Learning from projects: Macedonian experiences with international civil engineering projects

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THIS ARTICLE PRESENTS AUTHORS EXPERIENCES COLLECTED DURING WORKING ON SOME INTERNATIONAL CIVIL ENGINEERING PROJECTS. The purpose of the article is to present possible obstacles during working on international projects, resulting from differences in levels of design, application of different standards and models for civil works, as well as different engineering practice. A special attention is given on problems connected with project management, technical documentation and construction projects determining factors. Main idea is to give possible way of overcoming the differences that can arise from different application of mentioned project elements. A main conclusion is that, before starting on working with international civil engineering projects, a detailed analyse of all law aspects, standards, technical legislative, local practice and culture is necessary. Authors believe that the gathered experiences can serve as a learning example for foreign parties and for improvement international cooperation in construction.

Keywords

learning from projects, international project, construction, standards

INTRODUCTION

During last 10 years, the number of the international civil engineering projects in Republic of Macedonia is increasing. Such trend is expected in a future, due to the tendency of the contry to be a part of European comunity.

The foreign participants in the Civil Engineering Projects, pursuant to the Macedonian Law on Construction (Assembly of the Republic of Macedonia, 2005) can undertake all the positions as the domestic participants. According to the relevant Laws legislative, Tendering for the larger Macedonian Civil Engineering Projects must be international. This leads to the increasing in number of foreign companies which apply on Civil Engineering Projects.

On the other side, Macedonian Civil Engineering Companies and Institutions also participates in foreign countries in a different Design Projects, Strategies for Development, Construction works etc.

A brief overview of the ongoing or future large international projects in Republic of Macedonia is given here. See Table 1.

Positive element is that this leads to the increased competition between participants, working with competitive

Project	Investor	Designers	Contractor	Stage of the project
Arch dam "Sveta Petka"	Public enterprise for electricity AD "ELEM"	RIKOM-Skopje, Energoprojekat-Serbia	RIKO-Slovenia with local subcontractors	In a phase of construction
Hydro system "Zletovica" (earth fill dam "Knezevo" with asphalt core is main element of the system)	Public enterprise for water supply "Zletovica" sponsored by Japanese bank	PCI-Japan, Coyne and Belier-France, Faculty of Civil Engineering (FCE) from R. Macedonia	Domestic companies "Granit" and "Beton"	In a phase of construction
Gasoline network in Republic of Macedonia	Ministry of transport and communications of R. Macedonia	Domestic company "Prostor" with Bulgarian subcontractor	-	Feasibility study and general project design in the phase of preparation
Arch dam "Cebren" with height 186-190 meters (depending on the project variant)	Public enterprise for electricity AD "ELEM"	Energoprojekat-Serbia, FCE and others	-	Basic Design Project exists
Pan European corridors (highways and railways) K-8 and K-10	Agency of State Roads	Several domestic and foreign companies	-	In different phases of design

Table 1: **Short list of ongoing and future large Civil Engineering Projects in R. Macedonia**

prices and interchanges of knowledge and experiences. Anyhow, the effective realization of the such international projects is connected with numerous problems. Sometimes problems are from formal aspects, but sometimes they are connected with differencies in a law legislative, different civil engineering standards and differencies in an engineering practice. The participation of companies with different engineering experience and references which earlier never worked together, working labor with different culture and tradition creates additional problems in coordination of the works and management of activities during the phase of project realization. Beside positive experiences from presence of international companies on an domestic market, there are serious problems and obstacles for both sides, domestic and foreighn parties. Analysing the existing situation, it can be noted that the foreighn companies are more competitive compared with domestic one, while the domestic companes usualy works as subcontractors, for lower prices, or they doesn't participate at all. In order to perceive the major problems and reasons for occurrence, the authors carried out an analysis of present conditions in the realization of international construction projects. The gathered experiences were the basis for this article. The analyses are based on the author's experiences by participation in several international projects in a revision council, consultants or designers. Special overview id given on the projects as Hydro-system "Zletovica", arch dam "Sveta Petka" (See Table 1) and prepairing of the Strategy for Civil Engineering Development in Montenegro (Cvetkovska at all., 2008).

