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Management of Hrvatske vode construction projects

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Professional paper

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Management of Hrvatske vode construction projects

Establishment of a clear and unambiguous matrix organisation, both at the level of project owners and Hrvatske vode, is a prerequisite for an efficient and stimulating relationship between functional organisations participating in a public construction project and a particular project organisation. This paper was prepared based on research conducted in 2016 and does not reflect the effects of data from 2017 and 2018.

Key words:

project, project organisation, water economics, project management, EU project funding

Stručni rad

Dejan Dragič, Mirko Orešković

Upravljanje graditeljskim projektima Hrvatskih voda

Uspostavljanje jasne i jednoznačne matrične organizacije, kako kod vlasnika projekta tako i kod Hrvatskih voda, jest preduvjet efikasnog i poticajnog odnosa funkcijskih organizacija sudionika javnog graditeljskog projekta i partikularne projektne organizacije. Ovaj rad nastao je na osnovi istraživanja tijekom 2016. godine, te ne odražava učinak podataka iz 2017. i 2018. godine.

Ključne riječi:

projekt, projektna organizacija, vodno gospodarstvo, projektni menadžment, EU financiranje projekata

Fachbericht

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Management der Bauprojekte der Hrvatske vode (Kroatische Wasser)

Die Schaffung einer klaren und eindeutigen Matrixorganisation ist sowohl für den Projektträger als auch für Hrvatske vode (Kroatische Wasser) die Voraussetzung für ein effektives und anregendes Verhältnis zwischen den funktionalen Organisationen der Beteiligten an öffentlichen Bauprojekten und der partikulären Projektorganisation. Diese Abhandlung entstand aufgrund einer Untersuchung von 2016 und umfasst nicht die Auswirkungen der Daten von 2017 und 2018.

Schlüsselwörter:

Projekt, Projektorganisation, Wasserwirtschaft, Projektmanagement, EU-finanzierte Projekte

1. Introduction

This paper draws its origins from the study of the actual project management system used by Hrvatske vode that was in operation in the early 2017. The paper received support both from project structures and from wider project environment. Appropriate Hrvatske vode documents are used in the paper, both with regard to their content and terms, the objective being to establish a clear and direct correlation between the existing approach and understanding, and the contemplation of possible changes that could improve the existing system as to distribution of project rights and responsibilities in the conceptualisation and implementation of projects that are realised in the water management sector.

2. Current state of the art

2.1. European frameworks programmes and programming periods

The establishment of a single economic space is one of strategic objectives of the European Union, and so various mechanisms and methods, aimed at facilitating realisation of this objective, are currently used by the EU. When applying for the EU membership the Republic of Croatia had to meet requirements for the improvement of internal processes and for meeting criteria that are the same for all EU member countries.

In the programming period 2007-2013, i.e. until the full membership in the European Union, the Republic of Croatia used funds from the Instrument for Pre-accession Assistance (IPA), the basic aim of which was to assist the Republic of Croatia as a candidate country in the harmonisation of national legislation with the EU *acquis*, and in the structural strengthening of public institutions and their capacities for the acceptance and implementation of requirements for the harmonisation of the existing laws and regulations with the EU *acquis*.

A little more than € 150 million annually, or approximately € 998 million in total, was made available to the Republic of Croatia for the said activities in the scope of the IPA programme. The funds withdrawn in the said period (by 30 June 2013) were to appropriately spent by the Republic of Croatia no later than until the end of 2016 (in conformity with the N+3 rule). As a full EU member, the Republic of Croatia can benefit from *structural instruments* through which the Cohesion Policy of the EU is implemented, the aim being to ensure economic and social development of individual member countries, which should in the future result in and uniform level of development of all regions and individual countries within the EU. The implementation of this policy is funded through appropriate funds. These funds are:

- Cohesion Fund (CF), aimed at Member States whose gross national income (GNI) is less than 90% of the EU average. It concerns projects from the field of transport and environmental protection,
- Structural Funds (SF).

In accordance with its long-term development policy, the EU has established two significant structural funds that are oriented to two socially dislocated funds:

- European Regional Development Fund is destined to strengthening economic and social cohesion in the EU and to reducing differences in the level of development of its regions;
- European Social fund is destined to encouraging employment and opening up of new business niches that will increase and qualitatively advance the employment space within the EU.

The amount of € 10.676 billion was allocated from these funds to the Republic of Croatia for the programming period 2014-2020. In addition, by the end of 2016, the Republic of Croatia had the right to spend the funds allocated in the previous financial perspective (funds from structural elements allocated for the period from 1 July to 31 December 2013, after accession to the European Union) in the amount of € 1.012 billion.



Figure 1. Allocation of funds in programming periods [1]

The strategic framework of the Republic of Croatia for the use of *structural instruments* in the programming period 2007-2013 is formed of the programming documents: *Strategic National Reference Framework (SNRF)* and four operational programs (OP) – Transport, Environmental Protection, Regional Competitiveness, and Human Resources. The financial perspective of structural instruments for the programming period 2007-2013 amounted to € 1.012 billion. This amount was allocated through the four above-mentioned OP. For the environmental protection OP (EPOP), the total allocation of funds for the priority axis 2: *Improvement of water supply and integrated wastewater management systems* amounted to € 199.1 million. For the programming period 2014-2020, the strategic framework for the use of structural instruments is formed of the following documents: OP Competitiveness and Cohesion and OP Efficient Human Resources.

In addition to the projects co-funded via structural funds, some Hrvatske vode projects co-financed through the IPA program, which were to be completed by the end of 2016, are still in progress. Taking all this into account, it can be stated that the situation regarding project implementation is rather specific as, by parallel implementation of different programming periods which were to be realized in succession, we are currently faced with the overlapping of various financial perspectives or various project processes, as shown in Figure 2.



Figure 2. EU funds – current financial perspective in the Republic of Croatia [2]

2.2. Projects co-funded through structural instruments

2.2.1. Structural instruments in the programming period 2007-2013

The EU funds are structured as financial documents that support and encourage realisation of various sectorial policies of the European Union. Thus, structural funds, i.e. European Regional Development Fund and European Social Fund, and Cohesion Fund, have been conceived to foster implementation of the EU cohesion policy. The financial perspective of structural instruments for the programming period 2007-2013 amounted to € 1.012 billion. The amount was allocated to four OP according to appropriate sectorial regions. For the OPZO, the total allocation of funds for the priority axis 2: *Improvement of water supply and integrated wastewater management systems* amounted to € 199.1 million. The structure of the system for the management and control of the use of funds, for the projects co-funded through structural instruments in the programming period 2007-2013, is formed of the following bodies:

- **Ministry of regional development and EU funds**, which is the coordinating body in charge of programming, establishment of management system, defining rules,

establishing the system for integrated management of information, monitoring implementation on national level, and coordination with the European Commission;

- **Agency for the Audit of the European Union Programmes Implementation System (ARPA)**, which is the auditing body, independent from the coordination body and certification body, and it responsible for external audit of the adequacy and efficiency of the management system;
 - **Ministry of Finance** is the body in charge of certification of: statements on expenditures and payment requests, before they are sent to the European Commission;
 - **Management Body:**
 - Intermediate Body, Level 1;
 - Intermediate Body, Level 2.

Based on new institutional framework of structural instruments in the programming period 2007-2013, Hrvatske vode obtained in January 2013 the EDIS (extended decentralisation implementation system) accreditation thus becoming an Intermediate Body – Level 2, which enabled continued

management of EU funds. In this respect and in accordance with new requirements and obligations, a Sector for Projects co-financed by the EU was formed from the Division for Preparation and Implementation of Projects Co-financed by the EU funds. The task of this Sector for Projects was to perform functions of a Level 2 Intermediate Body for EPOP in the water management sector. It is formed of four divisions.

Project Selection Division:

- performs the tasks related to the selection of projects to be co-financed through EU funds;
- provides information to end users about requirements to be met by projects so as to become eligible for EU financing, and information about project implementation requirements;
- provides expert assistance to end users in the preparation of documents required for project approval;

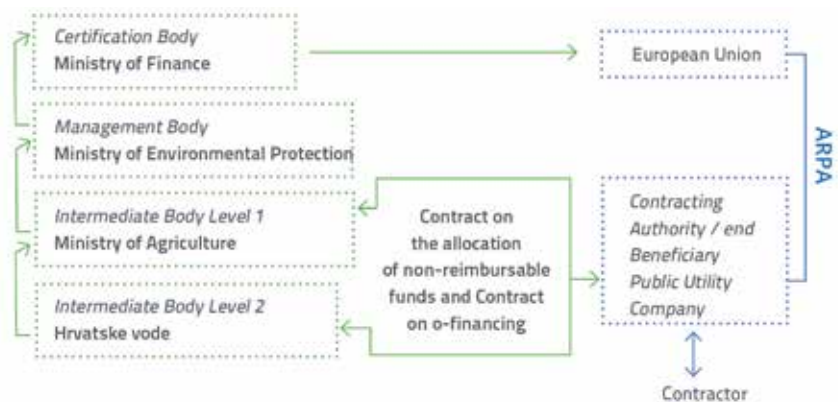


Figure 3. Management structure for the programming period 2007-2013, [3]

- performs all other activities related to providing information and assistance to end users about preparation of projects for co-financing from EU funds;
- prepares contracts for co-financing of selected projects;
- takes part in planning the budget as related to the use and the control of use of the European Union funds;
- prepares contracts on the allocation of appropriate sums from EU funds to the selected end users.

Project Implementation Division:

- performs tasks related to the control/approval of costs on projects approved for EU co-financing during implementation of such projects, in the part relating to the control of project costs and control of physical progress of projects;
- performs tasks aimed at providing information to end users about project implementation requirements relating specifically to cost control and physical progress of the project during implementation of selected projects;
- provides expert assistance to end users in the preparation of applications for the allocation of funds, and conducts all other activities as needed for informing and assisting end users in the implementation of projects and in the control of implementation of projects.

Procurement Approval Division:

- performs tasks related to the control/approval of public procurement procedures;
- performs tasks aimed at informing end users about project implementation requirements relating to the approval of procurement plan and previous and subsequent approval of procurement procedures related to the implementation of selected projects;
- provides expert assistance to end users in the course of preparation of procurement plan and tendering documents, and conducts all other activities as needed for informing and assisting end users with regard to the implementation of public procurement procedures;
- controls/approves project procurement plans, performs preliminary control/approval of tendering documents, and gives instructions about changes to tendering documents.

