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Construction project monitoring

Author:

Mirko Orešković,PhD. CE
Investinženjering d.o.o., Zagreb
mirko.oreskovic@gin.hr

Subject review

Mirko Orešković

Construction project monitoring

Monitoring has not so far been recognised in Croatian construction practice and, hence, it has neither been introduced nor used as a basic component of construction project management. This situation is the consequence of the approach currently adopted in the study and scientific research of the construction project management phenomenon, which is viewed as a system of management of the cause and effect related activities of planning, design, procurement, realisation, equipment, supervision, reporting, project decision-making and, finally, handover of project outcomes. The need to introduce independent project monitoring functions is exposed in the paper, and the influence of high-quality monitoring on successful achievement of construction project results is explained.

Key words:
construction project, project management, monitoring, planning, project objectives, risks, project inspection, decisions

Pregledni rad

Mirko Orešković

Monitoring graditeljskog projekta

U hrvatskoj graditeljskoj praksi monitoring nije ni prepoznat niti uveden i korišten kao temeljna komponenta uspješnog upravljanja graditeljskim i građevinskim projektom. Zatečeno stanje posljedica je prisutnog pristupa u izučavanju i znanstvenom istraživanju fenomena upravljanja graditeljskim projektom kao sustava upravljanja uzročno i posljedično povezanim projektnim aktivnostima planiranja, projektiranja, nabave, izvođenja, opremanja, nadzora, izvještavanja, projektnog odlučivanja i na kraju preuzimanja rezultata projekta. U radu se obrazlaže potreba uvođenja neovisne projektne funkcije monitoringa i pokazuje utjecaj kvalitetnog monitoringa na uspješnost rezultata graditeljskog projekta.

Ključne riječi:
graditeljski projekt, upravljanje projektom, monitoring, planiranje, projektni ciljevi, rizici, kontrola projekta, odluke

Übersichtsarbeit

Mirko Orešković

Überwachung von Bauprojekten

In der kroatischen Baupraxis wurde die Überwachung weder anerkannt, noch eingeführt, noch als grundlegender Bestandteil eines erfolgreichen Managements des Baus und der Bauprojekte angewendet. Der aktuelle Stand ist die Folge des gegenwärtigen Ansatzes bei der Erforschung und wissenschaftlichen Untersuchung des Phänomens des Managements von Bauprojekten als Managementsystem, das kausal und folglich mit den Projektaktivitäten der Planung, Projektierung, Beschaffung, Ausführung, Ausrüstung, Überwachung, Berichterstattung, Projektentscheidung und am Ende der Übernahme der Projektergebnisse verbunden ist. In der Abhandlung wird die Notwendigkeit der Einführung einer unabhängigen Projektfunktion der Überwachung erklärt und sie zeigt die Auswirkungen einer qualitativ hochwertigen Überwachung auf den Erfolg der Ergebnisse des Bauprojektes.

Schlüsselwörter:
Bauprojekt, Projektmanagement, Überwachung, Planung, Projektziele, Risiken, Projektkontrolle, Entscheidungen

1. Introduction

A long time ago, I read in a newspaper a message concerning a country that will not be explicitly named here, and this message, if I remember correctly, read more or less like this: *It would be much better if the EU monitoring still remained present in the everyday political, social and economic practice.*

And then I asked myself, and I am still pondering on this issue, whether the author of this message was really aware of the meaning of the word monitoring. Particularly as this word is so often used in situations and at places where it certainly does not belong. In fact, the word monitoring covers the activity of an institution and/or person, which is aimed at determining a real state of some natural phenomena, or the state of progress of a special human endeavour in real time. Thus we can talk about monitoring of water level variations, weather changes, migration of birds of passage, human right issues, people and animal migrations, etc. The list could go on and on and still would not cover all aspects of life manifestations that are or should be the subject of monitoring. When establishing any kind of monitoring system, we have to articulate quite clearly where and why are we establishing the monitoring, and what tasks will the system have during implementation of its activities. In other words, what results do we expect from monitoring, in what density, and at what level of reliability. This is especially important in case of construction projects with a large number of participants, a large variety of tasks and, sometimes, with conflicting interests. The use of monitoring in the implementation of construction projects in Croatia can not practically be perceived as an organised, independent project function, established within a project management team, with precise tasks and defined expectations.

