Theoretical problems in control of construction projects

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Abstract

The ongoing crisis in the construction and engineering industries is tending to become a permanent reality pushing to a further shrinkage both private and public investments. In an era, where only negative growth is being recorded and future predictions are grim for the entire industry, we need to turn it to our advantage. Crisis management in the construction projects can help pinpoint problems that rise and handle them as well as control them effectively. Utilizing the derived information during the execution of these projects will eventually reveal prospects and gain insight to grab new opportunities.

In the current study, aspects regarding the management of construction projects in conjunction with exploitation of generated information are being discussed. This review articles based on bibliographic information.

Through this study, we have come to conclude that management in construction projects and gained insight throughout this process, challenges someone to think about projects in a different way, in order to improve their productivity, achieve new goals and overcome problems.

All of the above can provide information of a new strategy regarding future developments in the construction industry and constitute the foundations as well as guidelines for designing an entirely new comprehensive building information management system approach for all construction projects.

Key-words: *Construction projects, Construction, Construction companies, Control, Information, Prospects.* ***JEL Codes:*** *L74, M10, N64*

1. Control as management function of construction projects

Managing the Construction Project is defined by applying knowledge, skills, instruments (tools) and techniques in activity of that project, meeting the requirements for that[i]project or meeting all composed modern management methods, with intended purpose for controlling time, costs and quality of specific project at all development stages[ii]. Additionally, one project that unites efforts of scientists, manufacturers, engineers, subcontractors and suppliers enables successful production expertise. For that reason, the Construction Project Management process is necessary set of business management activities to be undertaken for reducing the risk of costs and time uncertainty and increasing the probability for successful project completion[iii]. Project management synthesizes modern management methods for controlling the time, costs,

and project quality at all stages of development[iv]. According to this, the Construction work management process includes:

- Requirements, needs and expectations identification
- Creating acceptable goals
- balance between the needs of time, cost, quality and physical object
- Compliance specifications, plans and approaches, according to project participants' needs and expectations[v].

The construction projects management process mainly deals with continuous control of time, price and quality during the project implementation. In this process good governance requires monitoring, but all contractors have different ideas about the necessary level of control in the projects that they contracted (undertaken).

The main factors are considered the company size and organization and the scale and complexity of the analyzed projects. Additionally for monitoring the productivity performance, should be collected information in the context of structured reporting system to enable activities in cases of arising problems - if and when problems arise[vi].

The goal is to complete the project considering the highest level of objective activity for building that project, optimal time and production costs. These goals are not easy to achieve, because quantitative and qualitative figures harmony and function are found only at finishing the project, when are applied processes to measure, execute, and calculate the total cost and project usability control. Big projects need the most observation and monitoring (controlling) at both stages - the design stage and the implementation stage[vii].

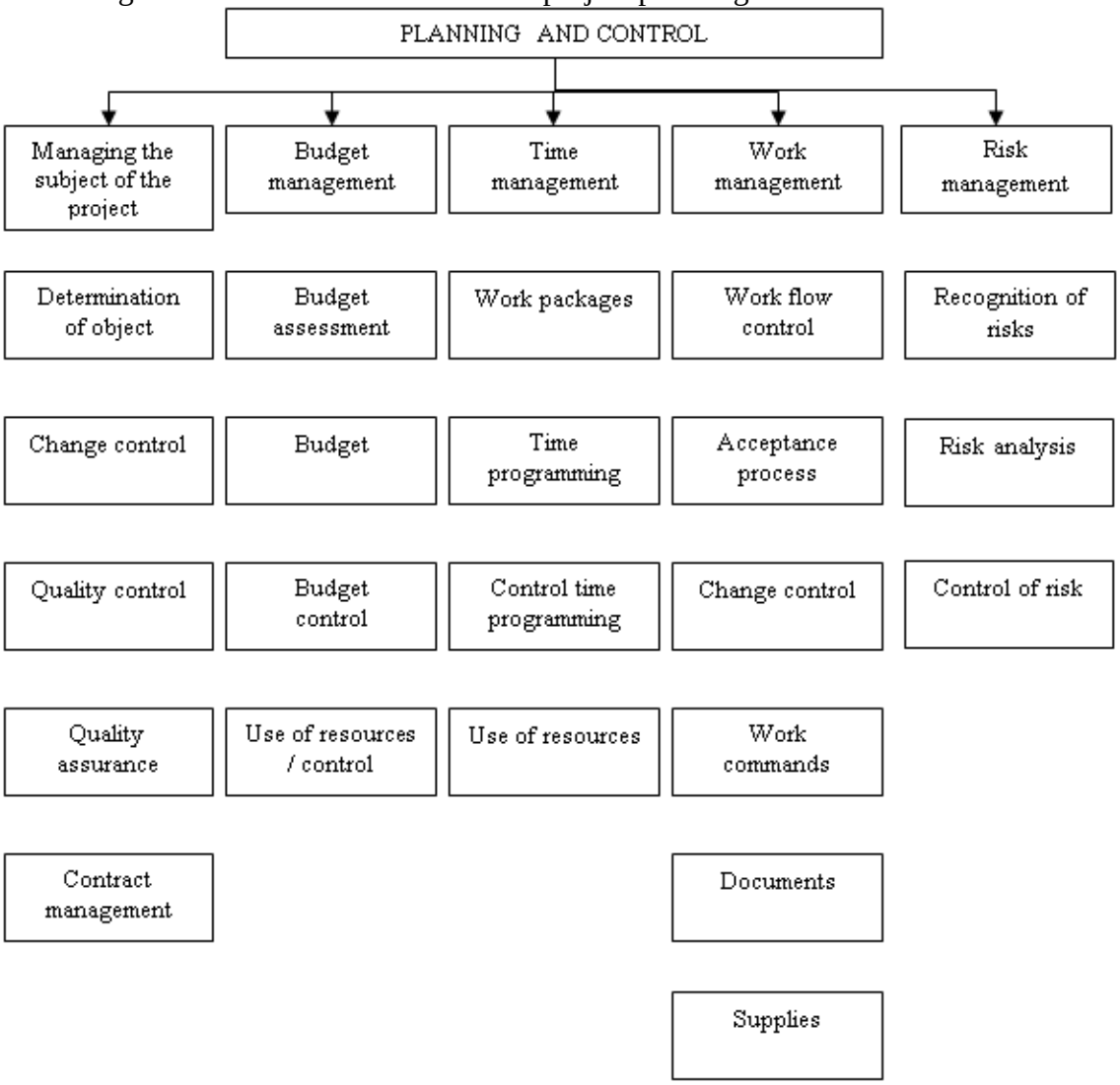
The Management process involves controlling the project results with actions taken by someone. This is reactions more active role involving the control. The checking control process usually is translated as a negative activity that creates and applies restrictions, which in other cases would be free activities. However, if this is an approach, a system for control is the possibility, because the system should have a continuous approach to management goals[viii].