Management System Development Division:

- performs tasks relating to the development of the Intermediate Body system and to the control/checking of its operation;
- performs tasks related to the preparation of the Intermediate Body manual in which work methods and

- procedures are defined, and which are compliant with relevant European and national legislation, byelaws, and other guidelines published by competent bodies;
- organises preparation of supporting technical documents, methodologies and guidelines that are needed for the conduct of activities of Intermediate Bodies;
- performs tasks related to self-assessment of functioning of the Intermediate Body system, and proposes/conducts system improvement activities;
- performs/organises verifications of irregularities and takes part in all audits of the Intermediate Body's activities.

2.2.2. Structural instruments in the programming period 2014-2020

In the programming period 2014-2020, the total financial envelope for the Republic of Croatia from structural instruments amounts to € 10.676 billion. Out of that, € 6.881 billion is available for investment in growth and development through the OP Competitiveness and Cohesion, i.e. € 4.321 billion from the European Regional Development Fund, and € 2.559 billion from the Cohesion Fund:

- Water utility reform € 1,049 billion.
- European Regional Development Fund –Flood protection- € 215 million.

In the programming period 2014 – 2020, the structure of the system for the management and control of the use of funds for projects co-financed from structural instruments is formed of the same bodies as in the programming period 2007-2013 (Figure 3).

As based on the Law on establishment of institutional

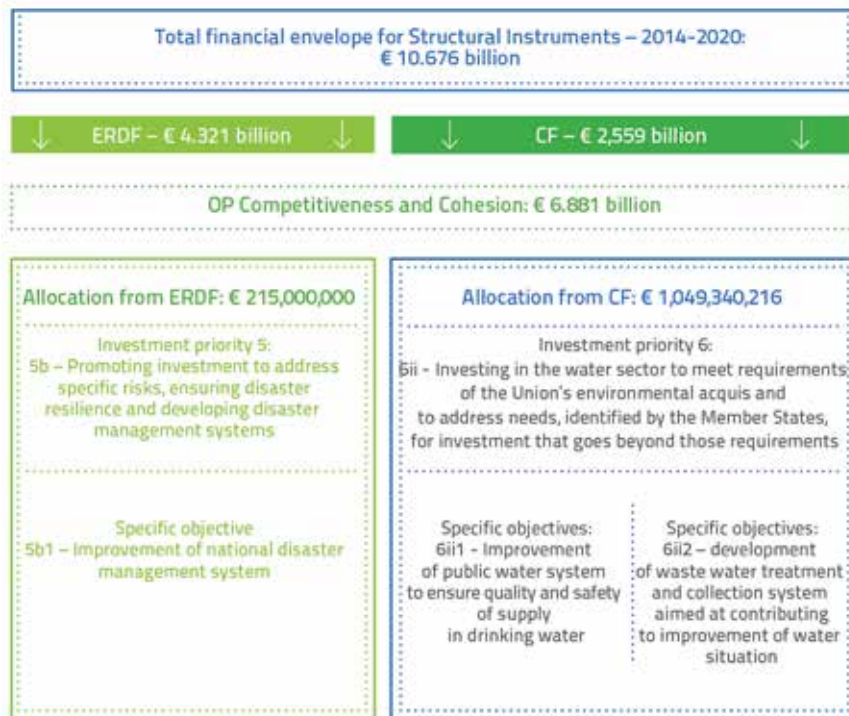


Figure 4. Allocations for OP Competitiveness and Cohesion, [4]

framework for the implementation of European structural and investment funds in the Republic of Croatia in the programming period 2014-2020 (Official Gazette 92/2014), and based on the Ordinance on the bodies included in the system for the management and control of the use of the European Social Fund, European Regional Development Fund and Cohesion Fund, as related to the objective "Investment for growth and jobs" (Official Gazette 107/2014), and based on the Ordinance on the changes to the Ordinance on the bodies included in the system for the management and control of the use of the European Social Fund, European Regional Development Fund and Cohesion Fund, as related to the objective "Investment for growth and jobs" (NN 25/2015), Hrvatske vode and other bodies included in the system are once again passing through the process of accreditation in order to continue with activities and with the realisation of tasks that were awarded to them, in their capacity as the Level 2 Intermediate Body, in the programming period 2007-2013.

The internal structure of the Sector for Projects Co-financed through EU Funds has not been changed with the new accreditation, although engagement of additional experts is planned because of intensification of activities performed in the Sector through two parallel programming periods – as the Level 2 Intermediate Body for the programming period 2007-2013, and for the programming period 2014-2020.



Figure 5. Hrvatske vode as the Level 2 Intermediate Body across programming periods [5]



Figure 6. Schematic view of a project cycle [6]

3. Understanding and management of projects

A brief overview or review of the message "Understanding and management of projects" from the document "Hrvatske vode: rules and procedures for the EU co-financed projects" (Hrvatske Vode, Zagreb, March, 2016.) is provided below to facilitate understanding of the approach and methodology proposed in Section 5 of this paper.

3.1. General

The objective of each project is to encourage changes in the way in which the system and the participants function, engaging at that the resources that have been defined in advance. Each project has its own objectives that can be fulfilled through implementation of project activities within a defined time and financial framework. All projects rely on three crucial elements:

time: accurately specified start and end of the project

result: measurable result related to project objectives that can be achieved during and/or at the end of implementation of the project

resources: all that is used for the implementation of the project (people, financing, knowledge, equipment, etc.).

These three elements are the parts of the so called "project management triangle" where each of the elements acts and has its limitations within its side of the triangle during realisation of project-related activities. The elements are also in interaction and they influence each other and so, for instance, an element / side of the triangle (result) can not be changed without influencing the other elements/sides of the triangle (resources and time). Project management is an efficient tool for monitoring work of the project team, and for checking resources, calculations and progress of work based on some specified time constraints, so as to achieve expected results in a satisfactory manner. Each project has its own cycle that is composed of various phases, i.e. that includes various steps in the process of creation, development and implementation

of a project. The project cycle defines the preparation, planning, implementation and evaluation of a project, ensuring throughout the project proper compliance with general objective of national and EU policies. In addition, the project cycle ensures that the project relevantly responds to real problems of target groups and project beneficiaries, and that individual project goals can be achieved within a specified framework. Regardless of the proportions, scope, perimeter and occupancy of a project, each project cycle includes the phases presented in Figure 6.

3.2. Specific feature of water utility projects

During preparation and implementation of water utility projects that are co-financed through the EU funds (Figure 7) care must be taken that the projects

Preparation	Implementation
Alternative solution	Detailed inspection of the existing situation regarding studies-technical documents for each project
Water quality and quantity monitoring (if necessary)	Analysis of required design-technical documentation
Feasibility study	Analysis of readiness for implementation
Cost and benefit analysis	Project readiness proposal
Environmental impact study	Definition of priority projects
Application package (application form and appendices)	Preparation of studies-planning documents
Design preparation up to the level of preliminary design for WWTP, and to the level of detailed design for all other project facilities	Preparation of technical documentation
Preparation of invitation for the submittal of project proposals	Start of project implementation
Preparation of project implementation plan	Resolution of property rights issues
Procurement of location permit for WWTP, and submittal of detailed design approval for other facilities	Procurement of required permits and construction related documents
Resolution of all property-rights issues	Implementation of procurement procedures (secondary procurement)
	Training of end users – public utility companies

Figure 7. Project cycle activities on water utility projects co-financed through EU funds, [7]

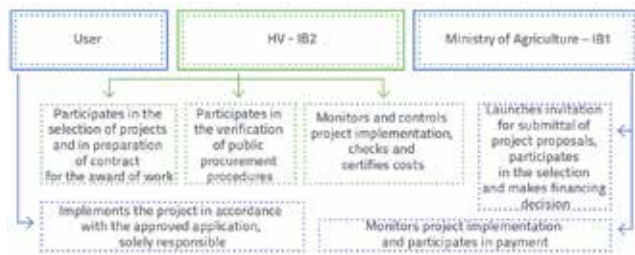


Figure 8. Roles and obligations in the implementation of water utility projects, [8]

comply with the EU environmental protection regulations (with an emphasis on the *Directive on the quality of water intended for human consumption* and the *Urban wastewater treatment Directive*), and that obligations assumed during pre-accession negotiations are respected. In addition, the projects must be harmonized with objectives specified in priority axes, and should contribute to the implementation of the said Directives. For the water utility projects co-financed through structural instruments, Hrvatske vode performs functions of the Level 2 Intermediate Body (Figure 8). The beneficiaries/applicants of the projects co-financed through structural instruments are public suppliers of water services (JIVU) backed by their partners – local government units (JLS). Their obligations and responsibilities include:

- responsibility for project applications;
- implementation of projects in accordance with approved applications;
- availability of capacities indispensable for project implementation;
- capability to efficiently use funds in accordance with the principles of cost-effectiveness, efficiency and effectiveness;

- cash flow and financing of all project costs, including unacceptable costs;
- responsibility for implementation of projects toward the Intermediate Body Level 1 (PT1) and Intermediate Body Level 2 (PT2) and toward other bodies included in the system;
- responsibility for implementation of public procurement procedures for secondary contracts (construction, supervision, etc.) that are within the scope of the project.

3.3. Division for the support to preparation and implementation of EU projects

According to its organisational structure, Hrvatske vode can be divided into two basic entities: Head office and Water Management Departments (VGO).

The Head Office has its seat in Zagreb and is structured as follows:

1. General Manager's Office,
2. Development Sector,
3. Water Management Office,
4. Sector for Protection against Adverse Effects of Water,
5. Principal Flood Protection Centre,
6. Water Use Sector,
7. Water Protection Sector,
8. Planning & Technical Inspection Sector,
9. Finance Sector,
10. Legal and personnel Sector,
11. Information & Communication Technology Sector tehnologije,
12. Unit for Implementation of National Programme for Irrigation and Management of Agricultural Land and Water Resources,
- 13. Sector for Projects Co-financed through EU funds,**
14. Unit for Implementation of National Water Management Projects,
15. Unit for Implementation of Coastal Cities Pollution Abatement Project,
16. Logistic Support Division,
17. Unit for Implementation of Projects for Protection against Adverse Effects of Water that are Financed through CEB Loans and EU Funds,
- 18. Sector for the Support to Preparation and Implementation of EU Projects.**

Territorial units for water management are formed of six VGO (Water Management Departments) and VGI (Water Management Branch Offices). The following VGOs operate in the territory of the Republic of Croatia:

- VGO for Middle and Lower Sava,
- VGO for Upper Sava,
- VGO for Mura and Upper Sava,
- VGO for Danube and Lower Drava,
- VGO for Northern Adriatic Drainage Basins,
- VGO for Southern Adriatic Drainage Basins.

Water Management Departments (VGOs) were established based on Hrvatske vode Statutes. Each VGO is structured as follows:

1. Division for Protection Against Harmful Effects of Water,
2. Division for Water Use,
3. Division for Water Protection,
4. Division for Public Water Domain,
5. Finance Division,
6. Legal and Personnel Division,
7. ICT Office,
8. Logistic Support Section,
9. Division for the Support to Preparation and Implementation of EU Projects.