However, this weakness can not be regarded as inherent in Croatian construction practice only because, all too often, the monitoring is simply omitted from or at least neglected in the literature dealing with construction project management [1-20]. This paper is not intended to answer the question of why is monitoring insufficiently recognised in our construction practice as a function that provides for a realistic information about the actual situation on the projects, but rather the objective of the paper is to explore the construction project monitoring activity as it should be.

2. Purpose of construction project management

To be able to understand the indisputability of the request for realization of a project through an adequate project organisation, we must comprehend the extreme complexity of a construction project which is characterized by:

- considerable price of investment;
- numerous and highly varied participants that (for the most part) have not cooperated on any earlier project and are included in the realisation of the project at various time intervals. Project participants are: investor, beneficiary of project results, public administration, financing institutions, insurers, architects, structural engineers, installation experts, contractor's companies, supervising engineers, etc.;
- project structure is defined separately for each particular project;
- long useful life and high significance of project results (building);
- defined objectives, scope and content of results, defined start and end, limited financing, specific quality requirements;
- one-time endeavours;
- specific project (temporary) organisation;
- complexity of relationships between participants in the project;
- indispensability of interdisciplinary cooperation in shaping objectives and achieving project results;
- uncertainty as to fulfilment of initial project implementation conditions and the related risks, from project idea shaping to project results [2].

The above characterisation of construction projects enables us to deduce quite easily the very purpose of construction project management. To enable development of a construction project that is at the same time purposeful, reasonable, effective, and compliant with goals and limitations set for the project, it is necessary to establish an organisational model that will be capable of meeting the recognized, unavoidable and sometimes unpredictable project requirements. All this in order to achieve expected objectives through a properly managed implementation of a construction project, i.e. to ensure that construction project results are compliant with expectations of the owner and other project stakeholders.

One of primary functions of construction project management is planning as it enable, before anything else, establishment of relationships between project team members, and definition of a well balanced duration of individual activities on the project. "Planning is undoubtedly an important project function, with extreme short-tem and long-term effects on the reasonable, well-balanced and expected project development.

Project planning starts after establishment of the project team nucleus, i.e. already at the first stage of project development (FOPI) when, during analysis of the initial project idea, a basic project plan (OPP) is established in order to determine basic planning guidelines that will define general project development trends in line with expected and/or assumed limitations" [2]. Even at this very first stage of construction project planning, it is very important to take into account requirements that will be set with regard to the construction project monitoring activity.

This means that, when creating higher level project plans, it is important to clearly establish measurable values on the basis of which the monitoring activity will be able to form an optimum and objective relationship between the current and planned situation on a construction project, within either a programmed or exceptional framework. Because the purpose of construction project management is to take actions - based on project plan, current situation on the project, current trends, expected or existing project changes and/or disturbances - in order to keep project development within tolerable limits that are defined by basic objectives of a construction project: quality, cost and time (readers are advised to read [1]), and hence to realise an acceptable construction-project result.

Such construction project result is the resultant of the success obtained in the realisation of project objectives, which is also measured through "client satisfaction" [16].

3. Significance of monitoring during risk management on construction projects

The risks that are or that can be present in the realisation of a construction project have been the subject of numerous scientific studies, research result presentations, symposiums, papers and books written by various authors. Only some of these efforts, i.e. those that also consider the monitoring activity, are mentioned in this paper [3, 6, 7, 25, 26, 27].

Construction project risks are basically related to uncertainties in the realisation of project objectives that are related to the activity within the project team and to influences generated outside of the project team. This means that we have to identify, at the very beginning of a construction project, all potential risks that might occur during realisation of such construction project and also to anticipate, through the framework of risk management, the measures to be taken in order to prevent realisation of risks and, should a risk actually occur, to minimise consequences of realisation of such project risk.

In order to have, on a construction project, an adequate information about the actual progress on the project, as well as the information about imminent risks threatening realisation of the project, we have to establish an appropriate project progress monitoring system that will take into account initial project assumptions and their relationship with the actual progress on the project and its environment which generates permanent "lines of force" of project risks and project opportunities.

