

ЗАГУБИ ПРИ РЕАЛИЗАЦИЈА НА ПРОЕКТИТЕ ЗА ПАТНАТА ИНФРАСТРУКТУРА ВО Р.С. МАКЕДОНИЈА

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Резиме: При реализација на проектите од патната инфраструктура настануваат загуби, т.н. „отпад“ кој се однесува, не само на материјалите и останатите ресурси, туку и на времето и другите елементи на проектот. Загубите резултираат со намалување на економичноста, ефикасноста и продуктивноста на трудот, а понекогаш имаат влијанија и врз квалитетот на проектниот производ-објектот. Резултат на тоа е проект со генерирани загуби, изразени како зголемени трошоци и поголема крајна цена на производот, што на крај ќе треба да се плати од страна на изведувачот и клиентот / инвеститорот. Согледано е дека најголем дел од проектите од патната инфраструктура кои се реализираат во нашата држава не завршуваат во предвидениот и договорен рок и дека кај многу проекти продолжувањето е еднаш а некогаш и повеќе од двапати.

Искуствата можат да послужат за намалување на трошоците и запазување на предвидениот буџет, намалување на оштетни побарувања заради доцнење и попрецизно дефинирање на потребниот период за завршување на проектите, односно, запазување на договорениот краен рок за завршување како значаен фактор кој влијае на зголемување на крајната цена за изведба. Во денешни услови кога има непредвидлив и огромен пораст на материјалите и услугите, многу е тешко тој пораст да се предвиди во краток временски период (во месеци), а уште помалку во подолг период (во години), тогаш проблемот со продолжување на рокот за изведба е многу поголем и поизразен.

Клучни зборови: градежни проекти, загуби, доцнење, краен рок

EXPERIENCES ON LOSSES DURING IMPLEMENTATION OF ROAD INFRASTRUCTURE PROJECTS IN REPUBLIC OF N. MACEDONIA

Abstract: During the implementation of the road infrastructure projects, losses occur, the so-called "waste" that refers not only to materials and other resources, but also to time and other elements of the project. Losses result in a reduction in the economy, efficiency and labor productivity, and sometimes have impacts on the quality of the project product-object. The result is a project with generated losses, expressed as increased costs and a higher final product price, which will ultimately have to be paid by the contractor and the client / employer. It has been observed that most of the road infrastructure projects that are implemented in our country are not completed within the specified and agreed time for completion and that on many projects the extension of time is once and sometimes more than twice.

Experiences can serve to reduce costs and preserve the anticipated budget, reduce claims due to delays and more precisely define the necessary period for completion of the projects, i.e. respecting the agreed time for completion as a significant factor affecting the increase of the final price for construction. In present conditions, when there is an unpredictable and huge increase of the materials and services, and it is very difficult to predict that increase in a short period of time (in months) and even less in a period (in years), the problem of extending the time for completion is much greater and more pronounced

Keywords: construction projects, losses, delay, deadline

1. INTRODUCTION

Researches in the world are showing that the losses in the construction industry, compared to other industries, are more noticeable and greater, which results in lagging in productivity regarding other industries [1, 2]. However, the number of new thesis and studies that analyze certain losses in construction is insignificant, especially when it comes to losses regarding the events in the world in recent years (the pandemic, the lack of qualified labor, the rise of the prices of materials and energy sources, the lack of energy sources etc.). On the other hand, increasing productivity requires lower losses of a different type, therefore considering that the majority of construction companies in R. N. Macedonia are small, only by reducing losses the productivity of construction companies can be increased, and thus their competitiveness on the domestic and foreign markets [3].

The intensive construction of road infrastructure projects in the country is evident in the last decade. Domestic and foreign companies are involved in the realization of these projects, and the management of the project execution, from the initial to the final phase of the life cycle is through planning, organizing, monitoring and controlling the process, with application of newer tools for modeling and planning (for example, using or introducing: BIM - Building Information Modeling, "OurPlan", "vPlanner", "Project Pro", etc.) [4]. But despite that, most projects are completed with delays and without retaining the originally foreseen plan program for construction which as a direct consequence has:

- Increase of the losses (different type and origin)
- Decreasing or raising of the project value
- Achieving smaller profit by all participants in the construction process
- Decreasing the planned benefits of the Employers
- Non fulfilling and non-observance of the Employer's planned strategies etc.