The previous Section 2.2.1 contains information about the sector for projects co-financed by the EU, whose main task is to select and control implementation of projects co-financed through European funds, i.e. to perform functions of the Intermediate Body Level 2. The data about divisions operating within this sector are also provided in Section 2.2.1.

In addition to the mentioned Sector for the projects co-financed through EU funds, the Sector for the Support to Preparation and Implementation of EU projects also plays a significant role in ensuring successful realisation of the EU financed projects. This Sector operates within the company's Head Office and as a separate unit within each VGO.

The main task of the Sector is to provide support to suppliers of water services and to local government units in the preparation, implementation and procurement of public water supply and drainage projects, including wastewater treatment facilities, which are co-financed through EU funds.

The Sector's services include: preparation of a part of Financial Plan, Water Management Plan and Procurement Plan for the programme/programmes for which the Sector is responsible; monitoring realisation of Financial Plans, Water Management Plans and Procurement Plans in the segment for which the Sector is responsible; cooperation with other Hrvatske vode units, competent units and bodies (Intermediate Bodies, European Commission), national government bodies, local and regional self-government units, and other interested bodies, in all matters relating to the preparation, implementation and procurement of EU projects.

The Sector operates within the Division for Preparation and Implementation of EU projects and within the Division for Planning and procurement of EU projects.

Division for Preparation and Implementation of EU projects

The Division provides expert assistance to the suppliers of water services and local self-management units in the preparation of studies (feasibility studies, investment studies, financial-economic studies, environmental protection studies, cost and benefit analyses, etc.), in the preparation of applications for EU projects, elaboration of terms of reference and other documents for the preparation of projects, preparation and inspection of design-technical documents; preparation of plans, forecasts and reports on the use of funds and on fulfilment of financial obligations by projects in the preparation phase; if necessary, provides for auditing and quality control of the documentation; provides for expert assistance in the cooperation, or directly cooperates, with national

administration bodies, local and regional self-management bodies, and competent units and bodies (Intermediate Bodies, European Commission), all as related to preparation of EU projects.

The Division provides expert assistance to the suppliers of water services and local self-management units in the management of EU projects, including preparation and submittal of request for transfer of public funds to the Intermediate Body Level 2, monitoring implementation of EU projects via an expert authorized for investment supervision, including on-site inquiries; preparation of plans, forecasts and reports on the use of funds and on fulfilment of financial obligations by projects in the implementation phase. The Division also provides for expert assistance in the cooperation with national administration bodies, local and regional self-management bodies, and competent units and bodies (Intermediate Bodies, European Commission), all as related to the implementation of EU projects.

Division for Planning and Procurement of EU Projects

The Division provides expert assistance to end users during selection and implementation of public procurement procedures as related to EU projects, including negotiations and contract-related legal services; establishment of the system for reporting and providing information on EU projects for appropriate units and bodies; preparation of plans, forecasts and reports on the use of funds and on financial obligations by projects in the procurement phase.

A precondition for the successful and undisturbed implementation of a project, at the very start of the project, when project idea is being initially shaped, is proper establishment of the project organisation, in full accordance with best interests of the project. This issue is elaborated in more detail in the following sections.

4. Current rules and procedures for projects financed through structural instruments

Submittal of applications and implementation of projects co-financed through structural instruments for the programming period 2007-2013 and 2014-2020 involves several steps that must be taken by project beneficiaries. These steps are shown in Figure 9.

5. Proposal for adjustment of current rules and procedures for projects co-financed through structural instruments

After review of the existing functional structure that supports implementation of projects financed through EU funds, the authors propose modification of the current system, all in accordance with limitations arising from EU requests toward beneficiaries of financial assistance, and in the light of requirements relating to project-oriented organisation.

5.1. Definition of project management in construction activities

A project is a unique time-limited and goal-oriented human endeavour that involves participation of several initially independent

1.	The beneficiary applies for the project based on the limited invitation published on internet pages of the Ministry of agriculture (IB1) and Hrvatske ceste (IB2), and on the pages of European structural and investment funds
2.	After approval of application and after the financing decision is made, the beneficiary enters into Contract for the allocation of non-reimbursable funds with the Ministry of Agriculture (IB1) and Hrvatske vode (IB2) (hereinafter referred to as the Contract) and, after that, it concludes the Co-financing Contract through which the national component of financing is defined
3.	Responsibility: the beneficiary is fully responsible for the implementation of the project (even in the case when the project is implemented with partners, the beneficiary has to ensure that partners carry out the work on the project in accordance with the Contract)
4.	Project costs: the beneficiary shall bear all project costs (except for acceptable costs that will be reimbursed to the beneficiary in accordance with the Contract). The beneficiary is required to secure financing and everything else that is needed for continuous implementation of the project.
5.	Conflict of interest: the beneficiary is required to take all necessary action and/or measures in order to prevent or resolve any conflict of interest, and is also required to advise IB2 about such event without delay. If a conflict of interest occurs during implementation of the Contract or if it is subsequently determined that it existed in the process of allocation of non-reimbursable funds, or if the beneficiary does not take, or if it is obvious that it will not take, additional actions and/or measures based on the IB2's request, so as to fulfil its contractual obligation, the Contract can be dissolved and, in that case, the beneficiary will not have the right to the compensation of damage.
6.	Secondary public procurement: the beneficiary is exclusively responsible for all public procurement procedures for goods/works/services (secondary procurement) that are conducted in the scope of the project; during the planning, preparation and implementation of such procedures, the beneficiary has to respect public procurement principles and IB2's recommendations for the implementation of public procurement procedures.
7.	The role of IB2 in public procurement procedures: IB2 conducts preliminary (ex-ante) inspection of public procurement procedures for individual projects (which are selected by IB2 based on risk analysis) and makes in this way recommendations that are not binding to the beneficiaries. In addition, IB2 also conducts ex-post evaluation of public procurement procedures, and the results obtained in this way may influence reimbursement of funds by the beneficiary.
8.	Reimbursement of funds: every 90 days, the beneficiaries shall submit to IB2 the request for the reimbursement of funds as well as the information about the progress of the project. IB2 is the first level of control of the way in which funds are spent at the project level. Other control levels that may be activated during implementation of the project include: Management Body, Certification Body, Auditing Body, European Commission Auditors (DG Regio) and auditors of the European Court of Auditors (ECA)
9.	Implementation rules: the Project has to be implemented in accordance with the Contract for the allocation of non-reimbursable funds and according to the rules on the acceptability of expenses. The beneficiary is required to realise the project with due attention, transparently, in accordance with best practices in this field of activity, and in accordance with the Contract and the prevailing national legislation.

Figure 9. Procedural steps for projects co-financed through structural instruments [9]

organisations, groups and individuals with specific knowledge, capabilities and skills, as well as the use of available material resources.

Project management is not a new and unknown category in the creation and implementation of construction projects in the Republic of Croatia. Although this is an undisputable fact, it is also undisputable that construction projects are still significantly, not to say dominantly (although it would be correct), carried out through a functional or hierarchical organisation that is not and can not be, by its character, a proper environment for implementation of projects. Functional organisation is not a natural environment for a project, as its hierarchical structure and competitiveness is contrary to organisational assumptions and requirements for an optimum development of projects.

Every project requires a specific organisation that is dependent on the project objective and that does not tolerate a vertical, hierarchical structure. It is therefore indispensable that the project owner, as well as project sponsors, understand project limitations and requirements

and that they support establishment, i.e. that they decide on the establishment, of a project organisation that will, through the project team, autonomously use resources allocated to it or to be allocated to it for the implementation of a project.

At that, everything must start by nomination of project manager. This has to be done at the start of discussions about an intention to develop a possible future project. It can too often be seen in real life situations that activities for the selection of project manager are initiated at the phase when construction contract is being entered into. However, at that stage the project does not need a project manager but rather, to put it figuratively, a fireman whose task is to put out smaller or bigger fires that were ignited in previous stages of project development.

Project manager can not be and must not be a hierarchically exposed person, i.e. it is not a person that has to have a hierarchical authority, but rather a person that has the knowledge, capabilities and virtues that are needed for proper project management. The authority of project manager is contingent on the success achieved in the development of the project.

Project management is a professional discipline that is not developed incidentally within a hierarchical structure. On the contrary, it is based on specific education, training and experience that is not gained by participating, but rather by acting.

It is very often heard that a project manager has to have communication skills so as to be able to efficiently manage the project team.

This is wrong. It is no more than a secondary task.

The task of the project manager, who can also be called project leader, or project director (none of these titles can be regarded as being either the best or the worst ones) is not to manage the project team, i.e. members of the project team, but rather to manage the project itself.

He fulfils this duty by making use of the triangle of project functions: project planning, project monitoring and project control. Project manager is a qualified person whose task is to lead the project team, which is why in literature his function is often understood as that of project control. At this point, a particular emphasis must be placed on the fact that project functions do not react hierarchically but rather through mutual encouragement.

Project manager must plan, purposefully and objectively, the physical and financial progress of the project. He must anticipate development of the project team based a properly elaborated and encouraging dynamism regarding reduction and increase in team members. He must adequately anticipate the tools that will

assist the project team in its work, apply appropriate models for the procurement of project resources, establish clear relationships within the project team, i.e. relationships that will not be burdened by mutual competition between team members, but will on the contrary be based on mutual understanding and encouragement. This is quite natural as project team members have a common goal that is to be realised as a resultant of a number of mutually harmonised and motivating intermediate goals.

All this is ensured by project manager through development and implementation of the Basic Project Management Plan.

The way in which the project team is formed is presented in Figure 10. Project owner experts and Hrvatske vode experts are included in the team based on an appropriate decision, while other team members are selected based on competitive bidding and contract award. The above mentioned requirements for an optimum functioning of the project team are met through engagement or "filtering" of project team members (based on contract award criteria).