"When an investor initially approves project requirements, he does not really know what he is going to get, simply because his understanding about the product is at that moment in time quite abstract. As the project advances, the product becomes more palpable and concrete, the investor has a much clearer notion about what he is going to get and he, at that time, has a firm basis for requesting adjustments" [6].

The uncertainty in planning individual elements of the project is directly related to the maximum realistic estimation of realisation of a project risk that can, through its occurrence, affect the project objective in the sense of either the quality and/or cost and/or time.

Without intending to plunge any further into the discussion about risks as such, and especially not about the project circumstances, I have to emphasize at this point the need to clearly and unambiguously identify possible risks already at the very beginning of a construction project, and to establish an efficient control of processes in which such risks are likely to occur. All this in accordance with the basic universally known saying "prevention is better than cure". And here the influence of monitoring is of immeasurable significance.

4. Project management triangle

Three fundamental project functions must clearly be differentiated in the management part of the team that has to bear full responsibility for the successful management of a construction project:

- planning,
- monitoring,
- control.

The basic organisation chart of project functions involving planning (PP), monitoring (PMo) and control (PC) within the scope of the project (PP) [2].

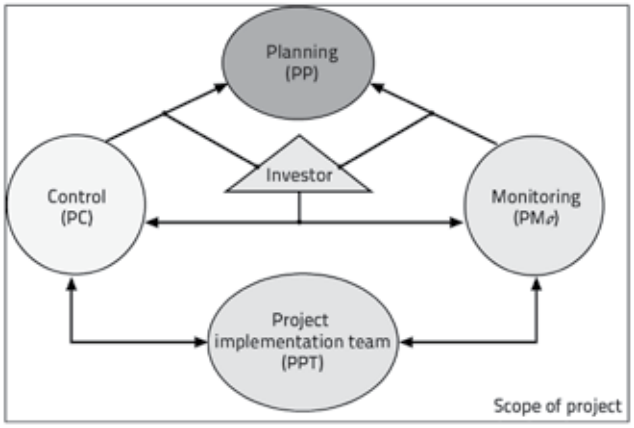

Figure 1. Basic organisation chart of project functions [2]

Without entering into a more detailed discussion about the triangle of management function on construction projects (reader is referred to [[2]), I would like to place an emphasis on the message conveyed in Figure 1.

In the interior of the triangle, whose peaks are the planning, monitoring and control of a construction project, we have the construction project investor. Depending on the author and the choice of title, the investor can often be referred to as the contracting authority or the client, although perhaps it would be advisable to use the term "project owner". However, at that we enter into the trap formed by the dynamism of project development where the entrepreneur is quite often recognised as project owner who sells the construction project result to third parties. This topic could also be discussed in a much greater detail, but it is outside of the scope of this narrowly targeted paper.

5. Project monitoring

In its general sense, the term monitoring is very widely used on a daily basis on both national and international levels. It denotes distinct functions that have been defined for the purpose of supervising some events (either of political, social or technical nature) and for reporting the results of such supervision or inspection to the institutions that have formed or engaged a monitoring entity [2]. In technical disciplines, the term monitoring is very often used in case when it is necessary to record and register the events that can be measure or unambiguously described, such as the events specified in [2]:

- level of watercourses,
- drinking water spring yield,
- precipitation level,
- potential landslide behaviour,
- behaviour of structures,
- pollution level for air, soil, etc.

In our construction project management practice, regarding either civil engineering or building applications, the establishment

of any form of monitoring activity is not a prevailing fact. What can be cited as Croatian experience, albeit based on individual rather than overall information, is the fact that the monitoring function is established at the stage of forced development of a construction project, and this always outside of the project management team. This is especially valid for projects co-financed through EU funds. Figure 2 [2] shows possible positioning of the monitoring function with respect to project team on construction projects.