Analysis of key international project problems in Macedonian construction

The main aspects can be systematized into three key group interaction issues and problems. They refer to the Project Management Problems, Technical Documentation Problems and Construction Projects Determining Factors Problems.

Project management problems

Such problems can be classified in groups of interconnected aspects as follows:

- Application of new models and unified standards for project management,
- Project management functions,
- Problems with management of Project Processes

Application of new models and unified standards for project management

The country has no accepted models, concepts and standards for quality of management with construction projects that would result from one's individual research, based on contemporary project management methods, techniques and software and that would correspond to the actual conditions for the project realisation, regulated by appropriate legal regulations (Zileska-Pancovska, 2006). That is the

reason why domestic participants in international projects usually use foreign concepts, models and standards, mostly ISO 10006 (International Standard ISO 10006, 2003) or PMBOK (A Guide to the Project Management Body of Knowledge, 2004) for project management or their work is based on their own experiences, education and intuition. Foreign participants in projects use their own approaches. This leads to different understanding in application of modes and standards for project management.

The *Learning from projects* in Macedonian Civil Engineering is not used as it can be. The Macedonian experiences from previously finished and from ongoing international projects usually are not presented in front of the public and civil engineering practitioners. Results of this, is a situation when the "same" or similar mistakes are repeated several times.

Project management functions

From the author's experiences, all sides in project usually use its own *organization structure*, mostly based on so-called functional organization scheme. Usual problems for domestic participants are low motivation of expert teams, which comes out from low degree of information on all necessary contractual and technical elements of the project. Most commonly used techniques for *planning* in the country are Gantograms and Network technique. Software support is based on MS Project or Primavera packages. On the other side, our practice shows that after *controlling* and *monitoring*, schedules for all international projects have been changed several times.

Problems with management of Project Processes

Risk management analyses usually absent in Macedonian parts of international projects, which mean that the risks managements during constructions needs further improvement. Most common risks come from organization nature. Importance of *costs, time, resources and procurement* influential factors, comes from the facts that international projects are usually of large scale, and needs high level of investments. To insure project realisation, the financial and other support come from our Government or stronger Public enterprises. Sometimes, this is connected with some inadequate requests by the Investor side, which can be a problem for domestic constructional companies. Here, we can note that tendering procedure sometimes involves factor time of construction as wining criteria. So, to fulfill this criterion, the time planning is inadequately presented in the offers. This has a direct influence on the resource incoming, and finally leads to the longer time construction. Looking backward, Investor or Government, force the initial terms, and this can lead to numerous misunderstandings. This deserves detailed analyses, which overcomes the frame of this paper.

Problems connected with project *strategy,* projects *scope,* and *inter connected processes* are not typical. But, at all international projects with authors' participant, because of the large scope of the projects, always new or not predicted activities arise during the working.

The *personal* is being chosen by each participant in the construction independently. In this sense, each participant applies individual criteria and procedures for selection of staff. The staffs selected by international participants are usually foreign persons that have appropriate certificates and licences. Disadvantages of selecting such staff, especially project managers are the insufficient awareness of the actual situation, when carrying out construction works in Republic of Macedonia. Additionally, problems arise if the project management team is occupied with more activities in a same time, or if the starting team is changed during construction. For an instance, during the construction of the arc dam "Sveta Petka", main manager is changed. In a case of dam "Knezevo", the whole design team from French company Coyne and Belier cancelled the participation in consultant services during the construction because of its own reasons.