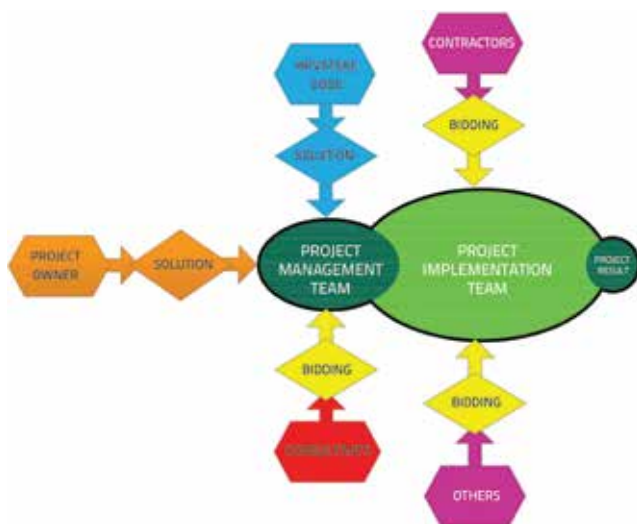


Figure 10. Establishment of project team

A project team acts through two organisational entities:

- **Project management team** whose project functions involve control, monitoring and planning; this team must imperatively be formed at the initial stage of project development and it remains in operation until the final phase of the project, i.e. until achievement of project results.
- **Project implementation team** is formed, as a rule, by conclusion of contract for provision of services, and the team members enter and leave the team as necessary, in accordance with project requirements. The project implementation team can, inter alia, be formed of: expert consultants, technologists, designers, reviewers/auditors, supervising engineers, contractors, manufacturers, suppliers, etc.

A particularly demanding task of a project manager is to identify and take into account specific interests of individual project team members, as proper and adequately directed realisation of these interests will undoubtedly contribute to the achievement of project goals.

This means that principles of maintaining good relationships, particularly those that accept differences and improve the sense of common goal, must be preserved throughout the implementation of the project, as a win-win project situation will only be achieved through realistic and unbiased understanding of conditions in which a project activity must be performed.

It can never be sufficiently emphasized that a clear relationship between the hierarchical and project organisation is crucial for the success of any project, and especially for the success of public domain construction projects. In this respect, the task of hierarchical organisation is to encourage project development by providing resources and motivation, while the task of design team is to achieve through project development an appropriate project result that is in full harmony with the project goal (objectives).

The goal of this document is not and can not be to elaborate the theory and practice of management of construction projects and so here, to make things completely clear, we are just touching upon: construction project; project management through its development stages; relationship between the functional management and project management; advantages of project management; optimum project development; use of financial resources; public procurement in the scope of project development; contract award criteria; construction work negotiation model; and, specifically, project requirements relating to wastewater purification systems.

In the implementation of Hrvatske vode projects, it is of utmost significance for Hrvatske vode project owners to develop a project-oriented organisational system that can optimally respond to project requirements and limitations. This paper discusses the way in which this can be done.

5.1.1. Construction project

For full understanding of this approach, an appropriate definition of a construction project can be cited as follows: "Construction project is a part of an investment project (undertaking), a part of an economic programme (of a complex or aggregate project), through which material, spatial and manufacturing requirements are to be met for the one time or continuous realisation of a goal (or goals) of an investment project within the service life of the project" [10].

The life of a construction project starts when an investor (client) submits its request to the consultant, or to its own functional organisation, for the elaboration of technological, urban planning, architectural-civil engineering alternative solutions for the construction of a building (project) that will fully correspond to technological processes related to the activity to be performed in accordance with the request placed by potential investor.

The construction project ends after removal of visible deficiencies and after initial operation, which is a prerequisite for the transfer of project outcomes from the project manager to the investor; this handover also marks the start of the period of regular use of construction project outcomes and of the defects liability period in which hidden defects, if any, must be eliminated. On a development project, construction project constitutes a major sub-project in the scope of which construction project stages – involving considerable spending of material resources – are materialized.

5.1.2 Construction project

A construction project can be considered at two levels, depending on the interest articulated by the project participants. Thus we can differentiate [11]:

- Investor's construction project or **construction**
- Contractor's construction project or **realisation**.

Construction is an endeavour in the scope of which the investor's expectations are to be fulfilled through realization of works on the building/project that has to meet the investor's requirements and expectations, taking into account legal and material limitations of the project site.

At that, throughout the construction process, the investor's interests are being confronted with the contractor's interests. Benefits to the owner of the construction project must be harmonized with benefits of the contractor. It is crucial for the success of the project to achieve an optimum solution for which the greatest responsibility is in fact borne by project manager.

The *client's construction project* starts with selection of the model for the award of construction work, and ends with elimination of visible defects, all in accordance with to the specification previously given for the construction project. The quality of realisation of construction work is dominantly influenced by selection of the contract award model, i.e. by the quality of preparation of technical documents and bidding documents, in which the investor's requirements and obligations of the future contractor must be clearly and unambiguously determined. The following situations can apply:

- these obligations/requirements can not be discussed neither during the tendering process, nor during realisation of work;
- these obligations/requirements can be discussed during the tendering process, but not during realisation of work;
- fixed elements are set during the tendering process, while conditions (subsequent work) are negotiated during realisation of work [12].

Construction projects are characterized by often conflicting interests, i.e. by client's requirements and expectations to get maximum quality (required by the contract, and sometimes modified at a later date) for the lowest possible price, and by the contractor's expectations (that are regularly expressed only during realisation of works) to fully or partly meet the investor's requirements at the lowest possible cost, and to gain maximum benefit for himself in the process (profit and reference).

The *contractor's construction project* is a project in which realization of work is planned within a required, accepted or offered time frame. Here, the contractor attempts to convince the investor, based on calculation of expected cost of specified work, that the contractor's offer is the most appropriate one as it provides optimum conditions for the investor. However, at the work realisation stage, the contractor attempts to reap maximum benefits for himself through the use of appropriate technological procedures, and through an optimum use of his own technological and material resources. At that, the deviation from the investor's initial requirements, i.e. the deviation from work realisation requirements and investor's expectations,

must be reduced to minimum. The realized work must be at the level that is acceptable to the investor.

The calculation takes into account the investor's requirements while it implicitly also includes the contractor's expectations that the latter will attempt to fulfill during realisation of works. The quality of work realisation project is dominantly influenced by the contractor through preliminary planning and calculation of expected cost, and through project discipline.

5.1.3 Project management and project stages

According to MPI guideline, project management can most broadly be defined as the use of knowledge, skills, tools and techniques to perform project activities in order to achieve project objectives. All this is realised through the following stages of construction projects:

- Project idea shaping
- Project preparation
- Project implementation
- Final stage of the project.

In the scope of realisation of projects, public construction projects in particular, it is indispensable – due to character and requirements of particular projects – to engage a project manager on time, i.e. already at the *project idea shaping* stage, as it is already at that stage that project manager will assume the role of the person responsible both for shaping project values and for taking action aimed at ensuring an optimum realisation of the project. For all activities that are to be realised on the project, it would be rational to engage consultants possessing specific and specialized knowledge, while the sphere of strategic decision making must be at the level of project owner.

The success of a project, construction project in particular, is explicitly contingent upon the quality of relationship that is established at the very beginning of the project, i.e. at the stage of *project idea shaping*, between the functional organisation and project organisation.

The main task of functional organisation is to create conditions for an undisturbed implementation of the project, both by ensuring material resources and by providing for transition of employees from the functional organisation into the project organisation, all in full accordance with the best interests of the project.

To ensure a successful realisation of the project, it is inadmissible to allow realisation of some project activities outside of the project team, i.e. within a closed functional organisation. This is unfortunately all too often the case in the realisation of public construction projects.

5.2. Project organisation in a project-oriented company

Based on the above information about the actual situation regarding implementation of projects in the scope of the Hrvatske vode program of development projects, and taking into account the pressing need for creating an efficient project organisation, the system of necessary organisational adjustment will be explained, and an organisation chart of an optimum functioning of a project organisation will be presented. All this with an objective to increase the current level of success in the implementation of construction projects.

5.2.1. Project development

Projects considered in this text result from strategic commitment of the Republic of Croatia which is realised through strategies of development of water sector in Croatia. The project idea is the consequence of close cooperation between Hrvatske vode and public supplier of water services (JIVU), which results in valorisation of a project idea. The block diagram presented in Figure 11 shows further development of a project idea which is translated, through participation and close cooperation between Hrvatske vode and JIVU, into the following project realisation stages:

- project preparation
- project implementation
- final stage of the project.

Project results are valorised at the final stage of the project, and this valorisation is one of key tasks of Hrvatske vode.

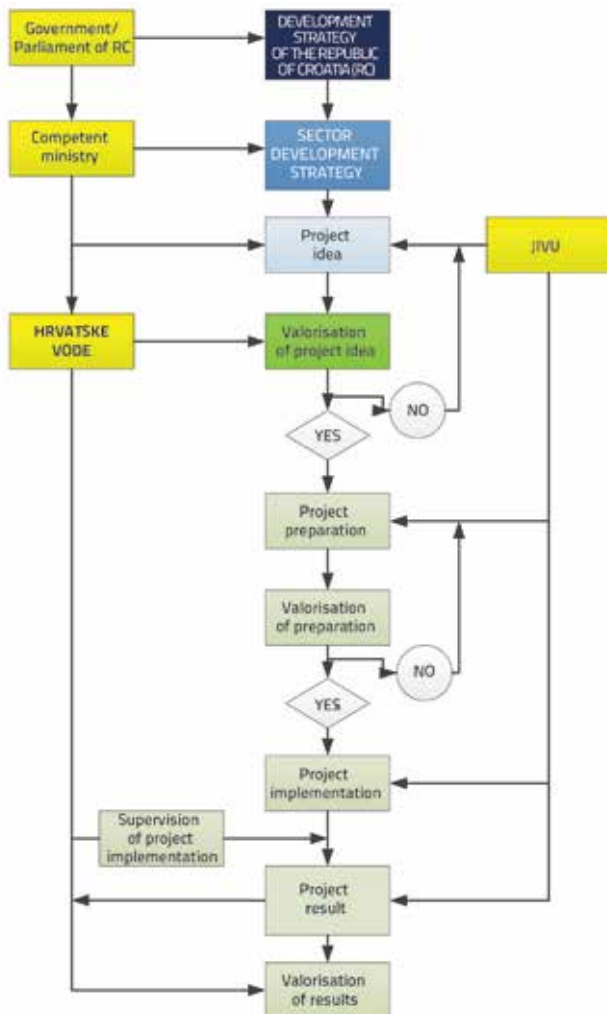


Figure 11. Project development from concept to result

5.2.2. Relationship between functional organisation and project organisation

When talking about the project organisation, it can be described in simple terms as a river with its tributaries that ends in the

sea, which understands, accepts and uses everything that the river has brought with itself. This means that, in accordance with the interests and requirements of the project, the project organisation uses in the project team the internal resources of the functional organisation as well as external resources acquired through separate contracts. The project implementation matrix is presented on Figure 12. Resources of the functional organisation are delegated to the project team by means of a hierarchical decision. At that, it should be noted that decision on the selection of a project manager can alternatively be made based on prior agreement between Hrvatske vode and JIVU.