The essence of project management is to guarantee the finished project condition to fulfill its purpose, in order to meet customer requirements and to be completed within the time and budget. For this reason, goals such as quality, time and cost, need to be completed simultaneously or to achieve a satisfactory balance between these three factors[ix].

Considering the above it is clear that control is important management function. According to W.J. Del Pico "the essence of any type of management is control. It is fundamental to project management"[x]. Jr. Pierce argues that controlling is the final action in the management process[xi].The similar opinion has Elías Bjarnason. At the same time, he adds that planning and controlling are closely related and that these functions can not be separated[xii].This is also supported by the opinion of Yu, Froese, and Grobler[xiii], who consider planning and control functions to be inextricably linked. E. Richard and P.E. Westney[xiv] also consider that are interrelated planning and control functions presented in Fig. 1.1. Regarding this the Bulgarian author I. Sakarev points out that planning and control are essential functions of the construction projects management process[xv].At the same time, he adds that the planning function should be reviewed from two perspectives - as operational production planning and financial planning. According to the author, the content of the interrelated planning and control functions is:

- Operational Production Planning - includes calendar plans with horizontal diagrams, calendar plans with sloping diagrams, calendar plans with network models and calendar plans with matrix models;
- Financial planning - includes a Balance value account statement report for a construction contract, a Balance value account statement report for the idea project, a Balance value account statement report for the technical project, a Balance value account statement report for the working project and a Balance value account statement report for actual costs;
- Control - consists of a time control system, a value control system, a quality control system, a wages control system, and financial control of profits[xvi].

Figure 1.1. Content of construction project planning and control functions



Source: Richard, E., Westney, P.E. The Engineer's Cost Handbook, Tools for Managing Project Costs, Marcel Dekker, Inc., New York, United States of America, 1997.

R. Maderova points out that during the controlling process the important information is obtained regarding functioning of all areas at enterprise's activity[xvii]. She places an extremely important emphasis (in our view) pointing out that control helps to respond in a timely manner, reveals the shortcomings and weaknesses at

enterprise functioning[xviii] and, in our view, to make the right decisions considering effective management of the project.

It is obvious that control makes possible to reveal the deviations manifestations and based on that to make decisions for the necessity to carry out the appropriate corrective actions.

The control completes its function through certain goals and plans. Regarding this, H. Koontz's position is: "without objectives and plans, control is not possible because performance has to be measured against some established criteria"[xix]. In addition, the basic purpose of controlling process is to ensure the plan indicators implementation and to increase the overall effectiveness of project planning and control process[xx]. Y. Olawale and M. Sun[xxi] have opinion: in the construction industry, the aim of project control is to ensure that the projects finish on time, within budget and achieving other project objectives. In addition, it is important to emphasize that the control role for the efficient management of construction projects is determined by the existence of the certain reasons for the necessity of this project. The view of some authors support this by pointing out the reasons for the necessity of control are non-determination, warning for crisis situations occurrence, success maintenance and scope of control[xxii].

