABORATIVE INNOVATION NETWORK SOFTWARE

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Abstract— Project management is a very broad concept that has in recent times is growing rapidly. Management is especially complex in the construction sector, among the other sectors, due to the high uncertainty of workmanship and complexity of construction projects. Proper project management skills are an important factor in the success of projects, leading to reduced costs and shorten the time of investment. Nevertheless, most of the projects still end up a failure or incomplete success. Therefore, an important issue is the development of project management methodologies and supporting them through the latest attainments of science and technology. The author proposes to improve the project management process through the use of the Collaborative Innovation Network software with paid particular attention to projects in the construction sector.

Keywords— project management, project management cycle, coin network, construction industry.

I. INTRODUCTION

In the last decade, the construction sector has undergone many significant changes. The constant increase in computer power, global development of Internet, the emergence of new management methods, modern building materials, development of precast elements, the establishment of European common building standards and the introduction of quality management contributed to the remarkable progress in the field of structural engineering. However, the fundamental things remain unchanged, investors still want to get construction facility within budget, at a specified time and with the appropriate level of quality. Significantly increased the quality of control and service. All of these factors contributed to the emergence of new professions, such as project manager, product engineer, occupational health, and safety inspector. Increasingly, we treat the construction process as a project that can be managed in accordance with known and proven methodologies. The creation of a business plan and mature management determines the success of a construction project, which is why it is so important fundamental knowledge in this field.

The purpose of this study is to analyse the life cycle of projects, paying special attention to the construction sector and implementation in this cycle proprietary software, which use the concept of Collaborative Innovation Network (CoIN). The aim of the research was to find the intermediate areas of project management in the construction sector, in which implementation of CoIN will bring maximum benefits. Literature was conducted to recognize the main topic of project management with special focus on the construction industry. Monographic studies on the basis of the acquired literature and scientific publications relating to coin the proceeds of the literature were carried out. Analysis of the issues subject and develop data obtained from research monographs led to the creation of a comprehensive project management software in the construction industry. Summary and conclusions will include a set of thoughts that and serve as a basis to identify the optimal direction in which it should develop the software and answer the question, in what areas of project management will be most useful.

II. CHARACTERISTICS OF PROJECTS REALIZED IN CONSTRUCTION SECTOR

The construction industry is a strategic and highly influential sector of European economy, it provides the necessary infrastructure and buildings that determine the efficient functioning of all other sectors of the economy.
Proceedings of 2nd International Conference on Civil and Architectural Engineering
Held on 13th – 14th July 2016, in Bangkok, ISBN: 9788193137352

In Europe, the construction sector employed 11.8 million people, which accounts for approx. 7% of total employment and approx. 28% of total employment in the whole industry. Moreover, it is estimated that nearly 26 million workers in the European Union depend on one way or another on the construction sector. The European Union in 2003 alone invested 910 billion euros in construction investment. Construction industry consumes the largest amount of resources among all other sectors of the economy, moreover, typically these are non-renewable resources. The inclusion of new less developed countries to the European Union requires an extraordinary effort to rebuild their infrastructure. Present before construction sector are facing extraordinary challenges, which are determined on the one hand with a need for sustainable development, and on the other with an emergence of new technologies. Moreover, what should be mention is that the increasing innovation of construction projects is stimulated by the emergence of new materials, technologies and management techniques, which is a natural consequence of the development of a modern knowledge-based economy. The continuing need to seek solutions and modernization of production and management processes is essential to be competitive on the market. Innovative management methodologies are extremely difficult to implement in high risk and constantly changing environment, whereas the process of change requires a combination of many rare skills [9].

III. LIFE CYCLE OF PROJECT

The life cycle of the project, it is a description of the project in time. The life of the project can be divided into phases (Fig. 1) which can be classified into five basic groups:

- Initiation
- Planning
- Construction output
- Monitoring and control
- Project close-out

Fig. 1 Phases of the project life cycle

The first phase of the project begins by defining the scope, purpose or goals, resources, expected results, timing, and structure of the project. The next step will be to develop an economic analysis, including several possible solutions to that issue, including an analysis of potential profits and losses. In order to select the best possible solutions and to determine an acceptable level of risk, a feasibility study should be carried out. Successively a complete range of activities and emerge project team should be established. The next step, in the planning phase, is to create a detailed project plan, which will be a tool, for the project manager, to monitor and control, cost, execution time and required quality. At this stage, the following points should be defining:

- Plan resources: human, hardware and materials
- Financial plan: estimated financial expenses;
- Quality Plan: define quality objectives and determining the methods of quality control;
- Timetable risk: identifying threats and opportunities, planned activities necessary to manage risks;
- Plan termination: defining criteria for transferring the results of our work to the target audience

Essential is to verify initial assumptions and approve them to begin the implementation phase of the project. Results achieved to date during the course of the project should be possible to evaluate.