Taking into consideration the abovementioned, the goal of this study is to point the perceptions for losses connected with the delays during the construction of road infrastructure project in RN Macedonia, based on the actual experiences of the authors. The experiences are connected with: design documentation, the duration of the construction, the period for execution of the works on the projects, withdrawal of the planed working plan program, disrupting the deadlines for completion, exceeding the agreed financial means and other anomalies that recur at the construction projects in the country.

2. LOSSES DURING EXECUTION OF THE CONSTRUCTION PROJECTS

According Alarkon" everything is a loss, except the absolute minimal quantity of the material, equipment and manpower, necessary to supplement value to the product" [5]. Basically, all losses made by activities that generate direct or non - direct costs, but are not adding value to the product by the employer's point of view can be called "waste".

2.1 Losses in the construction projects

The losses in the construction mainly are identified as waste that occur during the project execution, which is a reason that often in the literature can be found as or the used term is "construction waste"[6]. It is pointed that many people in the industry believe that the losses are directly connected with waste that is removed from the location and transported in the landfills. The main reason for this relatively limited point of view on the waste as a loss, can be the fact that it can be relatively easy seen and measured. The main focus of this conventional studies for the construction material waste is limited on the physical waste or material waste during the construction and on the specific influences of the physical waste itself [7-9].

Basically it is assumed that in the civil engineering there is a high level of activity with added value and therefore, many times, it is very hard to measure all losses in the construction sector [2, 3].

According to the analyses for time losses in the production and in the construction industry [photo 1] it is concluded that the percentage of losses is drastically different depending on the fact for which industry is relating. The Construction Industry Institute in the Report for year 2004, gave an comparison of the lost time against the productive time in the production and in the construction industry. It was shown that 88% of the time in the production is productive (adding value), against 43% of the time spent in the construction industry. This report is showing that more than 50% of the time spent on Site is waste (without added value). The conclusion is that main attention should be dedicated on their decrease [10].

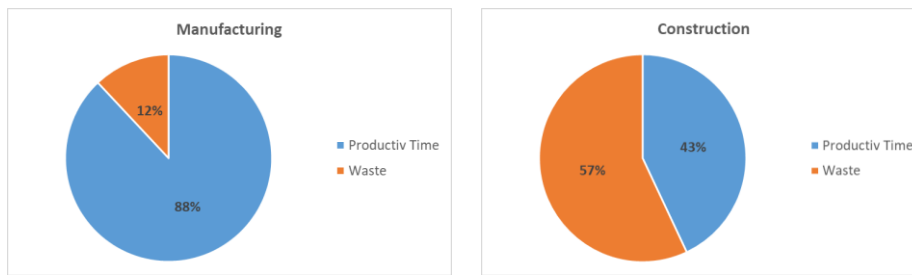


Photo 1: Percentages of losses in the Manufacturing and in Construction (Construction Industry Institute, 2004)

Based on the analysis of construction sites, the basic classification of losses is divided into nine groups: overproduction / production of quantities more than required or production executed earlier than required, replacement as financial (monetary) loss, waiting time, transportation, processing, inventory, movement, production of defective products etc. The reasons for occurrence of losses in construction are of a different type, both in our country and in the world, they are: waste in production, excessive production of non-wanted products, storage of goods that need to be processed, unnecessary processing, unnecessary movement of people, unnecessary transportation of goods, waiting for employees due to production stagnation, production of goods and services that do not fulfill the needs of clients and other losses (losses of any nature other than the previously mentioned, such as robberies, vandalism, bad weather conditions, floods, accidents, etc.) [11-13]

2.2 Impact of the losses over the expenses for the construction projects

Construction management has many problems and most of them are of a practical nature. As a result, the construction industry is overwhelmed with postponements or delays and often as a result loss occur. Studies done in 2009 in Great Britain showed that losses in the construction industry represent a relatively large percentage of production costs and that only 50% of projects in the construction industry have a chance of being completed on time or within the agreed budget [14-16].

The previous report also showed that up to 30% of construction work needs to be executed again, only 40-60% is potential work efficiency, accidents typically are 3-6% of total costs, and at least 10% of material is lost [17].