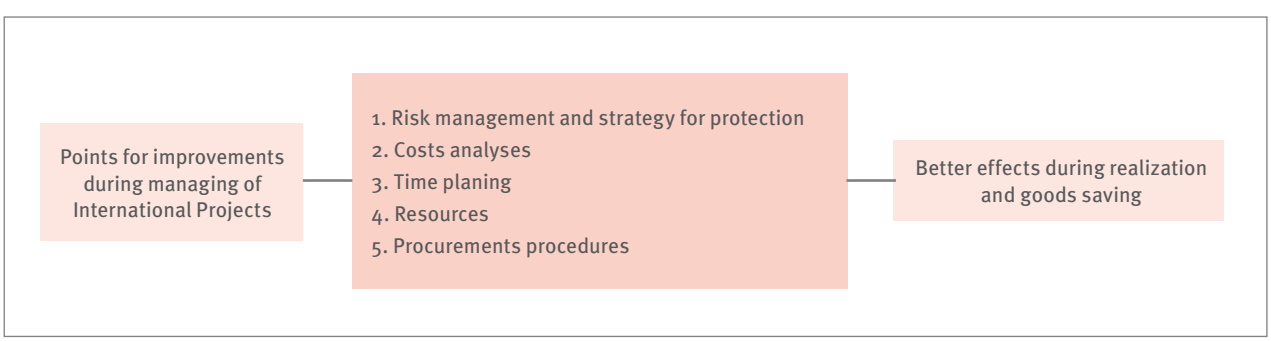

Figure 1: Weak points in international project

When our engineers applied for work in foreign companies, obstacles came because of the fact that Macedonian construction Licenses for Design, Supervision and Revision are not recognized in other countries. When the foreign architects or engineers want to apply as a person in some projects in the country, obstacles came from the fact that the Directive 2006/123/EC for services in an internal market (Directive 2006/123/EC of the European Parliament and of the Council, 2006) is not fully accepted in our Law for Construction. Additional problems occur because of the fact that in Republic of Macedonia lacks National Certification Program in the area of construction project management that would be in line with similar international programs. Also, Republic of Macedonia does not have stages of competences and qualifications, as well as phases of the certification process. As a result, large problems exist concerning project managers appointment and the work of staff that works as project managers is based on their own experiences, education and intuition. The majority of project managers are civil engineers having experience with construction of structures at home and abroad and they are familiar with the planning, regulations, technical specifications, negotiations in the construction business, construction management and IT. They also have a good knowing of English. It should be mentioned that there are project managers in Republic of Macedonia with foreign license, especially those who work for foreign companies. The majority of them are also foreign managers, who have modest knowledge of the real construction situation in Republic of Macedonia.

The *communication* problems arise from the fact that the participants are usually with different culture, tradition and way of working. Sometimes, foreign experts needs longer time to accept all necessary project data. The organization of working meetings, different ways for preparing of reports and other factors sometimes leads to the misunderstandings in realisation. Just for an illustration, in a process of construction of HS "Zletovica", the teams from Japan, France, Macedonia and Norvey are involved, and all of them have its own way of working and managing of the problems. In a project for arch dam "Sveta Petka", the teams from Slovenia, Serbia and Macedonia are involved, and here the problems with not resolved contractual arrangements are present. But, there are cases of well established communication. We will note the way of working during the preparing of the Strategy for Civil Engineering Development in Montenegro (Cvetkovska at al., 2008). Here, the main leader of the Project is Faculty of Civil Engineering. Also, local partners from Montenegro was involved, and participants from Serbia and Germany. The problems with information managements, language of communication etc shall be also noted. The feed back of information's is not satisfactory while the main language for communication is English, usually not mother tongue language for all participants. So, some optional solutions are involved. For an example, in a case of project "Sveta Petka", all participants are from Former Yugoslavia countries, so the Serbo-Croatian language is used informally on a meeting sessions. According our experience, the weak points in international projects are the factors given in Figure 1.