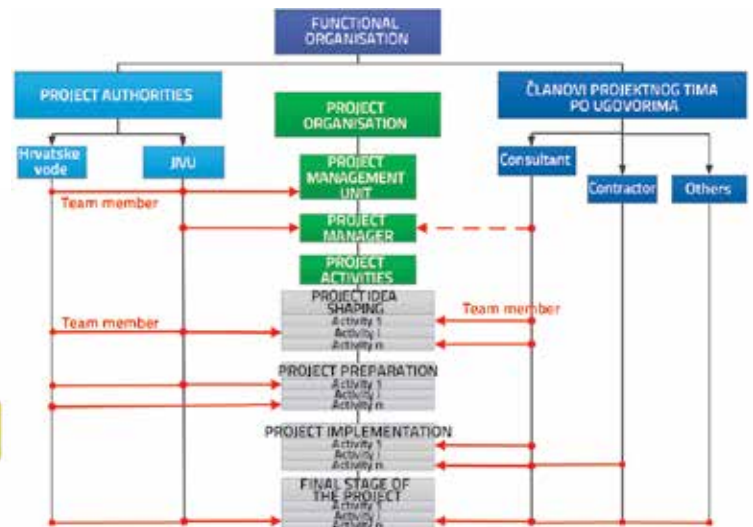


Figure 12. Hrvatske vode – project implementation matrix

5.2.3 Why project organisation

The conceptualisation, preparation and implementation of any construction project is an unrepeatable and unique endeavour, regardless of possible similarities with a previously realised project. The character of the functional organisation and the very basis of its effectiveness is the hierarchical structure where individual organisational units have tasks and the implementation of these tasks results in a product and in the unit's capacity to respond to relevant requirements. Functional organisation is characterized by competition between the employees, the objective being to advance on the hierarchical ladder.

The objective of the project organisation is to realise the task that has been set at the very beginning of project development. In this way, the result of project development will correspond fully or mostly, or at least to an acceptable level, to the initially set project goal (objective).

The project organisation does not recognise the hierarchic advancement system, and is formed exclusively horizontally, so that project team members advance in knowledge, capabilities and skills.

It can be seen in Figure 13 how conflicts occur in case of functional organisation when the transfer of individual segmental project results is operated from one functional unit to the other, which inevitably leads to conflict with regard to

efficiency of and accountability for the realisation of project segments. Nodes shown on the left side of the diagram illustrate possible disturbances in project implementation when the result of a previously performed activity passes into another functional unit as a basis of its activity (nodes that occur on the left side of the diagram).

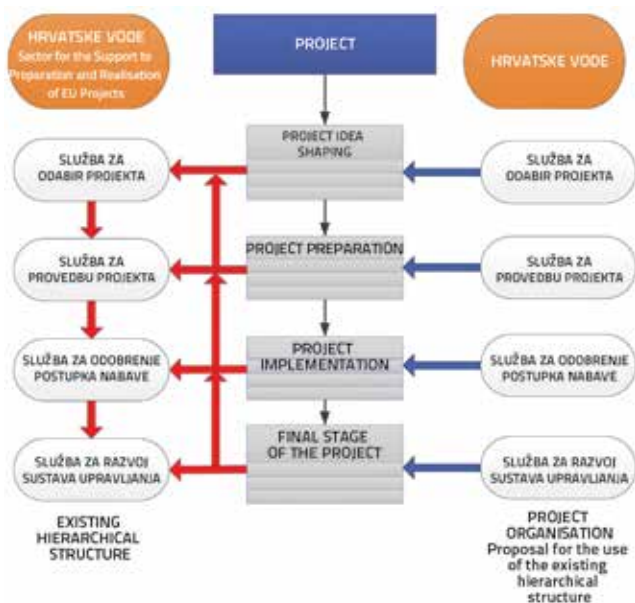


Figure 13. Functional and proposed project organisation in implementation of a project

It can clearly be seen on the right side of the diagram that the mentioned nodes are lacking. This is achieved by direct delegation of resources to the project team and their project autonomy.

The relationship between individual organisational units currently in place in Hrvatske vode and the requirements arising from the staged planning of project development is shown in Figure 14. Already at the first glance, it can be seen that there is a lack of harmony between the required structuring of project development and the existing functional organisation.

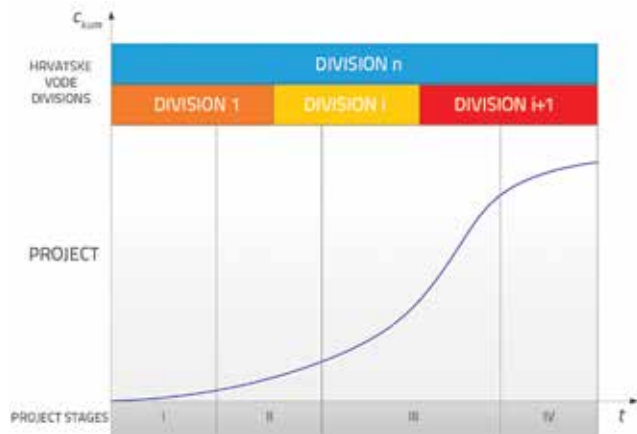


Figure 14. Hrvatske vode divisions and time schedule of project development

Figure 15 shows the relationship between functional units and time of project development where it is assumed that an individual functional unit would delegate available resources to the project team at the required stage of project development. This not a regular project requirement but a kind of concession to the existing hierarchical structure in case Hrvatske vode is not organised in accordance with project requirements, i.e. based on project organisation.

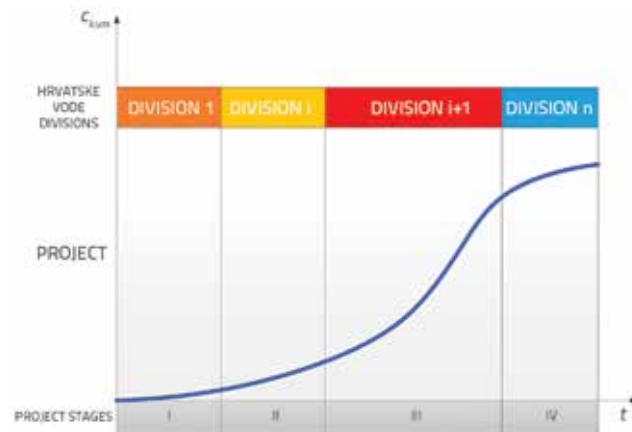


Figure 15. Hrvatske vode units harmonized with project development stages

5.2.4. Optimum project development

The projects that are analysed in this paper are determined by various influences coming from their interior and their surroundings. The projects initially occur within Hrvatske vode and are organized under the responsibility of JIVU, with significant influence of project sponsors, which in this case includes EU cohesion funds, all this with limitations arising from the relationship between the functional organisation and project organisation. Independently from external influences, the project must be realized in accordance with the development schedule shown in Figure 16. Not entering into the issue of the conditions of project financing, the diagram sets the basic relationships in the implementation of a project, from setting the project goal, to setting up the project organisation, to implementing the project and to achieving the planned project result, the ultimate aim being an optimum use of project results.

Here it should be emphasized that the project is on the one hand exposed to influences of available work resources, while it is on the other had continuously exposed to the influence of time factor. Time is a project resource that is consumed independently of the progress of activities on the project. All measurable and immeasurable indicators of the progress achieved on the project are expressed in the units of time and it is on that basis that conclusion is made on the current and/or final successfulness of the project.

As already indicated, the project team dimensioning in accordance with the planned progress on the project, i.e. through appropriate time stages, is a highly delicate task. During its implementation, it is highly significant to pay attention to the following significant project requirements:

- exact and timely planning of any increase of project team staff,

- determination of available project resources,
- engagement of additional project resources,
- reduction of project team staff in accordance with the level of completion of project tasks.

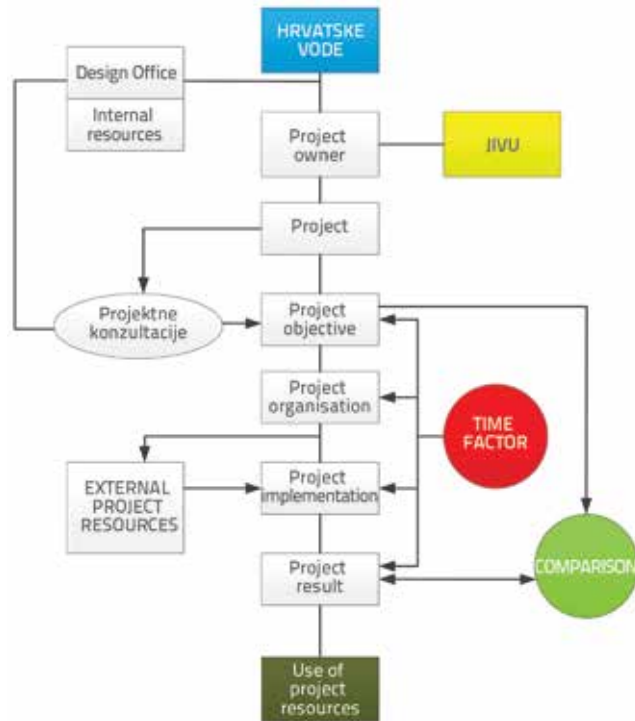


Figure 16. Block diagram of project development

The increase of project team is generally shown in Figure 17. It can be seen in the diagram that Hrvatske vode and JIVU, as project authorities, participate in the work process of the project team throughout the development of the project, which is the task of consultants who are included in the project team based on an appropriate contract with clearly articulated obligations and time in which these obligations have to be fulfilled. The same is true for the contractor, for construction of project facilities, and for equipment suppliers.

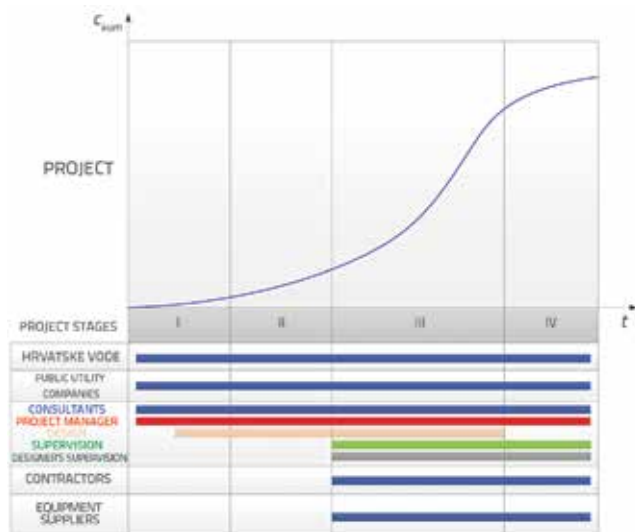


Figure 17. Project team dimensioning by project stages

The project time is a project resource that can not be influenced by the project, but rather it is used in a way that does not permit substitution but requires continuous project discipline, which is a precondition for an efficient use of available project time so that the project can be realised within the planned time (without exceeding the deadlines).