Generally, in the construction the waste are measured regarding the costs, because the other types of losses are related to the efficiency of the processes, the equipment or the personnel and are more complicated for measurement. The activities according to their impact on the costs are defined as activities that add value and activities that don't add value [18,19]

3. LOSSES IN THE CIVIL ENGINEERING CAUSED BY THE EXTENSION OF THE TIME FOR COMPLETION OF THE PROJECT

The final value of infrastructure projects from the road infrastructure depends on the time for completion of the project [20]. Thus, in the country, a small number of road infrastructure projects are completed on time, regardless of who is appointed as a contractor, employer, engineer, the method of financing, the structure of the terrain, the complexity of the project, political opportunities, etc. The consequences of that are: failure to fulfill the agreed deadline for completion of the project and exceeding the foreseen (agreed) financial resources. The key reasons are: not following the planned working plan program or multiple re-planning; delay in supply of materials, equipment, machines, etc.; lack of necessary personnel or mechanization according to the planned or realistic scope of work; not taking into consideration the construction periods of the year for works execution; not sufficient number of professional staff for larger projects; lack of trainings, seminars, workshops etc., which will help in the improvement and training of the staff, including the management staff; minimal or insufficient professional literature, IT equipment on the project etc.

Many factors have impact on the time extension for project completion. In addition of this study they are grouped in several groups and are regarding the: design documentation, defining the duration of the construction, following the deadlines for execution of the works, the period for the commencement work on the projects etc. Parallel with their elaboration are given recommendation for their decrease

3.1 Design documentation

In the country, for large infrastructure projects the state always occurs as an Employer. According to the regulation and the Terms of Reference prepared by the Employer, a designer (licensed design company) is selected, which in principle (almost always) is the company with the lowest financial value offer for designing and preparation period. Normally, the selection is made according to the Law on Public Procurements, except in other cases which are regulated by different laws.

The design documentation is prepared in accordance with the relevant regulations, but often are omitted precisely defined particular conditions and requirements that should be included in and covered by the design documentation in the form of: directions, clarifications and details (lit... the construction law). During construction, the problems are noted as omissions or incomplete documentation, and they are the most common reason for modifications and corrections – variation orders i.e. increased costs and deadlines.

An additional problem is the existence of standards and regulations for designing and execution of construction works, which for certain segments of construction are not clearly defined, as well as a frequent reference to standards and norms in the design for which there is no official translation in the country. Because of the significant freedom that designers have, certain types of designs can be prepared completely differently, especially when they are designed by two design companies, or even by designers working in the same company. As an example, only a few cases from practice are listed¹:

- for overpasses on a highway on the same section and in locations with very similar conditions (geotechnical, hydrological, topographical, etc.), the overpasses is expected to have similar, almost same structural elements, but they are designed differently, in terms of: foundation, pillars, capping beams, drainage, fencing, insulation, abutment cones, pavement construction and many other elements, even though they are on the same highway and on almost identical terrain in terms of topography and geology. Regarding such cases, a separate design documentation (with different construction technology, equipment, mechanization, materials and other resources) is needed for each overpass. And, on the other hand, there is no unification and possibility for usage of the same equipment and technology (scaffolding, formwork, metal molds, etc.),
- designing of road elements and pavement construction is similar as for the construction, and often in same design documentation prepared (verified) by one company there are different design solutions regarding the slopes at the excavations and embankments (for the same material), drain and drainage, upper layer of the asphalt construction, guardrail and wire fence, protection of the road influence on the environment and people (oil catchers, sound barriers, borrow pits, landfills etc.),
- insignificant attention is dedicated during the preparation of the design documentation, and especially in the Elaborate for environmental protection for infrastructure projects, on their impact on the local, earth, forest and other roads that are intersected, as well as the impact of the project towards the needs of the local population. During the construction of new roads, the problem almost always arises of providing access for the local population to their houses, properties and farmlands, connection with local roads that intersect with the new road, additional culverts for passage of people, goods, animals and agricultural machinery from one side to the other, as well as channels for drainage of water from the road to the final recipient. All this requires additional: expropriation, designing, time and means, which greatly affects the deadline and the budget for project execution.

3.2 Duration of the construction

In our country the time for execution of the projects for road infrastructure mainly is determined by the Employer i.e. the team in charge (because they are mainly financed through credits, grants or co-financing that is directly connected with the foreign banks and financial sector and predetermined deadlines). The Employer besides that has predefined time frame in which he can use the means from the bank system, often also defines the deadline for completion of the works i.e. the commencement date and the completion date.