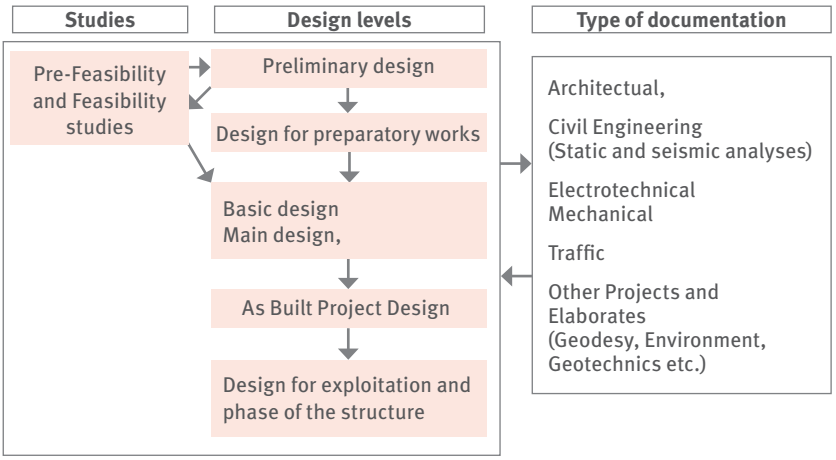

Figure 2: Main levels of design and type of documentation according to the Law on Construction

Technical documentation problems

In accordance with the Law for Construction (Assembly of the Republic of Macedonia, 2005), the structures are divided in five categories according their type, specifics, complexity and technical-technological conditions for their construction. The law prescribes several types of documents which are necessary to be prepared in several design phases (Figure 2). Depending on the structure category, not all levels of design are necessary for each structure. This is defined in the mentioned Law on Construction, but unfortunately, not all sub-law procedures are finished. So, there are not well defined aspects in the law framework, which is as a basis for misunderstanding for foreign contractors. The need of more detailed explanations about the project content and design details for different level of design is evident. For an example, this produce a lot of problems with design team from Energoproject-Serbia in a

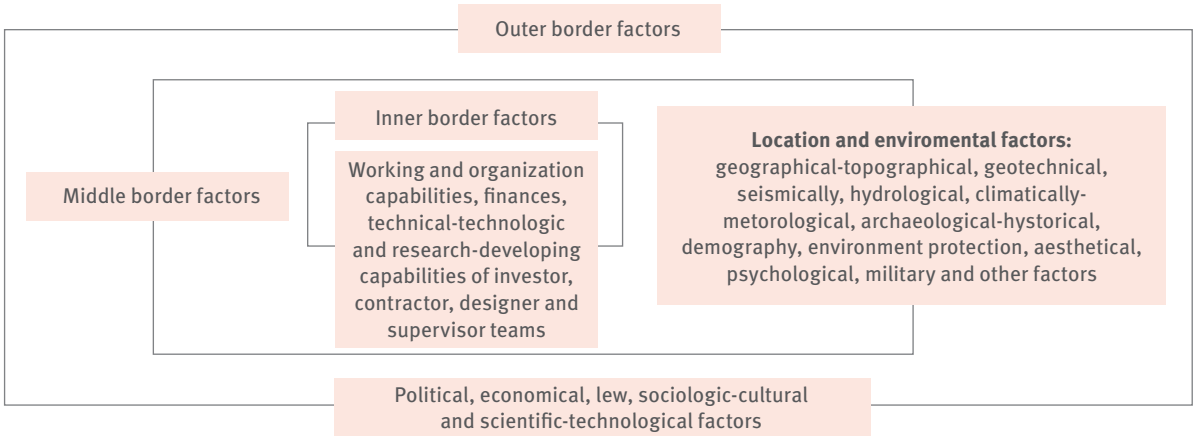

Figure 3: Illustration of three-tier approach for construction determining factor problems

case of arc dam "Sveta Petka". The Serbian team insists on the former Law on construction, which was similar for Former Yugoslavia countries, and which prescribes different phases of design. The levels of Macedonian technical documentation and its scope are not harmonised with the contemporary regulations used in other countries in the relevant field. For an example main levels of technical documentation, depending on the type of construction and level of design, in accordance with Montenegro' Law for space planning and construction (Law on space planning and construction, 2008) are: Preliminary Design; Basic Design; Main design and As Built documentation. This is somehow different from Macedonian practice (Figure 2).