In the implementation phase of the project, an executive team is achieving assumed goals and the main task of the project manager is to monitor and
control. At the stage of execution, a number of factors (Fig. 2) should be managed, such as:

- Time management: tracking and recording duration of the tasks in relation to the planned timetable;
- Budget management: recognizing and accounting costs in the project budget;
- Quality management: a review of the results quality and management processes;
- Change management: review and registration of changes concerning the project, including how to deal with making changes;
- Risk management: assess the level of project risk and take action to minimize them;
- Problem management: identification and solving problems arising during the implementation phase of project;
- Communication Management: to inform relevant stakeholders about the progress of the project, risks, and problems;
- Project close-out management: management of project closure process, an audit of obtained results, receiving of the product by the customer.

Once the client accepts the results, a preliminary evaluation will be carried out, in order to determine whether intended results are achieved and the project is ready to close. When the project close-out will be approved project manager should free up all resources and start evaluation phase. Evaluation should be carried out to determine the success level of the project and answer the question whether all originally founded benefits have been obtained. Evaluation should be carefully documented and serve as a knowledge base for future projects [3], [6].

**IV. COLLABORATIVE INNOVATION NETWORK - CHARACTERIZATION AND DEFINITIONS**

A Collaborative Innovation Network (CoIN) is a social construct used to describe innovative teams. The idea has been originally defined by a Peter Gloor at MIT Sloan's Center for Collective Intelligence and defined as "a cyberteam of self-motivated people with a collective vision, enabled by the Web to collaborate in achieving a common goal by sharing ideas, information, and work.". Software considered in this article has implemented CoIN, all participant has remote access to the core modules (Fig. 3). Concept of CoIN might be especially important in Research & Development projects [4], [5], [7], [8].

CoIN Definition:

A Collaborative Innovation Network (CoIN) is a group of self-motivated people with a collective vision, enabled by the web to collaborate in achieving a common goal by sharing ideas, information and work. It takes a series of innovators who are ahead of their time to prepare the groundwork for the CoIN. Their ideas are then picked up by CoIN leaders excelling in collaborative skills to carry the innovation over the tipping point by assembling a team of dedicated experts. CoIN combine 6 types of networks: work, social, knowledge, strategy, learning, and innovation networks.

The main "glue" that holds the network together is the shared vision and a bond of mutual trust. Initially, the activities of a CoIN are invisible to the hosting organization. Subsequently, the hosting organization is slow to recognize the value of the innovation of the CoIN. CoIN results are only brought to the attention of top management through external recognition. Once the results of a CoIN are fully recognized, the CoIN has reached the end of its useful life. It usually transforms itself into other organizational structures [1], [2].

**V. DEFINITION PHASE OF THE PROJECT**

**A. Initialization phase**

Initiation is one of the most creative phases of the project lifecycle. It involves creating ideas and formulating thoughts in the form of design concepts. Formed in this way, ideas are put to the later stages of selection, which will select the projects most profitable, least risky, or fit within the current strategy of the company.

Generally, initiation of the project in the construction industry in a general contracting company is to create a database of ongoing contracts and making offers such projects, which the company in the context of its experience and capabilities can realize. A different situation exists with developers who have their own
department of manufacturing, where initiation can start with an analysis of market needs and financial analysis. Due to the nature of bidding tenders, initiation is based on a logical calculation and requires no additional comment. Initiation requires a lot of creativity because by analyzing market needs, including market segmentation and marketing new product have to be created. In order to generate an appropriate amount of fresh, innovative, interesting ideas, a team that will be responsible for initiating projects must be selected. The team has to apply appropriate techniques to stimulate themselves for creative and constructive thinking. Keep in mind that in large companies, corporations, timely and bottom-up initiatives in the direction may be difficult. Project initiatives should be formulated in a clear and concise manner. The resource of initiatives gathered by organizations should be at a certain period of time revised because changing market conditions cause that the projects which could not be completed sometime in the new environmental conditions become profitable.

Fig. 4 Project Defining module in UnicornPMS

B. Project Defining

Project Defining is a process of crystallization and refinement project ideas generated in the Initiation Phase (Fig. 4). Defining is to design an outcome, clear presentation of objectives and in-depth environmental analysis of the project, both internal and external. It is also necessary at this stage to create an accurate and in-kind design specifications. Project documentation should include details and specifics of the venture. According to literature on the subject, the contents of properly defined project should contain the following ingredients, very vividly captured in the acronym BOSCARD, namely: Background, Objectives, Scope, Constraints, Assumptions, Risks, Deliverables. If the initial analysis of the project showed that the project is targeted, cost-effective and feasible, it is recommended to perform the so-called Statement of Work (SoW). Statement of Work is crucial because each successive operation will be carried out by different teams of specialists. This simple tool standardizes work carried out by individuals. Classifies duties and responsibilities, so that they are clear and understandable, therefore consequently performed correctly. However, it should be kept in mind that SoW is not an exhaustive inventory of specific activities or purely technical issues related to the technology of the work. All the more that technology of performed works in the construction industry, has this property that it is strongly associated with the experience and capabilities of specific contractor or subcontractor. SoW should contain clear wording, accurate description of the tasks and responsibilities, transparent definition of supplied material goods, take into account existing standards and procedures, companies reference documents, avoid duplication and unnecessary specification. One of the very good methods for defining objectives of the project is a Logical Framework Approach (LFA or log frame) [11].