Predefined deadline is significant for the Contractor because:

- Preparation of the working plan program for execution of the works;

¹ Personal experience of the first author of the study, T. Kovacovski

- Preparation of financial plan;
- Plans for involvement of necessary manpower by number, qualification and phases
- Plans for involvement of the necessary equipment and mechanization according to the plan program
- Plans for supply of necessary materials and equipment, transport, storage, usage
- Obtaining necessary licenses
- Testing, attests, approvals
- Everything necessary according to the Contract in order to avoid delay or other digressions from the planned plan program

If the planned activities by items, phases and deadlines are not defined at the beginning, later are frequent reason for project delay and breaking through of the deadline. That mostly leads to increase of the costs and decrease of the predicted company profit, according to the legal and contractual conditions for financial penalties, to which the Employer is entitled, because of not retaining the agreed deadline (penalties)

Other reason for not retaining to the agreed deadline for construction is the lack of attention by the projects participants in the following of the planned working plan program for construction and the deadlines. The consequences are unplanned costs of the contractor that occur from the delay of the construction, and are expressed through prolonged time for construction and increased costs for: salaries, personnel, equipment and mechanization engagement, extended guarantees etc. This practice in the country is due to several reasons:

- Insufficient importance of the time and the deadline as a factor during works negotiations
- Mistakes in the design documentation, which preparation is Employer's responsibility
- Necessity of additional works because of: omissions in the design documentation or other requests of the Employer for the necessities of the projects, local self-government, the population, requests by the project participants etc.
- Unpredicted works (climate factors, factor time, standards, law provisions and modifications in the regulations, requests by the project participants etc.)
- Additional expropriation (mostly due to the discrepancies in the design documentation)
- Modifications in the design documentation, necessary for re-designing, etc.

Practice shows that the planned and determinate deadlines necessary for completion of projects are often prepared without a detailed analysis, in order to perceive all the factors that have or can have an impact, for each project individually, therefore there are often discrepancies between the predicted and actual deadlines for construction. It is recommended the construction deadlines to be determined according to: the requirements and needs for the specific construction project / road, design documentation with bill of quantity, expropriation and works related to property - legal matters, previous experiences for similar projects as well as the need for completion and use of the specific project / road depending on: conditionality from other projects, planned budget and financing, social - economic, political and other occasions.

3.3 Examples (Analyses) of the delays with project realization

On photo 2, 3 and 4 are given graphical reviews of the results of the execution of 13 infrastructure projects in the last 14 years (year 2009-2022) in our country and abroad². All analyzed projects are related to construction of roads with exemption of one (related to reconstruction of streets with sewage system). The budget for the pointed projects was within 1.5 to 226 M Euro.

Photo 3 shows that the deadline for execution of the analyzed projects extended for once at 5 projects, twice at 3 projects, at 2 projects the deadline was extended for more than twice, 2 projects were finished on time and only 1 project was finished before the planned deadline.

² Personal experience of the author of the study, T. Kovachovski

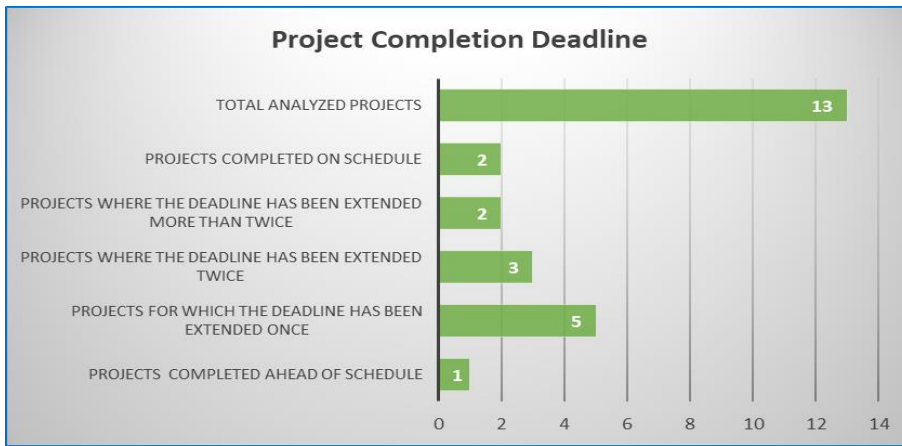


Photo 2: Fulfilled and extended time for completion

Regarding the predicted and real deadlines for projects execution analyzed by months (photo 3 and 4) it can be seen that:

- On two projects the time for completion is fulfilled, one is highway and the other project (which is shortest by time for construction and with the smallest budget by value) is also a project from civil engineering i.e. sewage and reconstruction of streets;
- The most significant delay for 530% is for infrastructure project i.e. highway where because of the problems the main contractor was replaced (months are studied as number of months to finish each structure separately. The number of months is not regarding the time period because some of the objects were executed in same calendar period i.e. in the same time).