It is obvious that control includes management activities that lead to achievement of planned results foreseen in the project. It allows to estimate whether the most appropriate management decisions are taken, both in terms of project implementation and specific tailored corrective action measures that need to be taken.

Considering this, the important issue is necessity for clarification of nature and particularities at project control. It will help to better outline the problems in controlling construction projects and the possibilities for overcoming them.

At scientific publications, the control is being investigated by a number of scientists. The analysis of literary sources on this issue reveals absence of generally accepted definition for the essence of control. There is aspiration to reveal the multi aspect content of project control process. For example, Y. Olawale and M. Sun[xxiii] define control as a role, as a process and as an outcome. Other authors review control as a practice, a system and a problem[xxiv].

At scientific literature, the essence of project control is treated by some authors as a process. For example, in his definition, A. Angelov points attention to the fact that control should be seen as a process that ensures achievement enterprise objectives[xxv]. The opinion of R. Madgerova is that control process can be explained by comparing planned indicators with obtained results and based on that to establish the presence and degree of correspondence between them[xxvi]. Additionally control is defined by Project Management Institute as a process of comparing actual performance with planned results, analyzing differences, evaluating trends in process improvement and possible alternatives, and recommending appropriate corrective action as needed[xxvii].

Different from the authors cited above, I.I. Mazur, V.D. Shapiro and N.G. Oldergrogge are pointing that the project control process is divided into basic and additional[xxviii]. According to them, the basic control process includes general control of changes and project reporting in implementation process. At additional project control process, the authors refer to content changes control, time control, cost control, quality control and risk control.

Independently from known differences regarding additional clarification, I.I. Mazur, V.D. Shapiro, N.G. Olderogge, H. Kerzner and A. Angelov consider that

control is a three-stages process. The position of I.I. Mazur, V.D. Shapiro, N.G. Olderoge is that control is a three-step process for tracking the actual condition of work performance, analyzing results and measure progress, and undertaking the corrective actions to achieve project goals[xxix].

In his definition H. Kerzner also points attention to the fact that "controlling is a three-step process of measuring progress towards an objective, evaluating what remains to be done, and taking the necessary corrective action to achieve or exceed the objectives"[xxx]. According to A. Angelov, the controlling process means developing standards and criteria, comparing actual results with standards and criteria and undertaking the necessary corrective actions[xxxi]. For better convenience, the authors reviews on the issue for control process stages are presented in table1:

Table1.1. Systematization of Control process stages content

Author	Stages content Stages systematization according to Foreign authors
H. Kerzner[xxxii] (2013)	1. Measuring - determining through formal and informal reports the degree to which progress towards objectives is being made. 2. Evaluating - determining the cause of and possible ways to act on significant deviations from planned performance. 3. Correcting - taking control action to correct a unfavorable trend or to take advantage of an unusually favorable trend.
I.I. Mazur, V.D. Shapiro, NG Olderogge[xxxiii] (2004)	1. Tracking - collecting and documenting actual data; determining in official and unofficial reports the compliance degree of planned indicators actual implementation. 2. Analysis - assessment of the current state of work and comparison of results achieved with planned results; determining the causes and ways for influencing on deviations from plan implementation. 3. Correction - Planning and implementation activities pointed to work performance according to the plan, minimizing unfavorable deviations or gaining benefits from the occurrence of favorable deviations.
Author	Stages content Stages systematization according to Foreign authors
Al. Polcovnicov[xxxiv](1998)	1. Track to actual work performance condition - collect and document the actual data. 2. Results analysis and progress measurement - assessment of the current condition of work performance and comparison between achieved results with the planned ones. 3. Corrective actions - Planning and implementation activities pointed to work performance according to

	the plan or minimizing discrepancies.
	Stages content Stages systematization according to Bulgarian authors
A. Angelov[xxxv](1998)	1. Developing standards - specific goals having a quantitative expression. 2. Matching the achieved results to the established standards - establishing the scale of the deviation; applying the principle of exclusion; measurement of results; evaluation of information and results. 3. Taking corrective actions - choosing the right line of behavior from the following: "nothing to do," "deviations removal," and "reviewing the standards."

Note: The systematization of the author is made according to opinions of the cited authors

The presented views of the mentioned authors reveal that, despite some minor even small differences in the stages definition of project control process, basic stages without which the project can not successfully be managed are tracking, analyzing and assessment of the condition and corrective actions.

A.N.Pshinko, A.V. Radkevich, L.N.Dadiverina complete the project control understanding, reviewing a set of activities related, on the one hand to checking and ensuring the implementation of obligations for project realization by the contractors, project participants and, on the other hand, by preventing deviations in the actual amount of project financing regarding actual and planned indicators set out in the project implementation timetable[xxxvi]. A more complete and accurate view for project control is given by some authors, defining it as a periodic collection of real indicators of the project's activity, comparison with planned, analyzing the results obtained and making management decisions that help to eliminate the negative factors and ensure achievement of the project's target indicators[xxxvii].