The diagram given in Figure 18 clearly points to an utmost significance of time discipline on the project, i.e. the previous stage of the project must be performed in such a way to enable realisation of the subsequent stage without serious project changes, and especially without any disturbances to the project. This means that, when planning time schedule for the realization of the project, a special attention must be paid to the duration of previous stages of the project and, at that, care should be taken not to allow overlapping of stages, i.e. the previous stage must not encroach upon the time reserved for realisation of the subsequent stage.

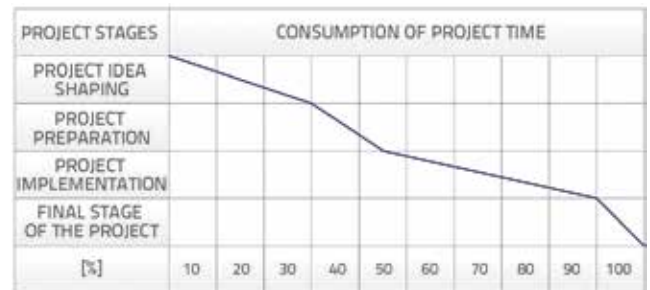


Figure 18. Distribution of project time by stages

Project discipline goes hand in hand with project accountability. A project team member's tasks must be clearly defined with regard to quality, scope and time, and the member must be aware of limitations as related to realisation of his task. The level of success in the realisation of the project task is the basis for rewarding the member for his success or lack of success.

5.3. Use of financial resources in the development of Hrvatske vode projects

Three resources are used for project financing: Hrvatske vode, JIVU and EU cohesion fund.

Considering the financing conditions associated with individual stages of the project, there are no possibilities at this moment for changing the current system of financing, as can clearly be seen in figure 19. It is obvious that Hrvatske vode funds and the project owner's funds are used for financing the first and second stages of project development.

Funds from all three resources are used in the third and fourth stages of the project. In the first and second stages, the proportion of funding by Hrvatske vode and the project owner is defined in the co-financing contract.

The proportion of individual resources is defined in the project financing section of the Feasibility Study. By approving the Feasibility Study, the financing obligations stated therein are also approved.

With regard to project financing, no changes in the existing system are anticipated in this document. This does not

mean that improvements can not be made. However, such improvements depend on relations that have already been established, and that can not easily be changed. In any case, it is indispensable to re-examine possibilities for initiating changes and for adjusting the financing system in accordance with requirements for an optimum implementation of the project.

5.4. Public procurement

5.4.1. Public procurement in the development of Hrvatske vode projects

The model based on selecting the financially most favourable offer must exclusively be used in the public procurement of services and works.

The financially most favourable offer is the one with the lowest valorised price, as based on the following formula:

$$C_{pv} = C_{po} \left(\varphi \frac{C_{po}}{C_{min}} + \Psi \frac{100}{K_{pv}} \right)$$

where:

- C_{pv} - valorised price of the eligible bidder
- C_{po} - revised price of the eligible bidder
- φ - weight factor determining influence of price
- C_{min} - minimum revised price of eligible bids
- K_{pv} - quality of a valorised bid
- 100 - maximum quality value of a bid
- Ψ - weight factor determining influence of quality.

Weight factors presented in Table 1 are recommended for the procurement of services. Weight factors presented in Table 2 are recommended for the procurement of works.

Hrvatske vode should set requirements whereby the services and works on the project would be classified into one of the above mentioned groups.

The weighting hierarchy is set in accordance with the requirements and limitations of a project. It is based on the estimation of certainty that the project results, i.e. its implementation stage, will be realized.

A credible system for evaluating acceptability of bids is established through weights, i.e. through prices and quality. This evaluation involves, on the one side, inspection of the bidder's references, and, on the other side, relevant estimation of the bidder's potential to adequately respond to the client's requests and expectations. Weights are not a fixed category: they are the basis for finding optimum solutions about the best possible response to uncertainties, relying in this respect on recent available data, information, and knowledge.

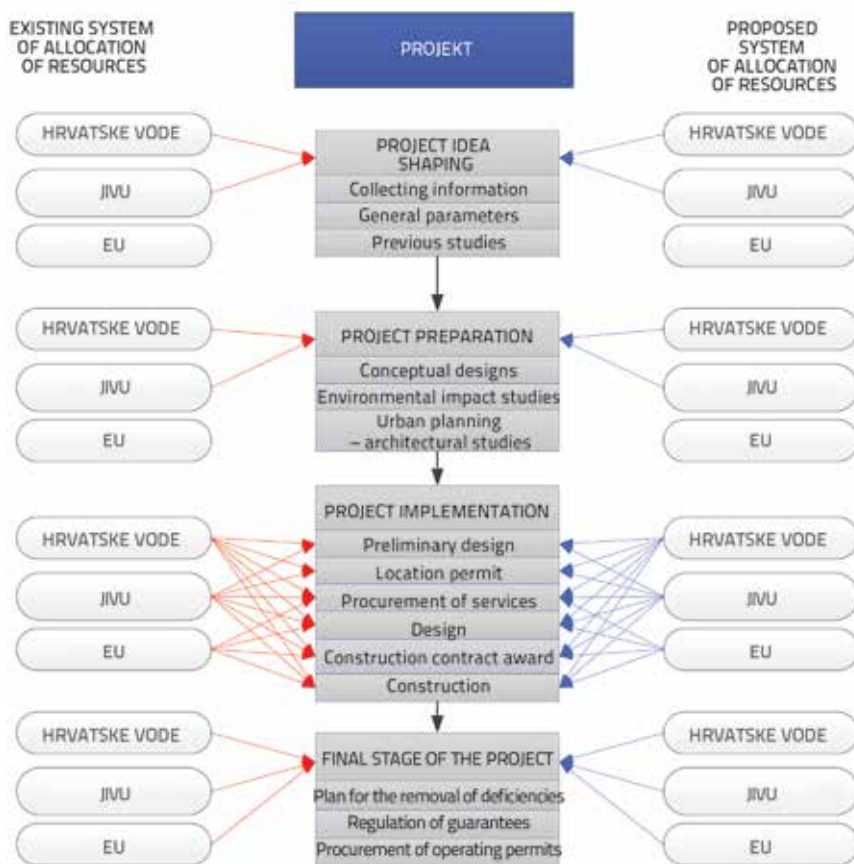


Figure 19. Allocation of funds over time

Table 1. Weights recommended for procurement of services

Project complexity	Weights	
	Influence of price (φ)	Influence of the quality of service (Ψ)
I. Highly complex projects	0.15	0.85
II. Complex projects	0.20	0.80
III. Simple projects	0.25	0.75

Table 2. Weights recommended for procurement of works

Project complexity	Weights	
	Influence of price (φ)	Influence of the quality of service (Ψ)
I. Highly complex projects	0.30	0.70
II. Complex projects	0.35	0.35
III. Simple projects	0.40	0.60

In any case, it is indisputable that the weight favouring an estimated quality of a bid, will result in a greater level of certainty for achieving the results comparable to project objectives, as the public procurement of engineering services (planning, design, auditing, consulting, supervision, realisation of works, construction, development project management, construction project management) is a job with an uncertain outcome. It is not like buying a finished product, it is a selection decision based on possible reduced certainty of selection outcomes, with which we will have to deal in the near or more distant future.

This is the advantage of using reasonable well-targeted weights defining relationships between the price and quality of eligible bids, and it objectively influences reduction of uncertainty of expected results of an engineering service, or the project in its totality.

This paper is the result of the approach through which attempts are made to make a step forward in the understanding of modalities of public procurement of engineering services, with the sequence of requirements and limitations relevant for the owner and participants in public construction projects that are realized in accordance with the Public Procurement Act.

The idea mentioned in this paper involves the conduct of public procurement in construction sector based on the model *with the price set in advance by the client*, while the bidding should be carried out exclusively through the quality-based competition.

The idea, although presumptuous at this moment, deserves – due to its exclusivity – at least the attention and acceptance, and possibly an objective evaluation.

In this way, through the use of the mentioned model, we would have a bidding results that would offer a socially acceptable cost for the project, with optimum conditions for project implementation, i.e. a win-win relationship would be established between the client and the consultant/contractor, which is a guarantee for successful outcome of the project.

5.4.2 Criteria for qualitative evaluation of bids

The criteria must be the result of previously accepted project objectives. This premise is the basis for shaping and dimensioning individual criteria and for the establishment of their correlations.

It would not be adequate nor acceptable to globally set criteria and their relationships, and it would especially be unsuccessful to attempt to do it through some regulatory modalities (such ideas have also been considered).

Obviously, it would be within the domain of expected project developments to logically insist on the reduction of uncertainty of the result of engineering services and, in this respect, it would be good to rely on already confirmed or, even better, specified solutions. There is nothing wrong with that, provided that all actions are taken in a cautious and responsible manner. This paper does not provide ready-made solutions but, rather, it points to some determinants that should be respected during shaping and dimensioning of individual quality criteria and their relationships. Even here, one should start from the specified project requirements, as already mentioned. The starting point is a general formula:

$$K_{pv} = a_1 \cdot k_1 + a_2 \cdot k_2 + a_i \cdot k_i$$

where:

K_{pv} - quality of a particular bid determined by the weighting criteria known to all bidders

a_i - weight of a i -th criterion

k_i - i -th criterion for evaluating quality of a particular bid.

According to requirements set for a particular project, value (I) should vary as follows:

I. high complexity projects: $i = 5$

II. complex projects: $i = 4$

III. simple projects: $i = 3$

$\max K_{pv} = 100$, the highest possible quality of a bid.

When defining criteria, one should not eliminate in advance possible application of value-based bid acceptability requirements, as they can and should be the basis for an accurate determination of value of individual bids, i.e. for ranking eligible bidders.

This means that, if it is specified in eligibility requirements that the bidder should have completed one similar contract amounting to no less than HRK 100,000, then a criterion for

Table 3. Criteria with maximum values

No.	Quality criterion	Basic value		Adjustment for project category		
		Criterion	Sub-criterion	I	II	III
1.	Financial capability	20		20	30	35
	1.1 Total income for the past 3 years		5			
	1.2 Similar contracts, no less than 1		15			
2.	References	40		40	50	50
	2.1. Completed contracts		5			
	2.2. Completed services		20			
	2.3. References for key personnel		15			
3.	Equipment	10		10	15	15
4.	IT support	10		10	0	0
5.	Methodology	10		20	20	0

contract award should and must be the proof of participation in a greater number of such completed contracts (\geq HRK 100.000). An individual criterion can contain two or more sub-criteria, depending on project objectives that have been set by the client. Based on relevant information available on a project, the criteria considered significant for evaluating quality of bids are proposed below, together with their respective weights.