Planned were total of 306 months for construction of the given objects (as a addition of separate duration for all projects, not as a time for parallel construction of multiple objects) They were finished for 422 months which is an increase of the time for construction for 116 months or for 38% longer time period regarding the planned according the contracts.

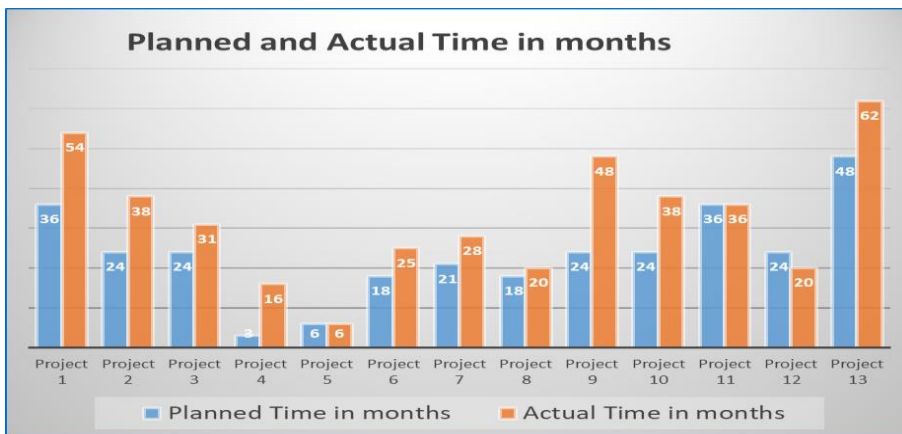


Photo 3: Comparison of the planned and actual Time for construction given in months



Photo 4: Predicted time and actual time for construction in months and percentage

From the abovementioned it can be determinate that the deadline for completion of projects most often is fulfilled and in most of the cases the extension is necessary once, twice, and even several times. This shows that is necessary to make serious modifications in the method of determination of the time period for construction, firstly by the Contractor, which in fact can determinate it realistically, and then by the Employer regarding the determination of the time frame for construction and the selection of the most appropriate contractor where a role has also the factor time.

On photo 5 are given some of the most frequent and evident reasons that have impact on the extension of the deadline for completion, although the infrastructure projects are realistically very complex and also are appearing many other reasons, in which can be included: experience and the method of managing the projects, knowing of the theory in the field of project management, learned during the work, following the modern methods, technics and metrologies and their application in the field of the project management etc. This reasons are objective perception of the authors and as such can not be given separate lately except as under other.

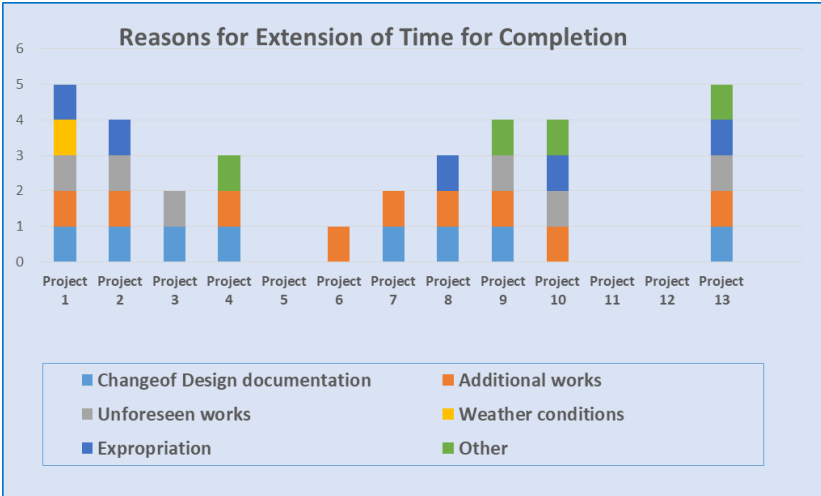


Photo 5: Reasons for extension of the Time for Completion

3.4 Period for execution of the works

A significant factor that affects the completion of the project within the specified time and budget, according to the authors' experience, is the period of the year for execution of the works, i.e. the period when the implementation of construction project activities commence and the period when the completion of the project is planned, which are directly related. Unfortunately, for the road infrastructure projects, there are not or the authors could not find some more detailed analysis and researches or literature that refers to this issue.