To the above-mentioned views can also be added the view of I.I. Mazur, V.D. Shapiro and N.G. Olderogge, which define the essence of project control as determination of activities results based on the evaluation and documentation of actual work performance indicators and their comparison with the planned indicators[xxxviii].

In the scientific literature, the essence of project control is also considered in terms of performing certain tasks. On this issue Al. Polcovnicov points that the following tasks are being solved within control and management function at implementation of project activities: measuring, forecasting and assessing the current situation for achieving results, time, resources and finances, analyzing and taking actions to eliminate the reasons for deviations from the plan and the plan correction[xxxix].At the same time, he adds that, additionally to controlling three basic quantitative characteristics - time, scope of work and costs with project management, the Managing Bodies must continually have control over managing the work activities content (changes), quality and organizational structure. On their side, A.N. Pshinko, A.V. Radkevich and L. N. Dadiverina have opinion that the basic tasks of the construction projects control are: continuous monitoring of project implementation;

Ensuring that project participants complete correctly their responsibilities regarding project implementation; timely risk identification affecting the possibility for project implementation and proposals preparation for their prevention; Form data on project progress; ensuring effective interaction and coordination between project

participants; ensuring rational and targeted spending of financial resources in the process of project implementation and information support for the project implementation[xl]. The position of Jr. Pierce is that the project manager must perform the following tasks:

- Plan: establishing realistic and usable schedules and budgets.
- communicate: The plans must be communicated clearly and effectively to the people who will be executing them.
- monitor and control: Ensure that the project goals are met and take action if necessary[xli].

Another understanding of project control defines it as: a complex task undertaken by project managers in practice, which involves constantly measuring progress; evaluating plans; and taking corrective actions when required[xlii]. These definitions highlight the important role of project control for successful management and realization of construction project on time, according to the budget envisaged and set goals.

P.E. Kam Shadan points: project control compares actual performance with plan (baseline), identifies variances, and corrects adverse variances[xliii]. At the same time, the author considers that the project control provides the procedures to track and control the project's scope, cost and schedule to support project management's objective of delivering a scope that meets project requirements, within the budget and on schedule[xliv].

In a broader sense, project control is a setting target, monitoring comparing and taking action to ensure the project goes as planned[xlv].At the same direction is reasoning of H. Koontz[xlvi].The author points that project control is "the measurement and correction of performance in order to make sure that the enterprise objectives and the plans devised to attain them are being accomplished." In composing aspect the control is reviewed as "controlling changes and recommending preventive action in anticipation of possible problems, monitoring the ongoing project activities against the project management plan and the project performance baseline, and influencing the factors that could circumvent integrated change control so only approved changes are implemented"[xlvii].Some authors perceive the project control realized during the construction process, such as planning, monitoring, comparing actual with planned and taking actions[xlviii]. According to them, the three major areas of control in construction are "cost control", "quality control" and "schedule or progress control". Considering this it is necessary to note that A.S. Kazi and C. Charoenngam distinguish three components of project control[xlix]. In their opinion project control consists of cost control, quality / specification control and time or schedule control.

A further clarification regarding essence of construction projects control can be achieved by identifying the characteristics and types of control. In this regard, A. Angelov believes that characteristics of effective project control are strategic focus, results orientation, timeliness, flexibility, simplicity and economy[l]. Another perception reduces them to continuity, system, timeliness, feedback[li].

For the present study is important to identify the basic types of control that contribute to the effective project management. Regarding the projects control types from the implementation point of view there is similarity in authors opinions. Their generalization and systematization shows that three kinds of control can be distinguished, namely:

- Preliminary, aiming assessing the level of commitment in plan implementation with necessary resources (human, material and financial);
- Current, allowing monitor and evaluation of different activities at the moment of their implementation and their alignment with the planned objectives and tasks;
- Final, serving to assess the results achieved and, if necessary, introduce corrections in the forthcoming actions[lii].

Regardless of consideration type of projects control it is undeniable fact that it is an important management function. It consists of setting standards, ie. of concretely set values of certain plan indicators that are directly related to the realization of the construction activities in given period of time. The assessment of the degree of achievement the standards is based on comparison between achieved results with set standards. If any discrepancies are found between the standards and the results achieved, corrective action is taken. It helps to take management decisions related to the effective realization of the construction project. At the same time, the implementation of project control concept is based on certain performance standards and developed plans to achieve the project's objectives, measurement techniques, comparative analysis of planned and ongoing project implementation, and take corrective actions for effective implementation of the construction project.