The eligibility and the corresponding weighting are specified depending on project requirements. The criteria are presented in Table 3 where maximum values are given.

Subcriteria are developed based on project objective structuring (bidding) in such a way that indicators are evaluated up to the total value of individual subcriteria.

For instance, for the criterion (1) Financial capability, subcriterion 1.2 Similar contracts, it would be reasonable to proceed to further subcriteria structuring in the following way:

- for $n = 1$ value 5 should be assigned to the contract
- for $1 < n \leq 5$ value 8 should be assigned to the contract
- for $3 < n \leq 5$ value 12 should be assigned to the contract
- for $n > 5$ value 15 should be assigned to the contract.

A similar procedure should be applied to all other subcriteria.

It should be emphasized at this point that evaluation of individual criteria is based on the best interests of the project, and so the relationship of criteria (i) is established using the ratios: $1 : 2 : 3 : 4 : 5 = 0,5 : 1,0 : 0,25 : 0,25 : 0,5$, which is a logical result of preliminary analysis of the influence of individual criteria on the probability that project results will be achieved, i.e. that the planned engineering services will be successfully realised. However, this is and has to be the subject of further considerations during the planning and implementation of a project, all in accordance with project goals as set by the project owner.

An especially sensitive criterion is the criterion (5) Methodology, where an estimate based on the evaluator's impression can not be avoided. It is therefore necessary to divide this criterion into subcriteria that would reduce the influence of impression, i.e. the evaluator's impression has to be the results of an objective analysis of the bid quality. Four subcriteria with maximum values are proposed in this paper:

- 5.1. task completion scheduling: 6
- 5.2. project team dimensioning: 4
- 5.3. task organisation: 7
- 5.4. logistic support: 3
- Methodology (5) total: 20

A similar procedure should be used for other criteria, but this is to be decided separately for each particular project.

5.4.3. Procurement of construction and/or engineering works

FIDIC contracts based on the Red Book or Yellow Book model, relying on the Civil Obligations Act and Construction Rules (adopted, new text is in preparation) is currently dominantly used in the procurement of construction or engineering works. Both

books are used in the realization of projects that in the focus of interest of the authors of this paper.

The Yellow Book is used for the construction of waste water treatment plants (hereinafter referred to as the WWTP), while the Red Book is used for the construction of water supply and waste water drainage facilities. As both books are well known and have been in continuous use for a long time, it is appropriate to mention below only a few facts that must be taken into account when deciding on the use of a particular book. The Yellow Book requires a clear, unambiguous and accurate preparation of the client's requirements regarding contract results. It is no less important for the client to determine requirements and limitations within which the contractor is required to build and/or realize the works. In order to protect the client's interests, it is important for the latter to clearly define the required result of a particular contract, and to commit the contractor to define project influences that can be changed during implementation of the contract and that must be adequately accepted in the process of implementation of the contract. This means, in the case of WWTP projects, that the contractor must be committed to determine the waste water system (input parameters) and its variations over time. In other words, the contractor is required to determine initial state of the project, design, construction and/or realisation of works in accordance with requirements and limitations set by the client, including the responsibility for the end result of the contract.



Figure 20. Client and contractor relationships in the realisation of contract according to Yellow Book



Figure 21. Client and contractor relationships in the realisation of contract according to Red Book

When opting for the Red Book, the client is obliged to prepare the entire technical documentation, which becomes an integral part of his requirements. At that, specifications are of prime significance as they limit the scope of the contractor's risks, and clearly differentiate them from project risks that are controlled by the client, and for which the client is responsible. The contractor is responsible for project results which have to

be in accordance with the conditions and requirements set by the client. The specific features of contracts based on the Yellow Book and Red Book can be seen in comparison diagrams.

The analysis of results obtained by using these contracting models leads us to the conclusion that, for the successful realisation of the project that will not involve project changes or, even worse, project disturbances, it is indispensable for the client to pay special attention to the preparation of procurement in such a way to:

- when using the Yellow Book:
 - clearly articulate requirements toward the contractor,
 - accurately determine the contractor's responsibilities for determining influences and conditions for the design of the plant, with defined results regarding operation of the plant after completion,
 - determine conditions and duration of initial operation of the plant,
 - determine conditions and modalities of handover of the completed plant,
 - determine conditions and modalities for maintenance of the system, with conditions for adjustment, if such adjustment proves necessary or is planned;
- when using the Red Book
 - conduct adequate preparation of the project,
 - perform an efficient monitoring,
 - design a flexible and elastic system,
 - determine conditions and modalities of handover of the completed system,
 - determine conditions and modalities for maintenance of the system, with conditions for adjustment, if such adjustment proves necessary or is planned.

In the case of construction of a system with sensitive and variable influences, it would be wise to apply the Yellow Book, while the Red Book is recommended in the case of closed systems.

5.4.4. Selection of project implementation model

In the case of public procurement, when building facilities that are required on Hrvatske vode projects, regardless of whether they are co-financed or not co-financed from EU funds, it is indispensable to select an appropriate project implementation model, and this selection must be done before conducting any public procurement procedures. The model must be the result of a thorough analysis of project requirements and objectives, and it must also be based on a detailed study of potential project capacities, both domestic and foreign.

When referring to potential project capacities, it is significant to clearly and efficiently determine the binding time schedule for the start, intensity, and completion of the use of individual capacities, i.e. available resources.

In order to respond to project requirements, it is indispensable to conduct at the very beginning, i.e. after establishment of the *Project idea shaping* stage, a continuous process of the supply of consulting

engineer services. The first step is to appoint the project manager, whose role is to project development of both the project and the project team.

It is only after completion of this stage, when decision on further development of the project has been made, that the project manager will prepare the proposal of the Basic Project Management Plan, which will then be subjected to the approval of the client or the project owner. In accordance with provisions contained in the Basic Project Management Plan, project manager will organise the process of the supply of consulting engineer services and, in that way, in close cooperation with the project owner, project manager initiates establishment of the project team. This team can be formed through one or several public procurement procedures, and it also involves appointment of some experts from functional organisations of the project owner and Hrvatske vode. It is advisable to procure in parallel the technological consulting & design services (in accordance with the scope of work required by he selected project implementation model) and supervising engineer's services. The need for timely engagement of technologists and designers with special competences can in no event be disputed.

Why is it necessary to engage at that early time the engineers that will supervise the construction work? Simply because they will thus be continuously acquainted - throughout development of the design process - with all characteristics, requirements and instructions contained in design documents, which all should be both timely and clearly communicated during actual realisation of construction work. In addition, the supervising engineer's experience in supervisory activities is also invaluable to the designers who will thus be cautioned about possible difficulties that might be expected during construction, i.e. during application of design solutions. It goes without saying that the engagement of supervising engineers at the stage of project development must be properly dimensioned, both with regard to time and cost of such engagement.

In the preparation of requirements to be met by the bidders, regardless of whether they are related to the supply of consulting engineer services or to construction award, the project owner is required to pay appropriate attention to the protection of interests of domestic capacities, and this in such a way that it can not be interpreted as restricting the free market competition. At that, he will have to take into account limitations of domestic capacities, and the fact that such limitations should in no way hinder implementation of the project. Depending on the project implementation model to be applied, as well as the FIDIC form of contract to be used, project manager will prepare a draft Framework Project Development Plan and will submit it to the project owner for approval.

When analysing the above plan, i.e. in the plan approval process, the project owner can use consulting services of any expert he considers appropriate, but must not circumvent Hrvatske vode in the process. The public-private partnership model is not considered in this paper although it could be applied on Hrvatske vode projects, albeit with special caution when structuring mutual obligations between the project owner and private partner(s). The FIDIC Yellow Book can serve as a basic guideline for determining contractual obligations. The most important issue is to clearly envisage distribution of responsibilities in the case of occurrence of project risks.

The diagrams that are used in this text to illustrate the models are not complete and, in particular, they are not detailed and are not defined in time, i.e. they can be used solely for presentation of basic processes occurring on a project. Detailed maps of project implementation processes must be prepared for each individual project, and especially when securing financial contribution from EU funds.

A comparative analysis of possible processes is made in order to select an appropriate project implementation model based on the FIDIC Red Book or Yellow Book, and it also serves for elaboration of an appropriate time schedule of the project.

The application of any model may involve risks relating to the existing and future variations in the load imposed on the system. However, the distribution of responsibilities for future variations and possible deviations is addressed through implementation of an appropriate model.

The scope of this paper does not enable a closer examination of the responsibility distribution system. That is why only a brief account will be given about the differences in the application of individual models.

In general terms, the FIDIC Yellow Book is appropriate for the construction of waste water treatment systems, although there is no reason to exclude in advance the possibility of using the FIDIC Red Book. This selection must be based on a thorough analysis so that an optimum decision can be reached.

We will not consider here the dimensioning, individual tasks, or the function of a project team. However, what is important is that a clear organisational distinction must be made within the project implementation team about the planning, monitoring and control of the project, and about the way in which members of a broader project team should be included in the work of the project team. An optimum solution would be to form the project team partly by delegation of experts from hierarchical resources, and partly by engaging experts from external resources (consultants) through appropriate contracts in which project relationships and responsibilities must be clearly and unambiguously established.

Due to considerable differences in project organisation and time scheduling that arise from the use of various implementation models, which dominantly influences the public procurement of services and works, we will show below how the system functions when the FIDIC Red Book is used, and how it functions when the FIDIC Yellow Book is applied.



Figure 22. FIDIC Red Book, project implementation process and EU funds

5.4.4.1. Model based on FIDIC Red Book

The basic feature of the project implementation model based on the FIDIC Red Book is the strict distribution of project responsibilities between the project owner and the contractor, both with regard to project deadlines and the final quality of construction projects.

The project owner is obliged to carry out the monitoring of existing loads, to make conclusions about possible future variations, and to prepare, on that basis, bidding documents for the award of construction work. It is only through the bidding documents, i.e. through particular conditions, that the project owner can define the required level of response of competed system to load variations. However, all further deviations, i.e. deviations beyond the planned scope, are the project owner's risk. It can clearly be seen from Figure 22 that the project owner is obliged to conduct the entire process involving preparation of technical documentation, which is the basis for preparation of the bidding procedure for the realisation of construction work. The project owner is fully responsible for the preparation of documents that are needed for submitting application for project co-financing from EU funds.

The certificate on the acceptability of the environmental impact study must be obtained within the time frame for preparation of the feasibility study. These activities are carried out after selection of an appropriate conceptual design. The contractor's responsibility for project results is limited by input parameters for which the project owner is responsible.

5.4.4.2. Model based on FIDIC Yellow Book

The basic feature of the project implementation model based on the FIDIC Yellow Book is the layering of design responsibilities between the project owner and contractor in relation to the deadlines. However, the contractor bears the main responsibility for the quality of construction project results and for successful application of the project.