3.4.1 Period for commencement of the project

In practice, it has been shown that a very significant factor for managing and leading projects is the time period of commencing the construction. With the total construction period (which is defined by the Contract Conditions), the period of the year should be defined when that project should commence with implementation at the latest, adjusted according to the annual seasons and climatic-meteorological conditions (with date).

A characteristic example are road infrastructure projects whose construction time is less than 24 months. In that case this factor has a significant role in the whole construction process and reaching the construction deadline (Table 1).

3.5 Current problems that impact the increase of the project budget

The prices of the materials, fuels and energy sources last year were increased for more than 50% regarding the prices during the same period last year. The prices of the resources that some company had considered during the submission of the offer and signing of the contract for the work appointed are drastically different from the prices in the period when works are executed. Therefore, the construction companies each day are cumulating larger loses and have difficulties in fulfilling the contractual obligations. If it is taken into consideration that larger number of contracts are including the clause for prices permanence (there is no price adjustment) and are working with agreed fixed prices, even more is questioning the realization and completion of the present projects. The Contractors are forced either to stop the construction activities and terminate the Contract for construction or to search other methods, in order to fulfill the contractual obligations and to finish the present projects. This is the main reason that is also becoming a practice in our country (and in many other countries), because of which the contractors in order to moderate the large and unpredicted price increase, are searching mechanisms for modification of the previously agreed prices in the Contracts, mostly as:

- request for legal provisions with which rules will be made in the direction of a real increase of the materials and products prices incorporated in the projects;
- requesting direct assistance from the state to pay contractors the difference between realistic and agreed fixed prices.
- request to change pre-agreed prices – usage of price adjustment;
- requests for compensation (claims) that are related to a modification (increase) of the materials and fuels prices, etc.

In order to moderate the differences in the already agreed fixed prices, the contractors, within the framework of the contract conditions and obligations, also submit other requests with which they can obtain certain adjustments to increase the unit prices, such as:

- request to change items or work methodologies, as an opportunity to adjust the agreed prices and include new prices;
- request for quality improvement of works and items with new materials, which are also related to new prices;
- request for application of new standards and regulations, according to which conditions a modification of the agreed in new prices will be legalized.

This directly affects the Employers, who are forced to provide additional funds in order to complete the already started construction projects.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

- During the construction and road infrastructure project management, weather conditions are very important factor, consequently certain “secure” and planned actions are not realized in practice
- Certain seemingly similar or same problems, often are solved with different methods, which depends of the experience of the whole team, the approach to the problem, the inventiveness and team members dedication
- A series of factors have impact on the pre-planned time period and project budget and its completion, such as: specific terrain and climatic conditions, coordination between the project participants, the teams expertise, the defects that appear, necessity for amendment and modification of the design documentation, law modifications, delay with the shipment of materials and equipment (human factor, custom and other formalities) and many other factors.
- Essentially the Employer – user, is not concerned significantly about the loses during defining the value that should be paid by his side, but he must be mindful that certain loses, especially every extension of the predicted deadline, almost always has significant impact and increase of the final price of the product/project.

4.2 Recommendations

- Today it is not enough to be technically prepared as a guarantee for successful project for road. Except the technical preparation important are also:
 - Application of knowledge and skills from different fields – interdisciplinary approach i.e. multidisciplinary expert teams.
 - Competence in the behavior, because people are working on the project. Human factor can significantly impact the project realization
 - Active engagement of all participants in the construction, in order to decrease the time for determination and approval.
- The project represents a temporary series of activities, which means that it is limited in time with a defined beginning and end, as well as quantitatively in terms of the scope and range of resources for achieving a certain goal, according to a defined quality. As such it is important to understand that a project is not a part of the usual work, but a compilation of specific operations that contribute to its execution. Therefore, recognition and removal of certain limitations during the implementation of the project is the work of the entire team involved in the construction. Others may be involved in determining certain limitations, but only team members can be entitled responsible for removing the limitation they are responsible for. It is crucial to determine in advance which of the members of the entire team will be directly responsible for solving any limitation.
- In project management, when there certain negativities are repeating constantly and lead to work stagnation, extension of the completion date, increase in budget, decrease in quality and other problems, it is a clear sign that the usual methods of project managing and construction should be revised i.e. changed.
- In general, timely decisions, approvals and even rejections significantly impact each projects and especially larger projects because at those projects the time passed in waiting for problem solving can cost much