As already mentioned, control can be seen as a system. In this regard, R. Madgerova has the opinion that for effective control and for taking right decisions for corrective actions, it is necessary in the enterprise to function a control system[liii]. The same author adds that this system determines the sources of information regarding the control, the criteria for input evaluation, the process of the current work and the output of the controlled object, the means of control and implementation periods[liv]. The understanding is that the project control system is part of entire project management system, between the elements with feedback and possibility of changing predefined indicators[lv].

Project management includes monitoring i.e. system for monitoring control, reflecting the progress of project implementation with opportunity for corrective actions. Systems for project control are used for problems identification and solving problems before their impact on project implementation progress.

The systems for project monitoring are structured hierarchically. Certain information reaches to certain member of the team project. The project monitoring and control system is determined by the presence of:

- Project calendar, including information on weather conditions, completed work, contractor human resources and technical responsible person, work sites and office equipment and materials, project visitors (consultants, services, etc.), laboratory work and checks
- Weekly progress reports
- Monthly progress reports.

In our view, at the same time, the experienced project managers recommend accepting organized approach to projects planning and control since having a good organized control system, all parties involved are familiar with work expected to be completed by them, expected results by them and the reports they need to collect. Monitoring and control procedures are helping to determine actual project position

regarding time period, commissions, resources and costs. If the project is inactive we should undertake some form of corrective activities. For effective control, measurement of project implementation must be completed during the stages with time for corrective actions. At the early stage of the project, some corrective actions are financially more favorable, and in many cases with project approaching the completion stage, corrective actions are impossible[lvi].

In our opinion, the project control system can be reviewed as mechanism that maintains system monitoring and avoidance of project variations from specifications (contract obligations and project quality characteristics).

It is necessary to note that, for effective project control system it must meet certain requirements.

According to A.N.Psinko, A.V. Radkevich and L.N. Dadiverina the control system for construction projects in general terms must meet the following requirements:

- Analyzed information content regarding the project implementation progress;
- Periodicity of collection, reporting structure and responsibility for collecting data;
- methods for analyzing information and taking relevant decisions[lvii].

Some authors suggest the development of control system to be limited to compliance with mandatory requirements a follows:

- careful planning of all the works necessary for completing the project;
- Accurate assessment of time period, resources and costs;
- reporting actual results and costs in time aspect;
- Periodic reassessment of time and costs necessary to carry out the rest of the work;
- Multiple periodic comparison of actual results and costs with schedule and budgetlviii.

A complete and accurate understanding for mandatory requirements about creating an effective system for monitoring project implementation is provided by A.A. Calashnikov and N.I. Watin:

- plans to be substantial, clearly structured and fixed;
- any change to the initial and following plan should be accompanied by a determination of made adjustments;
- The system of performance reports or financial statements must be clear and understandable to contractors and to reflect the project status according to approved plans;
- determine in advance the periodicity of presentation of all reports;
- provide for an effective response system to address deviations from the planned project progress, including a plan review;
- the control system allows tracking the actual project status at each stage and at any time of the analysis; identifying deviations from planned project progress and developing corrective actions[lix].

The specific issue concerning control of construction projects is the one for its bodies. The selection of efficient staff personnel can be reviewed as a key role for

company success and a key human resource management function[lx] and, in our opinion, for each construction project successful control and implementation. Also the incomplete organizational structure, in our opinion, is the basic reason for inefficiency at construction project control. This structure is characterized by complexity and double-meaning at the competence of each person. Regarding this I.A. Kokkosis considers that confused responsibilities or lack of responsibility undoubtedly lead to reduced performance, employees' conflicts and disputes between employees[lxi].

"Project control is considered to be a necessary skill for all types of construction manager: project managers, contract managers, engineering managers and of course control managers"[lxii].Regarding this it is necessary to note that project manager's typical responsibilities are coordination and integration of subsystems work, assistance in assessing employment and equipment requirements, time and budget, and at the same time calculating and analyzing the project performance of technical progress, schedule and budget.

However, the project manager should have important role in designing and controlling the project and is also responsible for bidding regarding agreements, determination of project organization and staff and taking leadership of team project considering production and development of new business profit[lxiii]. Some authors have opinion that:" one of the most important role of construction manager is the design management in the early design phase where the cost, time and quality of a project are determined."[lxiv] With a certain difference, to these opinions is joins the opinion of Jr. Pierce mainly regarding the manager role in the project management process. He believes that: to achieve and maintain control, the project manager must monitor the progress of the job and, in case if short-term goals are not met, he must take action to get everything back on track[lxv].

Along with the unavoidable increase at the size and complexity of construction projects, leading project managers or the ones acting on behalf of technical engineer or representing manufacturer in order to have better understanding between all involved and related to them financial aspects of their work. They should be able to apply a higher degree of control without being limited to the daily development of costs and quality of work, but taking into consideration the effects of the entire external environment were the issue project will be built[lxvi].

Project managers always should face the challenges with approach concerning the project progress, despite uncertainty, the wide variety of projects, their diversification, and a large part of potential relevant information. They manage a large and diverse group of people, although they do not have direct control over most of them.