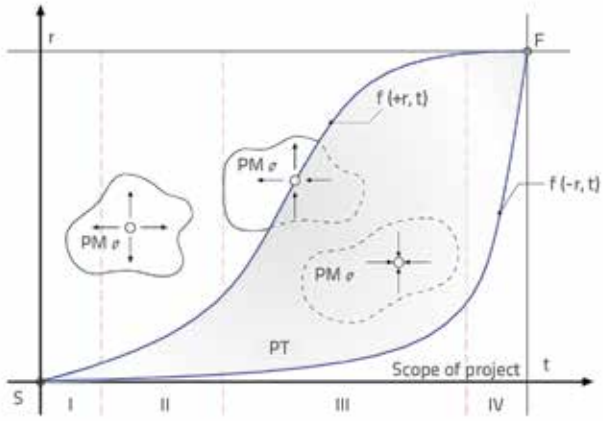

Figure 2. Relationship between monitoring and project team [2]

The monitoring activity, as an unavoidable construction project management function, can be organisationally positioned within, at the periphery, and outside of the project team. Readers interested in this topic can find further information in [2].

5.1. Objective of monitoring activity

In order to understand and accept the necessity of establishing an independent monitoring function, we have to start by considering the objective that actually shapes the organisation of monitoring activity on a construction project. Construction project management is the activity that is aimed at keeping development of a construction project within planned constraints while at the same time aiming at maximum fulfilment of project requirements. To enable the construction project controlling authority to make project development decisions, it has to have at every moment an updated information about the progress of activities on the project, about conditions in which these activities are realised, and about possible or real occurrence of project changes and/or disturbances. All this of course must involve comparison between the planned progress of project activities and project events on the one side, and the actual situation on the project on the other.

In essence, and in order to enable successful development of a construction project, this controlling activity must not come as a reaction to possible project deviations such as changes or disturbances, but rather it should come, before everything else, as anticipation of project trends. This anticipation of project development is an unavoidable activity in the control of the project, i.e. it must be the basis for making project-related decisions. The objective of monitoring activity on construction projects can be basically defined by the need to control the project but it can also be - in case monitoring is established at the periphery or outside of the project team - the basis for changing relationships between the project team and project sponsors and/or interest groups.

The above discussion clearly demonstrates that the objective of monitoring activity on construction projects is the firm establishment of a continuous, objective, and non-selective relationship between the planned and actual project activities and events, i.e. between the planned and actual project trends.

5.2. Possible forms of monitoring

The monitoring activity on construction projects, as a function established through project organisation, has been considered, based on various approaches and interests, by numerous authors. At this point, I am citing just some of them that might be of interest to the reader of this paper: [2, 8, 13, 15, 19-21, 25, 27]. Although, when discussing possible forms of monitoring, we find ourselves in the realm of convention, it is nevertheless necessary – in order to define conditions for establishing monitoring on construction projects – to make distinction between various forms of monitoring. At that, we are not considering actual place of monitoring with respect to the project team, but rather the "visible" or partly or fully "hidden" activity that vaguely leads the observer to the conclusion that we are in fact dealing with monitoring on construction projects.

The form of monitoring to be applied on construction projects depends on the understanding on its role and objective through which it is either established or not established as an independent project function. In fact, the form of monitoring is directly dependent on the level of the investor's acceptance of requirements regarding the planning, monitoring and control of the construction project, which is reflected on the organisation of management activity on the project. According to [2] and based on recent developments, the form of monitoring to be applied on a construction project is dependent on:

- scope of project,
- investor's interest to make use of an appropriate project organisation,
- investor's resources, i.e. availability of project resources within the hierarchical organisation,
- general understanding of the monitoring function, its objective and tasks to be accomplished,
- influence of project participants on the organisation of a particular construction project,
- influence of project sponsor on the organisation of a particular construction project.

In cases where the monitoring is organised within the project management triangle as an independent function, with all features that define organisational and operative position of monitoring team members with respect to the management and implementation team on the project, the following two forms of monitoring can be differentiated:

- explicit monitoring on a construction project [2],
- implicit monitoring on a construction project.

Explicit monitoring on construction projects

As a rule, the explicit monitoring should be established at the beginning of the initial stage of project development, i.e. at the stage in which the project idea is being shaped or formulated. At this stage, the monitoring team closely cooperates with the project planning team so that optimum conditions for independent, efficient and cogent monitoring can be ensured in subsequent stages of project development.The term direct monitoring is also sometimes used instead of explicit monitoring in literature. In any case, it can always be affirmed for this type of monitoring that it is very visibly present of the project, that it is independent from any other project function, and that the monitoring team gains from the project objective, confidential and actual data and information, and returns to the project the information that constitutes the basis for project management. If monitoring formally does not appear as a recognisable and independent project management function, but is realised through other project management functions [2], then we have:

Implicit monitoring on construction projects

In this case, we can not realistically state that an instrument of monitoring actually exists on the construction project, simply because organisational preconditions indispensable for establishment of the monitoring function do not exist, and hence the term is used only conditionally to give a name to a project behaviour that is not compatible with the basic culture of a project management system. In fact, the term "implicit monitoring" covers the area of activity of various project functions which, by the way, do realise in practice some monitoring activities on construction projects. However, this is done without powers that must be attributed to ensure a truly independent monitoring. In this way, the data and information that arrive to the project control team and/or are submitted to interest groups and other project participants, bear the burden of the source of data, i.e. of the information provider.

To put it simply, this means that it can realistically be expected that the project function/entity that performs some explicit monitoring tasks in addition to its primary duties, is bound to use a subjective and selective approach in the distribution of data and information, i.e. such function or entity will attempt to adjust the information to its own particular interests. If it were not for such fragmentation of activities, the implicit monitoring could also be named as a pseudo-monitoring. It is clearly stated in [2] that in the case of implicit monitoring "the project team does not include the specifically appointed monitoring team members who are familiar with the monitoring to be conducted, and who are at the same time sufficiently separated from the rest of the project team". Without having illusions that the construction project management practice will change in the near future in Croatia, I nevertheless wish to point out here that the explicit monitoring is an institution or instrument that has to be understood, accepted and organisationally very clearly and distinctly positioned when shaping the construction project management triangle. Without that we will still have construction projects, both in public and private sectors, that are managed from time to time, based on a mere impression that is all to often very far away from the real project implementation situation and from realistic conditions in which a construction project should be realised. Taking this into account, whenever the term monitoring is mentioned in the remaining part of the paper, this term will specifically refer to explicit monitoring only.

5.3. Monitoring task

The monitoring task on a construction project arises from the objective that is defined as a request for the delivery of a timely, confidential, correct and objective information about the actual progress on the construction project and about the trends observed as to development of the project. In order to gain a realistic and true insight into the actual progress on a construction project within a given time frame, we must have at our disposal a reference basis with which we can compare the current progress of activities and events on the project. This means that, at the very beginning, a good quality time and cost schedule must be developed, i.e. an integral programme of the construction project must be put in place, as basis for the continuous and final evaluation of the success achieved on the project. In addition to the quality, time and cost requirements, the project programme must also contain requirements with regard to project monitoring activities, including also the tasks and assignments that are individually given to the monitoring team on a construction project. Monitoring activity on construction projects is "the field of activity in which attempts are made, through supervision, recording and reporting, to monitor the level of achievement of a goal or goals with respect to the planned or expected values [21].

Monitoring activity operated within the project team enables achievement of an objectivised relationship between the planning and control on a project. "Monitoring entity is required to record and report actual situation on the project as related to planned values" [2]. According to the author's experience and the results obtained during previous studies [19], the tasks of the monitoring team on construction projects are:

- permanent monitoring of progress on a construction project, using tools and processes that are specified in the construction project programme,
- thorough and continuous recording of phenomena that are of importance to the actual situation on the project, with reference to the planned project activities, their intensity and quality, and influence on project costs,
- prompt and regular reporting on the recorded progress on the project within the predefined or specially requested time frame,
- special attention must be paid to the situation regarding project discipline within the project team,
- registering (possible) occurrences of project influences (positive and negative) coming from project environment,
- registering possible occurrences and/or present trends that might give rise to conflicts between the project team and project environment,
- timely registration of possible occurrence of trends that might generate or be the basis of a project change,
- timely registration of possible occurrence of trends that might generate or be the basis of a project disturbance,

- urgent reporting about possible occurrence of processes that jeopardize project results.

The task of monitoring on a construction project is not and can not be reduced to mere recording of historic facts regarding realisation of the project, but is and must be to anticipation of project trends, all based on relationship between the planned, possible and existing project development trends. Monitoring is and must be the basic lever through which the project control entity manages the construction project.