Macedonia has not accepted technical specifications and standards for all civil engineering works. The Council Directive 89/106/EEC (The Construction Product Directive, 1989) and other Directives relevant for the Civil engineering projects are not transposed in all relevant Macedonian regulations. Also, there are problems with the harmonization of Euro Codes EC1 to EC9, which deals with Civil Engineering. But, the process of harmonisation is also not easy in the EU countries. Almost all EU countries have their own National Annexes, which can differs a lot from case to case. If we transform this into the Project Design level, then in international civil engineering projects in Macedonia, all participants can force their own view about the applicable standards, content of documentation etc. Such situation is not easy to be managed, and needs high effort from all project participants in order to fulfil all necessary criteria about safe and economical construction.

Construction determining factors problems

The realization of international projects is determined by numerous interconnected and mutually connected complex set of time dependent factors. In Figure 3, we introduce a concept of three-tier approach in Macedonian Civil Engineering, in a similar way as it is given by Hudson (Hudson, 1993) for other problems. The influence of each factor is different at each project, but for all named projects, experience shows that some of them are usually underestimated. For an example, during realization of HS "Zletovica", an archaeological-historical factor stopped the construction for several months, because uninvestigated archaeological localities were found at the zone of working. The other example is a case connected with changing in design (from clay to asphalt impervious core in a dam' body). Having in mind that the domestic companies do not has an experience about this type of dam, a

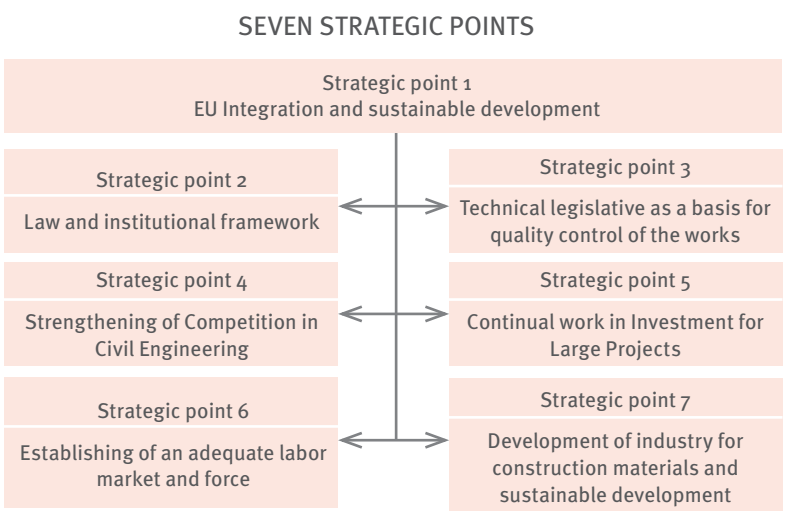

Figure 4: Seven strategic points for improved management with Civil Engineering Projects

Norwegian company is involved in the construction. For the project arch dam "Sveta Petka", the uncompleted investigations of geotechnical factors have a large influence because of the heavy terrain conditions and slope-stability problems for the access road.

Possible solutions

What can be learned from the international projects in R. Macedonia and if it is possible to offer some acceptable solution?

It is evident, that, mutual influences between elements in international projects, needs complex detailed strategically, economical, technical and other type of analyses. This means that the problem can be resolved in an apropiate way for all involved parties, when it is accepted as a multidicsiplinary problem. At a first step, the country itself, must establish in a clear way it's perspectives in Civil Engineering. One possible scheme, applicable for developing countries in the region is given in a Figure 4.

Authors believe that so-called interaction matrix method can be useful de-

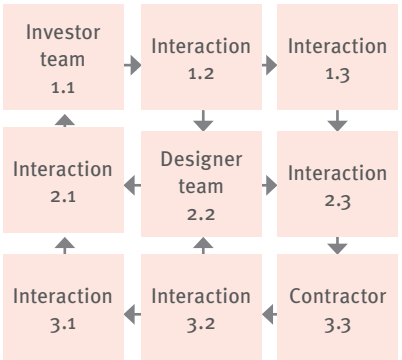

Figure 5: Conceptual matrix of interaction with three main factors during the project realisation

vice. The method is introduced by Hudson (Hudson, 1993) in rock-engineering analyses. In a frame of this article, we will shortly introduce possible application in Project Design Management problems for international projects. One example of conceptual matrix with three elements in a leading diagonal is given on Figure 5.