Knowing the project subject by the manager and what kind of skills he / she can demonstrate during his / her career is a very important step in the process of selection and development of effective manager, necessary to face some problem and achieving unique results at limited timeframe period and resources[lxvii].

At Conception stage and accepting the project (Constructubility project), the project manager is necessary to understand and to apply basic principles for investing and financing companies in economic condition of potential project owner.

The project manager should consider the different sources and types of available funding and implications of using any appropriate alternative. Furthermore, the relationship between time and money should be considered as very important, since there is inevitably delay between investments in capital at project construction and expected benefits arising of using the unit built. For this reason, at this early

stage, the project manager should also be able to assess the possible risk costs, the variations at projected estimates of the project as well as the range of potential revenue expectations and may differ of those expected from the project, that are base for initial decision for investment. At the conception stage of the work project, the project manager should be familiar with design and production processes proposed for using and to know how to make the best economic use of each of these project technical aspects. These technologies should be selected considering total expected capital costs for each alternative, not only at the design stage, but also in the choice of the manufacturing process and method. In addition, they should be considered at determining future use of the built module. Therefore it is necessary at this stage to use opportunity for project creation, likely to reduce the price for building the project, considering owner's requirements.

In addition to the aspects costs, time and quality, the project manager responsible for designing and building a project should be aware for the type of contractual relationship that can exist between the owner, professional consultants involved in the project in order to formulate plan - study and to monitor the project construction and their contractors / suppliers involved in the supply and construction. There must be a well understood subsequent distribution of risk by the contractors in the terms of contract that will certainly have some differences in acceptance.

It is important the chosen form of partnership contract to offer contractors the best possibilities for completing the project in the timeframes without exceeding the assessment of survey, quality, in order to provide adequate and necessary functionality and the serving unit (installation), at the time of risk allocation according to requirements, understanding and experience of each team member[lxviii].
The project manager significance for successful projects implementation is followed by possession of considerable size of necessary knowledge, skills, personal skills and qualities of effective and successful manager[lxix].

The project manager needs to understand all the possible effects of such a diversion of sustainability of any organization involved in the project. When the project is completed and begins operational use, the contractor involved in the operation should have an entire value assessment of the asset that he is responsible for, and based on initial and subsequent financial investment. For this reason, he should be familiar with level of efficiency and profitability to serve the building in order to become a successful investment. In addition to these important responsibilities, that will be undertaken by project contractors during the construction of a building, there are many other economic factors from outside of the direct activity scope to many construction contractors. Such factors, as inflation, taxes, legislation, etc., will affect the project financial results both during construction and after completion at the time of starting the use and operation. The information outlined above is quite important in defining the context of the overall project management objective[lxx].

Modern building projects are not limited to only one single specialty, but have the potential to include many specialties. Usually, a great part of work requires coordination between different departments and expertise of the staff personnel[lxxi]. In building crises, uncertainty is often subjected to a productivity test by the project manager. The name "project planner executive" is used in the general sense for the person responsible for managing entire project or most of the project[lxxii].

There are factors focused on the actual activities by the project managers regarding to personal characteristics. Also, managers should spend most of their time

outside the office, talk to staff, especially with technical supervisors. They show that their primary goal is to coordinate engagements with technical issues and this way to create very capable working groups[lxxiii].

At the same time, experienced project managers need to be aware of cost or time problems in order to better understand the condition status of a certain project. Tracking time period for work and cost could be unfavorable development of the project even project suspension. This may cost over costs or delays because measurement or tracking the work is not included in the cost control system. For this reason, project manager should develop an integrated cost system - programming - work progress during the time of the project and not at the end of the project. The project status should be clear with equal necessary corrective activities that can be completed with minimal cost[lxxiv].

It is necessary to consider that technical responsible personas not always involved in the project from the initial stage of design, but comply important interventions and studies for his preparation until completion of construction, and this way are used his services until the end of the project construction[lxxv].

In the scientific literature devoted to the organizational structure of the building control and management team, there is no generally accepted structure of project control bodies. For example, regarding project organization, O-Kyung Kwon and Jong-Hoon Kim offer the following project control bodies:

- Design management team consisting professionals of each field including specialty consultants to keep up consistency;
- risk management team;
- consultants for each trade as well as owner, contractors, designers and supervisors[lxxvi].

Different from above-mentioned author, I.P. Woycu points that project control and management bodies are project manager and team associates, including team for organization the project financing, project implementation team and project team for introducing the project in operation[lxxvii].According to V.A. Zarenkov the project team consists project manager, the basic team members of the project, additional team members of project and consultants[lxxviii].The opinion of I.I. Mazur, V.D. Shapiro and N.G. Ol'derrogge is the structure team responsible for project control and management must contain Project Manager, Project Engineer, Project Administrator, Contract Administrator, Supply and delivery Manager, Personnel Manager, Quality Manager , Finance Manager, Coordinator Manager, Designers and Consultants[lxxix].