5.4. Monitoring team dimensioning

When defining programme for a project, the project control entity, i.e. the construction project manager, has to clearly and accurately analyse the continuity of monitoring tasks and define, based on this analysis, time frames in which monitoring team will perform its activity on a construction project, Figure 3. This means that at the time the project development is planned, project manager has to anticipate the moment in which the monitoring function will be activated and ended, and the time intervals in which the monitoring team will be increased or reduced. The control entity must understand the need for establishment of the monitoring team, i.e. it must accept the request that the monitoring team has to professionally respond to the need to inform - in a timely, accurate and confidential manner - the control entity and other users of such information about the actual progress of the project and about trends observed with regard to development of the construction project.

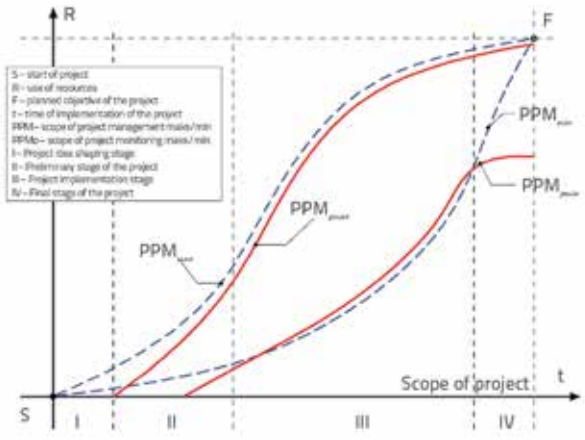

Figure 3. Dimensioning of monitoring team [2]

Related to the above discussion and without entering into specifics, it should be noted that, when establishing the monitoring team, care must be taken about the tasks to be allocated to the monitoring team and, in this respect, that the team should be dimensioned by recruiting and releasing experts as appropriate throughout the realisation of the construction project. Supervising engineers must not and can not have an imminent monitoring task, as this is contrary to the basic objective of monitoring activity.

5.5. Relationship between the monitoring team and project management

The relationship between the project control and project monitoring is defined through the scope of activity as presented in Figure 3. The scope of the project (the scope of activity on the project) is defined by the planned/realized time of project implementation (abscissa) and the planned/realised consumption of resources (ordinate).

"The project management or project control represents the scope of activity in which predefined objective or objectives are to be accomplished using appropriate tools, knowledge, and skills, while minimising consumption of available resources. The intensity of project management activity is dependent on the extent of the use of resources in a unit of time. It is evident from definition of the scope of project, project management and project monitoring, that the project objective initially imposes the use of the project management and project monitoring functions, regardless of their possible specific relationships" [2].

To enable proper understanding of the relationship between the project control entity (often referred to in literature as "project management") and monitoring, it is important to understand that the role of monitoring is to provide support to project management while at the same time being independent in its activity from the project management. Although it seems quite impossible at the first glance, it can in reality be achieved by separation of tasks. Monitoring team provides to project management the information about current project trends and, on that basis, project management conducts project analysis and makes decisions about further development of the construction project. This means that the task of monitoring team is not to propose measures, procedures and decisions, but only to provide the data and information to the project management as a basis for further action. Thus, on the one side, the monitoring team is required to harmonise its activity with the project time schedule and project quality requirements and, on the other side, to react, first and foremost, to the project trends it has registered. In this way, it liberates project management from routine tasks of comparing planned and realized progress on the project, and so the project management can concentrate on direct management of project variations, i.e. on making timely and encouraging project decisions.

5.6. Relationship between the monitoring team and the project planning function

The relationship between the monitoring team and the project planning function is established on the basis of main planning documents for construction projects. In fact, the planning and monitoring are the functions that are related by having the same subject of interest. Monitoring establishes a permanent relationship toward time plans, quality plans and cost plan, which are all created by the planning function at the beginning of the project. Simultaneously with the conceptualisation and preliminary verification of plan

values and their relationships, the planning function has to provide to monitoring a clear and unambiguous possibility to rely on actual planning requirements throughout the development of the project. This means that the planning and monitoring activities are interdependent.
The planning defines the time of occurrence of activities and events, while monitoring determines the actual relationship between the planned and actual situation on the project. The relationship between the plan and current situation advises the planning function about the possibility of confirming fidelity of planned values or about the questioning and estimating viability of initial planning parameters which might, as a last resort, lead to the request for revising the existing plans. The request for the revision of existing plans is made by the project management, and the role of monitoring is to bring the attention to the current situation on the project. The success in cooperation between the monitoring function and planning function is directly dependent on the cooperation at the initial stage of the project and on mutual appreciation throughout the implementation of the construction project.