The project owner is required to carry out the bidding procedure for the provision of consulting engineer services. In this model, the project owner prepares the bidding documents for the award of construction works, based on the approved conceptual design (with possible alternatives). On the other hand, the contractor is required to order or organise - at its expense but for the benefit of the project owner - the entire technical documentation, from the preliminary design to the working design. So as to respond to the project owner's requirements, the contractor must organise monitoring of the existing loads, estimate possible future variations, and prepare, on that basis, the required technical documentation.

The contractor must predict through technical documentation, i.e. through the expected results of the system, the response of the future system to the expected variations in load. However, all other deviations outside of the estimated variation range are also the risk to be borne by the contractor (of course, within the previously defined limits).

As can be seen in Figure 23, the contractor is obliged to conduct the entire process involving collection of technical documents for construction work, and this on the basis of the contractor's

contractual obligations. What can not be seen in this figure is the responsibility for the procurement of location and building permits. This obligation can be directly assumed by the project owner, or it can be done by the contractor in the name and for the account of the project owner, i.e. the option that is more beneficial to a particular project is adopted in this respect. The preparation of documents for making the project eligible for co-financing from EU funds is the obligation that must be fully assumed by the project owner. The certificate on the acceptability of the environmental impact study must be obtained within the time frame for preparation of the feasibility study. These activities are carried out after selection of an appropriate conceptual design. The contractor's responsibility for project results is indivisible, both with regard to functioning and use of the future system. The project owner's responsibility is reduced to timely payment of financial obligations and to continuous control of the system's output results, taking into account limitations that are defined by the beneficiary of the project outcomes.



Figure 23. FIDIC Yellow Book, project implementation process and EU funds

5.5. Project requirements for waste water treatment systems

The construction of waste water treatment systems is one of the most demanding public construction projects, primarily because of high risk involved in achieving expected results. Risks and their (very probable) occurrence are directly dependent on (extremely high) variations in the level of waste water ingredients, both as to their content and time of occurrence.

The systems are required to be flexible and elastic in the treatment of waste water, and to provide the defined results, i.e. the defined quality of waste waters that are evacuated into the final discharge zone.

That is why the applied prediction/planning system, which indisputably must be based on a necessary level of speculation, is of crucial significance for the success of the project.

Long term monitoring is the basis for obtaining historic data that illustrate variations in capacity and load of waste water with particular ingredients. However, conclusions about future are burdened with a high level of unreliability. In this respect it is necessary to determine:

- the existence of network and its scope by areas;
- variations in pollution, both as to content and time, and speculations are made about:
- time frame for network extension

- changes in the waste water system (population/industry)
- possible staged construction of the system.

This means that various system dimensioning models must be considered already at the *project idea shaping* stage. At that, various assumptions, characterized by high level on uncertainty, have to be studied, analysed, and valorised.

The starting point must be that the growth of network and system capacities must be harmonised, i.e. that the system must be capable of reacting to the level of estimated variations. In other words, the system must be able to absorb – without any disturbances - the estimated variations, while the result achieved must be acceptable for the final discharge zone (receiving bodies of water).

At that, it is important to take into account limitations involved in the mechanical and biological treatment of waste water, including definition of special requirements for large polluters (industry).

A parallel albeit often neglected task involves treatment of sludge. This issue must be given a proper and timely attention taking into account the existing technological solutions on the treatment of excess sludge. The above brief considerations lead to specific requirements for proper planning and development of the system:

- the system is dimensioned based on new knowledge;
- when designing the system, it is necessary to take into account assumptions regarding development of user network, namely from the aspect of pollution capacities and content;
- the system must be designed for the staged development of capacities;
- the severity of new requirements for the final discharge of treated waste water can be greatly increased over time;
- with regard to requirement for staged development, the system must be designed using a modular concept;
- when developing a modular solution, decision must be made about providing space for the storage of new modules, and everything must be harmonized with water discharge limitations.

With regard to responsibility for the result the system is to show in the future, the contractor's responsibility is of undisputable significance, especially for the client but also for the project in its totality. Thus the contractor's task is to:

- to take into account the existing limitations in the preparation, design and construction of the system;
- predict future variations and anticipate appropriate stages for the construction and maintenance of the system;
- design and build a flexible i.e. adjustable system;
- assume responsibility for an appropriate functioning of the system and for its maintenance.

The contractor will be entitled to receive payment of the total sum for construction work only after expiry of the defects liability period, and after achievement of the result (completed system) that is unquestionably acceptable for the final discharge of treated waste water. Proper use of the bank guarantee instrument is highly significant in this respect.

The contractor will be entitled to receive payment for system maintenance in accordance with load of the system, but under condition that the system operates without any deviations, and in the manner that is acceptable for the final discharge of water. The system maintenance payments must be directly dependent on the actual operation of the system, i.e. an impeccable functioning of the system is a precondition for payment of maintenance costs. This means that the quality of treated waste water must be indisputably appropriate for the final discharge of water. All this undoubtedly leads to the conclusion that it would be appropriate to use the FIDIC's Yellow Book in the public procurement of services for system construction, namely because these rules will contribute to the safer operation of the system, while possible misunderstandings regarding unrealised system assumptions would thus also be avoided.

The graphic representation of the process according to the Yellow Book and Red Book shows that the consumption of project time is identical in both contract types, but also that the distribution of risk differs considerably. The bidder who offers the best possible system result, who assumes full responsibility for the achievement of future results thus safeguarding the client against possible system malfunctions, and who assumes project risks (as it is he who sets up the system) but for a reasonable price, should and must be selected as the most favourable bidder. The mentioned reasonable price must result from an open, well-targeted and honest bidding, and the implementation of such bidding requires a concentrated and all-encompassing preparation. This is the task of the project team led by project manager. When this model is implemented, the system functioning risk is transferred to the contractor, not because it would be convenient for the Client, but for the project optimisation purposes.

6. Conclusion

This paper is based on the research on the implementation of the projects of Hrvatske vode and project owners, as financed through EU funds, and is also the result of experience the authors have gained in the management of complex infrastructure development projects. The objective of this research is to propose direction for alteration

of the existing system for implementation of public construction projects, including those of interest to the authors. This alteration must start from good practices and it should be harmonised with the principles and requirements of the project organisation. This requires functional adjustments in the organisation of activities for the preparation and implementation of the projects under study. The establishment of a clear-cut matrix organisation that will strengthen project requirements in an optimum way, while properly taking into account relationships between the hierarchical organisation and project organisation, is a precondition for an efficient and inspiring response to particular limitations and conditions regarding conceptualisation and implementation of construction projects. At that it is necessary to apply the expertise and knowledge existing outside of the existing functional organisations of the participants in the project, the aim being to enable optimum engagement of available internal and external resources and to respect deadlines for the achievement of construction project objectives.

It is of crucial significance to emphasize that the segment of project management requires special attention, and that project manager must be appointed in the initial stage of project realisation, i.e. during initial shaping of the project idea. It is only in this way that it would be possible to achieve a continuous and purposeful development of the project through further dynamic shaping of the project team. The project result is dominantly influenced by the first project step in which the very implementation of the future construction project is being structured. This paper was prepared in order to structure the construction project implementation space in such a way to enable optimum consumption of available project resources, but this is a task that is imposed to every project owner as a professional challenge.

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REFERENCES

- [1] Hrvatske vode: Pravila i procedure za EU sufinancirane projekte, Hrvatske vode, Zagreb, ožujak 2016., p. 6, www.voda.hr/eu/dokumenti
- [2] Hrvatske vode i Europska unija, Hrvatske vode, Zagreb, prosinac 2015., pp. 4, www.voda.hr/eu/dokumenti
- [3] Hrvatske vode i Europska unija, Hrvatske vode, Zagreb, prosinac 2015., pp. 8, www.voda.hr/eu/dokumenti
- [4] Hrvatske vode: pravila i procedure za EU sufinancirane projekte, Hrvatske vode, Zagreb, ožujak 2016., p. 16, www.voda.hr/eu/dokumenti
- [5] Hrvatske vode i Europska unija, Hrvatske vode, Zagreb, prosinac 2015., pp. 18, www.voda.hr/eu/dokumenti
- [6] Hrvatske vode: pravila i procedure za EU sufinancirane projekte, Hrvatske vode, Zagreb, ožujak 2016., p. 8, www.voda.hr/eu/dokumenti
- [7] Hrvatske vode: pravila i procedure za EU sufinancirane projekte, Hrvatske vode, Zagreb, ožujak 2016., pp. 9-10, www.voda.hr/eu/dokumenti
- [8] Hrvatske vode: pravila i procedure za EU sufinancirane projekte, Hrvatske vode, Zagreb, ožujak 2016., p. 10, www.voda.hr/eu/dokumenti
- [9] Hrvatske vode: pravila i procedure za EU sufinancirane projekte, Hrvatske vode, Zagreb, ožujak 2016., p. 17
- [10] Orešković, M., Bandić, M.: Projektni menadžment u graditeljstvu, TVZ, Zagreb, 2015., p. 82
- [11] Orešković, M., Bandić, M.: Projektni menadžment u graditeljstvu, TVZ, Zagreb, 2015., p. 84
- [12] Orešković, M., Bandić, M.: Projektni menadžment u graditeljstvu, TVZ, Zagreb, 2015., p. 85
- [13] Nakić, D., Vouk, D., Štirmer, N., Serdar, M.: Gospodarenje muljem s UPOV-a – novi uvod u mogućnosti njegove uporabe kao zamjenskog cementnog materijala, Građevinar, 70 (2018) 4, pp. 277-286, <https://doi.org/10.14256/JCE.2164.2017>
- [14] Zekić, E., Vuković, Ž., Halkijević, I.: Primjena nanotehnologije u pročišćavanju otpadnih voda, Građevinar, 70 (2018) 4, pp. 315-323., <https://doi.org/10.14256/JCE.2165.2017>
- [15] Tadić, I., Barač, B., Tadić, Z.: Analiza financijskih pokazatelja EU sufinanciranih projekata odvodnje i pročišćavanja otpadnih voda u Republici Hrvatskoj, Građevinar, 70 (2018) 4, pp. 345-352, <https://doi.org/10.14256/JCE.2166.2017>
- [16] Čosić Flajsig, G., Belaj, M., Karleuša, B.: Upravljanje površinskim vodama primjenom kombiniranog pristupa, Građevinar, 69 (2017) 8, pp. 617-631, <https://doi.org/10.14256/JCE.2063.2017>
- [17] Stanković, D.: Biljni uređaji za pročišćavanje otpadnih voda, Građevinar, 69 (2017) 8, pp. 639-652, <https://doi.org/10.14256/JCE.2062.2017>