Obviously, the creation of optimal organizational structure for the control and management of construction project is prerequisite for successful realization. At the same time, creation of effective control system enables not only selection of correct input criteria, in entering process working process and exiting process of construction object – subject of control but also for control information sources.

2. Information as a source of control information

Successful control and on this basis effective implementation of the construction project can not be carried out without the necessary information. In support of this, G. Nani and Th. Adjei-Kumi underline:'' effective control of construction works involves acquisition of information related to the volume or quantity or work that is used to set the budget and monitor it"[lxxx]. By the opinion of

the same authors: in all planning / setting target and monitoring, work quality information is used within the control mechanism to provide vital information[lxxxi]. In this sense is also the opinion of I. Sakarev that realization of effective management, resp. Control of construction project is based on receipt and processing of site status information in order to prepare the necessary solutions as well as the bringing of the command information to the contractors[lxxxii].

The problem for information as a source for control reports regarding construction project is particularly important because the control system must provide the project manager with information on the progress of the project at any time. There must be development and implementation of all stages of the project, from the project study (planning and budgeting), to the establishment of a project control team, monitoring and management of the construction, collection and management of the project.

At the same time, given that the construction industry has undergone significant changes related to the business environment and internal organization, according to P.R.C. Marchesan and C.T. Formoso requires new cost management information, anticipating new perception, understanding and support for the management of complex manufacturing processes[lxxxiii].

It is necessary to take into account that controlling external and internal uncertainty is considered a major part of any construction project[lxxxiv]. This means that an important requirement for effective control and management of the construction project is the availability information on both the external environment and the internal environment of the project / 1.1.4 /. It is obvious that the data that is internal and external to the project must be taken into account. In addition, the internal environment information is related to the initial purpose of the project, scheduled timetables, budgeting costs, quality completion, changes during construction, personnel, equipment, and available materials. As far as the external environment information is concerned, it includes the cost of purchasing materials (orders), taxation, conditions (time, topography, household, etc.), time for order delivery.

The issue of information as a source of control information is addressed in the scientific work of some foreign and Bulgarian authors. There is a perception that information is treated as collected, processed and distributed data[lxxxv]. Similar is the opinion of I. Sakarev. According to him, the information is collected, processed and commanded information[lxxxvi]. In our opinion, the information represents a set of knowledge and information about the state of the construction site, the surrounding environment and the processes in it.

In the context of the above, it is particularly important to clarify the essence of the main components of the information. In the research, different qualitative aspects of the information are considered, with the authors' assessment of some of them approaching. Al. Polcovnicov[lxxxvii] points out timely, purposeful and convenient form as the main components of the information. G. Aretoulis, Manitsaris and I. Mavridis[lxxxviii] believe that the characteristics of the information are limited to accuracy, accessibility and timeliness.

In the Bulgarian scientific literature, too, attention is paid to this issue. There are some differences in the qualities of the information. Some authors reduce them to timeliness, accuracy, accuracy, and cost-effectiveness for receiving the information[lxxxix].Other authors concretize them to credibility, accuracy, completeness, relevance, comparability, accessibility and economy[xc].

Based on highlighted information components and above opinions we believe that the information components as a source for control reports of construction project can be reviewed as follows:

Credibility /Reliability. The information credibility can be considered as real data and reports information. Regarding this characteristics some authors point that information should be real and without distortions to reflect the state of studied object[xci], which is a prerequisite for taking right management decisions and exercising effective control. At the same time, for effective control realization process, building construction managers need constant access to reliable information.

Accessibility. The information accessibility stems of possibility for correct perception. Accessibility is reviewed by some authors as information ability to be understandable and having acceptable type for the subject intended to and presented to a user-comfortable medium[xcii].Also the information accessibility to the project manager at all construction stages, is assisted by the information timeliness, i.e. it is accessible as necessary and is not "older" due to delay. Continued access to correct information, reasonable use and processing for decision-making process can contribute positive to business competitiveness. Monitoring the information flow in construction work at construction site has vital meaning for timely and successful completion of construction works. For its part, construction projects effective management is based on adequate access and information control[xciii]. Decisions regarding the path followed at the project to reach its ultimate goal require information to be collected, analyzed and reviewed continuously during the project[xciv].

Actuality. The actuality (up-to-date) information represents new and updated (up-to-date) information.

Timeliness. Timeliness means providing and having necessary information regarding control of construction project at the particular time point.

Completeness. The information completeness should be seen as providing necessary and sufficient conditions for decision-making process[xcv]. In this sense, the information completeness provides the consumer with all data and report information that should be available considering the specific situation.

Form. The form as a information distinctive feature can be reviewed as appropriate way / ability to presentation (for example quantitative or qualitative, graphic/charts or tables, etc.).