5.7. Relationship between the monitoring team and the project implementation team

Although monitoring is an independent function on a project, this fact has never been sufficiently emphasized. In addition, this function must be permanently present on the project. However, its role is not to "breathe down the neck" of the project implementation team but, without disturbing the work of the project implementation team members in their daily activities, the monitoring function observes project phenomena/events and informs the project management about such occurrences.
The role of the monitoring team is not to question members of the project implementation team about the way they work or perform their duties, but rather the monitoring team must not disturb project implementation team members in their activities, and is required to inform the project management – through daily monitoring of activities on the project - about the trends in the development of the construction project. Monitoring does not have and can not assume the role of advisor to the project implementation team, i.e. the monitoring team have to be "invisibly" present on the project and this in such a way to be able to procure to the project management optimum construction project management conditions. At that, it is especially significant for the monitoring team members to establish a proper relationship with the project implementation team members that has to be based on mutual trust and reciprocity, as the role of the monitoring team is, *inter alia*, to encourage – through the result of its activity – development of qualitative relationships among the project implementation team members, based on information thati is truthful, reliable and confidential.

5.8. Influence of monitoring on project success

The issue of the influence of monitoring activity on the success of implementation of construction projects is explicitly analysed in [19], where the author examines the success achieved in the management of risks that are related to three basic goals of construction projects: quality, cost, and time. It was proven in the paper that the successful monitoring is the one that has been established as an independent project function.
According to its tasks as determined in the project development programme, the monitoring activity on construction projects can not and must no act directly on the success of the project. This means that it must not directly influence the direction in which project activities will be carried out.
Based on the permanent monitoring of the project development, recognition of possible or present project development trends, the monitoring team timely submits to the project management the data, and less often the information, on actual progress of activities on a construction project. The project management uses such data/information to perform necessary analyses of project tendencies. Based on promptly realised analyses, the project management will be in position to make timely and relevant project-related decisions. This is a precondition for successful realisation of a project. This successful realisation is the result of the activity made through independent integral monitoring in the scope of the project team.
All other forms of monitoring realised outside or at the periphery of the project team (presented in detail in [2, 19]) are a direct consequence of requests of particular interest groups that are outside of the construction project team.

5.9. Responsibilities of monitoring team

Responsibilities of the monitoring team on construction projects can be derived from the tasks to be completed by the monitoring team according to the project development program. These tasks are: permanent monitoring, recording, and reporting on the development/progress of activities on a construction project.
Responsibilities of the monitoring team on construction projects can taxatively be recognised as a required system of behaviour in which the monitoring team members have to:

- continuously monitor the progress of activities on a construction project,
- recognise project signals pointing to a possible change in trends as compared to planned trends,
- identify presently hardly noticeable albeit present changes in trends of project implementation activities,
- unambiguously identify any indication of possible project-related changes,
- permanently record, in an appropriate time frame, the progress of project activities as compared to scheduled progress,
- continuously advise the project management about the current progress in the realisation of the project.

The above mentioned responsibility is related to the explicit monitoring [2] that has to be established as a part of the project management team, i.e. as one of the peaks of the construction project management triangle (planning – control – monitoring).

6. BIM and monitoring

"The term BIM does not have a single definition, and is interpreted in a variety of ways. It concerns processes and technology rather than the software or "intelligent simulation of architecture", where architecture denotes all segments of construction industry or civil engineering" [12].

In the ECES (European Council of Engineering Chambers) Statement on Building Information Modelling – BIM [6], it is stated in the English original published in 2018 (ECEC AISBL Coudenberg 70, B-1000 Bruxelles): "Digitalisation is one of the most important future topics for the building sector. Digital data processing supports engineers planning and designing since more than three decades. Due to the fast modernization of the utilized software, planning has changed a lot during that time. The term planning includes all design activities.

Building Information Modelling (BIM) is a cooperative working method that comprehensively captures and administers information that is relevant for the life-cycle of a building and allows the transparent communication and information transfer between all persons involved in the process.