Here, the most important step is to establish the objectives of the project and the analysis. The relevant variables must be chosen in a first place and they are placed along the leading diagonal of the interaction matrix. In this case, these variables have to be more conceptual in nature. Then, all the interactions are established so that the problem structure is developed. When the variables are conceptual in nature, the off-diagonal interactions can be assessed using qualitative explanations (See Table 2).

This, at a first view 'simple' scheme indicates that not only the group factors covered by the Investor side (from investment point of view) influenced the scale of the project, but also designer team can introduce its own view for optimal project realisation. In this scheme, contractor plays very important role, and with well analysed project data, can offer its own view during construction phase. These leads in most-appropriate application of designer's solutions on the site according to the real conditions defined during working.

It is very useful if such approach will be arranged at the beginning of the projects, but this shall be accepted as an ongoing process during all time of project realisation. It insures all time communication, resolving of problems and development of understandings between different teams. All methods

Interaction case	Description of possible interaction elements and influences
Interaction 1,2	Investor team gives basic expected elements of the Project for detailed further analyses to the Designer team, notes the applicable Laws and Standards, gives the data about Involved Public enterprises, level and content of documentation that he needs etc.
Interaction 1,3	Investor team prepares contractual arrangements and present them to the Contractor, with detailed instructions about time-schedule, payment details, rights and penalties based on the tender dossier for construction and project elements etc.
Interaction 2,1	Designer team suggest to the Investor options in the project solutions, optional applicable standards and technology for constructions, based on the analyses of the market conditions and contractors capabilities etc.
Interaction 2,3	Designer team explains the project elements to the Contractor (if necessary), especially some most-critical project elements.
Interaction 3,1	Based on the detailed analyses of the contractual arrangements, Contractor suggests Investor some changes in the contractual arrangements and optional ways of constructions, which in general doesn't change financial estimation for the project costs.
Interaction 3,2	Contractor based on detailed analyses of the project elements and real field conditions, suggest to the designer possible optional ways of constructions, that in general doesn't change the safe and economical exploitation of the structures.

Table 2: Qualitative explanation of the interactions

that give a positive reflection earlier in the practice shall remain. Some positive experiences are connected with application of known and widely accepted international documents. For an instance, in Macedonian Civil Engineering Practice, juridistical arrangement and internal contractts or subcontracts are based on FIDIC Books, which is allowed by the Law in the country. This can be noted as a positive experience.

CONCLUSIONS

The international construction projects in Republic of Macedonia and presence of foreign companies has an increasing trend. Main reason for this, is the fact that the Law prerequisites gives equal level for participations on an Macedonian market. With a full acceptance of European Directive for services on internal market in our Laws, the main prerequisites for integration of Macedonian civil market will be established.

Unified and standardised methodology for construction project managements, which would cover all the activities and phases of the project life cycle, is not applied. In addition, little attention has been paid to issues related to construction project management in the Law on Construction and the Manuals deriving from it, as well as in the remaining legal regulations. An additional problem is that the phases in preparing of technical documentation and its content that are not equal with the contemporary regulations used in other countries. This is not only Macedonian, but international problem.

Problems related to international construction project had their effects on increasing expenses for project realisation and postponement of realisation deadlines. This directly affects the Macedonian civil construction business.

However, the public concerned with the area of international construction projects is becoming aware of the need to take practical steps for improving the situation. Furthermore, the inevitability of paying more attention to all significant issues and problems concerning international construction project realization was acknowledged. Their resolution will create conditions for eliminating the causes for many other problems emerging during realization of international construction projects in Macedonia. Condition will also be created for quality, cost-effective and efficient construction of facilities at home, and the possibilities for international cooperation of the Macedonian civil construction engineering will be increased. All this will allow faster integration of the Macedonian within the international construction business.

We believe that the given analyses and recommendations in this article will help in capacity building of domestic institutions, as well as it can serve as a kind of guideless for foreign companies which shall apply in some future large scale civil engineering projects.

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