It involves a gradual and systematic analysis of the problematic typical for all projects. Analysis by using LFA was used as a tool to project defining. Prelude to the development of the logical framework is a stakeholder analysis, problem analysis, analysis of objectives and strategy analysis (Fig. 5). The premise that motivated the author was to create a platform on which all members of CoIN, will be able to exchange ideas and thoughts on each stage of the logical framework [10].

Work with UnicornPMS starts with complete the forms, which will build the Logical Framework. Only after completing the form, users are able to see other CoIN participant entries. Before user adds their filled form, data and ideas of others CoIN participant are hidden. It has been implemented to not inculcate the ideas of other members in user's mind and to prevent copying thought processes. Under user's own entry, as well as under entries of other people, a user can add comments and discuss the various elements of the logical framework. After a period of creative
Proceedings of 2nd International Conference on Civil and Architectural Engineering
Held on 13\textsuperscript{th} – 14\textsuperscript{th} July 2016, in Bangkok, ISBN: 9788193137352

Brainstorming, each CoIN participant can start option "Final Version". This feature allows any user to add their own final version of the document, the text added by each user is identified by individually assigned colour. The document can be edited by anyone with users in real time. Nevertheless, to avoid build-up of text, errors and editing the same part of the document at the same time, the author decided to equip UnicornPMS with lending function. Due to edit final version of the document, CoIN member must first borrow it. Borrowed file is fully editable and added text is highlighted by colour assigned individually to the user. After editing part, the file must be returned to the pipeline, so then another user will be able to rent it and edit it. Each cycle of a borrow-return can be seen in the history of changes and bear by the signature of author, date and time of return. Below the Final Version edition panel of the document was placed chat, which allows all CoIN members to comment document on the course of the editing process. Following the development of the final version of the document by all CoIN participants, they are obliged to accept their versions of the document by using the option "Accept Final Version of Project Definition Document". The final document can be exported into popular formats, i.e. RTF, DOC, DOCX, PDF.

The first step in the creation process of Project Definition Document is an analysis of stakeholders, i.e. identification of individuals, groups or institutions that through their initiative can have a negative or positive impact on the project. Stakeholders should be grouped and analysed in order to specify their potential impacts on the project. Stakeholders, which are potentially more influential and with high motivation to act should be carefully analysed (Fig. 6). This will allow the user to avoid many unexpected situations during the project.

After thorough identification and analysis of stakeholders need to take appropriate action or lack of action in relation to each of them (Fig.7). The second step is to find key problems of the project and the designation of potential risks. Describe the causes of certain difficulties and try to predict their consequences in time. Goals should be analysed and clearly defined, at this stage detailed descriptions of problems must be carried out. Users should think about the ways in which problems could be solved. Next step is to choose the right strategies in order to achieve founded goals. Resources which lead to primary objective, as well as intermediate targets, should be specified. Internal and external condition and a correlation between them should be determined [4], [12].

The obtained data will allow the user to create a logical matrix which is a tool to find the best possible solution (Fig. 8). Having such prepared tool vertical and horizontal logic might be examined, in order to determine a detailed plan of the project.

![Fig. 6 Characteristics of stakeholders](image6.png)

![Fig. 7 Plan of action in relation to stakeholders](image7.png)

![Fig. 8 Logical Framework](image8.png)
VI. CONCLUSIONS

Using UnicornPMS software, help in an efficient way to streamline the process of defining project within the project management cycle. The idea of Collaborative Innovation Network implemented into software has introduced a project definition phase to a new dimension. Project management software based on an open, remote, cooperation of people as part of CoIN is the future of project management. In the future, project groups made up of people living in different parts of the world, will work together on large and diverse projects. The idea of openness and mutual trust postulated in the literature on Collaborative Innovation Networks has been realized in the form of clear and transparent rules on the listing of entries, commenting mutual ideas, joint edition of the final document. Responsible and creative approach to project management is the way to growth and longevity of businesses. All companies, including companies from the construction sector, tend to stabilize, strengthen and increase profits. These three universal goals might be accomplished by creating an efficient and stable working mechanism in an unstable and chaotic reality. However, the project team can compare to the watchmaker, who with the relevant parts, gears and springs create a mechanism for fulfilling his will. Project management software is the aggregate of spare parts and in the hands of the right team of people create a mechanism that will set up your project to live and perform happily until the finish. Application of the software described in above does not guarantee the easy success of the project, but it is the basis by which chances of success might be increased. Further, work the author will focus on software development by extending the functionality of the program for the next stages of the project management cycle. The intention of the final product will be integrated platform, which will enable to the implementation of project life cycle by remote project teams.

ACKNOWLEDGMENT

I would like to express my special appreciation and thanks to my advisor Professor Michal Trocki, PhD, Eng.

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