Recommendations during preparation of design documentation

In order to obtain the necessary quality during the preparation of the design documentation, it is necessary to make modifications / amendments of the legal regulations related to:

- precisely and clearly defined Terms of reference according to the needs of the Employer and the conditions on the location;
- detailed basis for underground and over ground infrastructures and defining of additional investigation works and means for these items;
- selection of a licensed design company, taking into consideration the achieved on completed projects, not the lowest financial offer for the planned projects;
- defining the impact of the solutions from the design documentation on the environment with an emphasis on the life of the local population, specifically their needs, requirements and habits;
- agreeing on a realistic time for preparation of the design documentation
- more detailed definition of investigation and geodetic works as basis for designing;
- engagement of a design company that designed the object or another design company during the construction process of the object as design supervision for:
 - correction of all errors or deficiencies by inclusion in the construction as a contractual obligation,
 - preparation of As built drawings which will be prepared parallel with the construction,
- accurate and clear defining of standards, rules and regulations according to which the designing and later the construction of the object will be executed, while the standards without MK version will be explained in detail;
- detailed elaboration and unification of the method of preparation of the Bill of Quantity in the design documentation, etc.

Recommendations for the duration of the construction at infrastructure projects:

- the deadline for construction to be determinate according to in details prepared working plan programs and realistic construction conditions
- the period for construction should be determinate by experienced engineers/personnel with great knowledge, not only in preparing plans, programs and contract but also an operational experience in projects execution
- the contractor, before and during the planning to make consultations with the sub-contractors, materials and equipment suppliers and other relevant participants in the project implementation
- design documentation to be elaborated in detail, including the bill of quantity in which the detailed description regarding the materials and working technology should be specified
- the terrain – construction alignment should be reviewed in details and all works included in the design documentation to be determinate
- defining access roads, necessary construction works on them, conditions for transport of material and transport distances etc.
- accessibility to local materials (for example: stone, gravel, sand, aggregate etc)
- taking into consideration the time for obtaining licenses for: materials exploitation, borrow pits, landfills etc.
- taking into the consideration the time for placement of structures on formation of a temporary construction site, equipment, mechanization and usage of plant (for production of asphalt and concrete) and obtaining ecological licenses
- time for demounting of the temporary site should be considered and other conditions

Recommendations for determination of the commencement of the construction of infrastructure project

The construction practice in the country has shown that in the winter period (from November to February) it is not advisable to start with the execution of works on the construction projects, especially for objects in the field of line infrastructure (roads, railways, sewers, etc.) where parallel with the preparatory work are executed earth works. In fact, in the initial period, the temporary i.e. construction site formation should be formed and execution of other preparatory works should start, because they are a precondition for execution of the other items. Mostly, these are earth works: clearing the terrain, opening and preparing the subsoil, excavation of foundation pits, access roads, starting with embankment, etc. These are works that are mostly executed outdoors and which are greatly influenced by climatic conditions. Periods of rain and snow are especially impacting, due to the impossibility of quick terrain drying and fulfillment of the technical conditions for execution of works. On the other hand, when preparing the working plan programs, resource plans with the financial plan and other work plans, the determinate construction period unfavorably affects the planned. This contributes the planned realization to be delayed from the beginning, especially if the climatic conditions are extremely bad. Modifications and amendments are required that later, in the further construction, will cause continuous shifts and delays that most often are causing not fulfillment of the construction deadline.

Losses in road projects should be subject to detailed analysis as one of the main conditions for their reduction during the construction of such objects. Contractors who have significant financial losses based on waste that could be used or recycled and which is usually not recorded and there are no indicators or data for it, should be most concerned about that. In order to overcome errors, deficiencies, claims and modifications related to the project during the construction, the involvement of all participants is necessary, according to their credentials, positions and authorizations.

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