Origin. Origin is the source of information delivered (acquired). Concerning this, the information used by the construction project managers is internal and external.

As evident of above information components, it is important prerequisite for construction project management and project progress control process. Effective project management is based on availability of accurate information at the right time. The available information should have possibilities for control actions. I.Sakarev emphasizes that completeness and accuracy of operational information regarding actual construction course depends on the periodicity of its entry, the way it is processed and quality and completeness of the calendar schedule model[xcvi].

In the scientific literature, cost management information has special attention. Furthermore it’s clear from above that one of important components of information as

a source for control reports at construction projects is cost-effectiveness of the construction.

It's necessary to note that during project implementation, the needs for information about construction site are organized in basic categories, one of them is cost management. This complex character requires integrated approach to management[xcvii].

In order to have full perception for cost control at construction site, information is necessary for significant number of projects, not just those as variations of different input data.

They are collected, processed and printed in the report form in quantitative terms. The cost control system should be analyzed as part of a written report by the project manager or the construction manager, making their own personal assessments about activities at construction site that might be related to this cost report. There is a possibility for unusual events by managers at the bottom of project manager hierarchy. Cost statements should be linked to total progress reports, in particular linked to predefined plan and timetable[xcviii].

At the same time, in our view information about construction project progress control helps taking right decisions for overall effective project realization and also taking corrective actions if necessary. In addition, the information from the implementation of the project calendar, weekly and monthly progress reports on the implementation of the construction project makes it possible to compare the objectives set with the results of the program and to identify potential problems[xcix]. At the same time, we believe that timely reports are absolutely necessary for adequate and effective control. It is necessary to provide all relevant information so that corrective actions can be carried out in time.

The degree of awareness of building control bodies in our opinion has a significant impact on their effective management. In this regard, it is necessary to bear in mind that in each construction project data on the costs generated from the outset are constantly evolving during the design, construction and consistent exploitation phase of the project. Much of the data presented in the early stages of the project is useful for the next stage[c]. Each scientific field produces its own information and exchanges it, regardless of the other participants in the project[ci].

Thamhain and Wilemon[cii] argue that successful communication between working groups is the third most important factor for the success of a project. Therefore, there is a clear need for an information system that provides a timely and reliable way for all project participants to use the subject matter of the information while providing the necessary basis for all communications. At the same time, much of the cost information is collected in one place. This information may hinder the development and evolution of the price parameter. In addition to collecting and storing this information, a standard classification method is also required where the available information will be presented and processed[ciii].

3. Conclusions

When a construction projects become a collective effort of scientists, constructors, engineers, subcontractors and suppliers, only then the best possible outcome can be assured, in terms of time, cost and the quality of the project. Management of construction projects constitutes modern handling methods that aim to control time, cost-effectiveness and the quality of an undertaken project at all stages during its development. Such goals are hard to achieve. Controlled

management during the design and the construction progress of the project at all stages, is the key for positive results. Aiming for quality, time and cost-effectiveness, are the three key elements that need to be kept in balance and be fulfilled concurrently.

Regardless the differences met in the definition of the stages involved in the controlled management prosses of a construction project, the main stages for supervised control are the monitoring of the progress, analysis and evaluation of the situation, followed by corrective actions. The controlled management system of the construction projects can be presumed as a monitoring mechanism over the progress of the project and aims to avoid deviation from the stablished technical specifications.

Nevertheless, for achieving the objectives, most important component is the selection of personnel that will conduct the project management prosses.

The project administrator mast be able to adapt to the various money resources and funding available each time and the consequences of using either alternative. The relationship between time and money should also be considered of prime importance.

It is necessary for each project manager to monitor and control the costs at the entire project. Follows to be possible to estimate the impact by any deviations of planned construction process and actions that should be taken in order to create a predetermined performance in case of deviation. Should be able to understand the advantages and disadvantages of accelerating the program in terms of costs and other resources.

Summarizing the cited authors opinions, can be concluded that the appropriate organizational structure, respectively choice of management and control bodies for the construction project is the most important condition and necessary to ensure successful project control and realization.

It is made clear that a successful controlled management system requires essential information that will eventually feed back into the effective materialization of the construction project.

The essence of successful project cost management depends on the ability, based on the state of the project at a given time, to assess the tendency and effect on the duration of the project and the final cost. Procedures, administrative and economic controls that have been adopted will need to be signed by a contract to provide data on the work done, and may be related to the physical state of the project at that time.

It is assumed that administrative measures are such that input data on the value of the work done can be given by providing a direct reference to the place of work, and then that assessment will be available as soon as possible. This is the circumstance mentioned above as the speed of the reaction. There is no doubt that the earlier, the issue of cost control and reporting, the more important it is for staff to act on the basis of the information.

Generally, on the basis of the sources examined, it can be concluded that the knowledge of the components of the information can contribute significantly to the formation of a correct strategic view and to the determination of adequate management decisions for the effective control of the execution of the construction project.

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