BIM is a result of the ability to process large amounts of information. It allows moving from the analysis of individual transactions to the analysis of their impact on each other. BIM works with a complex structured database. It offers the possibility to expand digital planning and include the cost and time dimensions. Main advantage of BIM application at the construction stage is the possibility of variant development of organizational and technological solutions to reduce construction costs and eliminate space-time conflicts" [6].

Where is here the position of the construction project monitoring activity? It is not specified. The reason for that is that the authors of the cited document were focused on BIM as a tool that supports and directly enables automatic coordination of project-related activities, and hence ensures realisation of expected results on the project. These are the assumptions justifying the use of BIM technology in the planning and implementation of construction projects and, what is of even greater importance, in the process of using construction project results.

While not entering into the study of BIM used in the monitoring process on international construction projects, here we have to take into account the limitation imposed by Croatian experience, which is non-existent.

In addition to a number of pertinent questions that should be dealt with already at the very beginning of analysis of the influence of BIM on the monitoring process, we must first of all accept the fact that the implementation of independent monitoring on construction projects in Croatia is at its very (theoretical) beginnings, so that for now it remains to be seen how BIM will assist monitoring and vice versa.

We can only speculate as to how will monitoring be using future advances in BIM technology on construction projects, and in what way will the planning of construction projects benefit from such a tool that will, on the one side, enable direct response to the requirements of a particular projects and, on the other hand, create the basis for instant comparison of the current progress of project activities with their scheduled intensity and result.

"Very few useful data have so far been published on the real costs of using BIM on construction projects, i.e. on the costs that would include all relevant BIM implementation expenses" [18].

Nevertheless, a new profession has emerged: BIM Manager. Unfortunately, there is no school in Croatia that would educate such experts, i.e. the education process for this profession has not so far been regulated. BIM managers "have a significant role in dealing with construction projects – from estimation of cost and time needed for BIM implementation, to recognition of the need to use specific BIM software, and to achievement of client satisfaction" [12].

Simultaneously, yet another new profession "Information Manager" has emerged. "Protocols such as the Construction Industry Council (CIC) BIM protocol, require appointment of information managers for setting up and managing the common data environment (CDE)" [12]. "BIM implementation requires a new 3-dimensional way of thinking. Old linear processes will be replaced by comparative ones. Project managers and BIM managers must think at least one step ahead so as to provide for the most efficient working environment for the entire project team" [5].

Presently, categories such as 4D, 5D, and 6D are considered, but this is outside of the scope of this paper. The implementation of BIM is at its very beginnings in Croatia's construction industry, and a lot of time might be needed for its widespread application. It is to be hoped that, over the next period, integrated efforts will be invested in the implementation of BIM as well as in the related organisation of monitoring activity on construction projects.

7. Conclusion

Monitoring has not been recognised in Croatian construction practice and, hence, it has neither been established nor used as a fundamental component of successful management of civil engineering and construction projects.

In projects co-financed through EU funds, some kind of monitoring has been put in place outside of the project team, the objective being to penalize lack of discipline (especially financial discipline) of the beneficiaries of EU funds. However, here also we do not have a properly established monitoring, but rather some sort of "makeshift" instruments are used for sporadic inspection of progress on such projects.

All this is done in order to protect the position of the financing institution, rather than to safeguard the interests of the project that is being financed.

The situation on the project is the result of the approach used in the understanding of the management system, especially in the light of scientific research in the sphere of construction project

management. Or, in other words, it is the result of management of project participants during implementation of planning, monitoring, and control activities.

When we are establishing a monitoring activity on a construction project, we have to know where and why this activity is being established, and what tasks are to be realized in the scope of such project monitoring function. First of all, we have to clearly set up requirements with regard to results to be expected from the monitoring activity, i.e. what will be the density of such activity, as well as the level of reliability.

For the time being, monitoring is nor recognised in our construction practice as a necessary function on the project. However, this is not the only ailment afflicting Croatia's construction practice. In fact, monitoring as a project function is all to often omitted from or at least neglected in literature dealing with management of construction and civil engineering projects.

The results are obvious: construction project management is all to often reduced to reaction rather than to anticipation, and the consequences are evident and registered. This issue is also insufficiently discussed and written about.

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