

# Identification of Risk Factors in Water Supply and Sewage Projects

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An investment project as an undertaking for the future, more or less foreseeable, is a priori encumbered with the possibility of occurrence of disturbances. In recent years there have appeared significant changes in the scope of execution of construction projects, connected with the investment execution time, manner of financing, investors, and the environment in which the given project is executed. That fact determines the need, or even the necessity, to conduct the research into the issues of risk assessment and its utilitarian aspects. That problem applies also to construction projects, including water supply and sewage projects. An example of the project with all kinds of threats characteristic of such types of investments is the project entitled "Complex protection of the underground waters in the Kielce agglomeration." The risk factors result from the complexity and specificity of that type of projects. The presented article is an introduction to the discussion on the issues of assessing the risk of execution of water supply and sewage projects. The intention of the authors was to present the specificity of that type of projects and the general identification of the risk factors accompanying them.

**Keywords:** risk management, project management, construction management, civil engineering.

## 1. INTRODUCTION

It may be assumed that the risk refers to the situation where the selection of the given decision variant results in the possibility of occurrence of various events, with negative and positive consequences for the project, with the probability of their occurrence that is known or possible to determine (Knight, 1921), (Pfeffer, 1956), (Sean & Regan, 2003), (Skorupka, 2012), (Willet, 1951). The presented assumption should provide the basis for describing the project execution risk assessment, including investment projects.

An investment project as an undertaking for the future, more or less foreseeable, is a priori encumbered with the possibility of occurrence of disturbances. The analysis of their impact, i.e. in fact the analysis of risk, is therefore an example of rational behaviour. Rational does not mean common, or applied in practice. There are several possible reasons for such state of things. One of them is the broadly defined discrepancy between science and business. Another reason is a so-called organizational culture, i.e. lack of acceptance or reluctance to change the existing procedures. That

fact determines the need, or even the necessity, to conduct the research into the issues of risk assessment and its utilitarian aspects.

That problem applies also to construction projects (Legal Act 1994), including water supply and sewage projects (Legal Act 2001). That kinds of projects are characterized by large variety of duration, cost consumption, complexity, i.e. the susceptibility to the potential disturbances, referred to in the literature as risk factors (Gładysz et al., 2015), (Hashemi et al., 2013), (Kaplinski & Janusz, 2006), (Kasprowicz, 2000), (Połoński, 2006), (Sobotka & Czarnigowska, 2005), (Skorupka, 2006), (Skorupka, 2008). Such type of projects is subject to the analysis presented in the article.

## 2. SPECIFICITY OF CONSTRUCTION PROJECTS

In recent years there have appeared significant changes in the scope of execution of construction projects, connected with the investment execution time, manner of financing, investors, and the

environment in which the given project is executed.

The proportions between the investment preparation period and execution time are changing. The preparatory period is becoming longer, and the execution period – shorter. It is associated, on the one hand, with the rising number of documentation at the preparatory stage, rising number of the required permits for execution of investments and arrangements associated with environmental protection, the investor needs to take into account the time associated with appeal procedures in the case of execution of an investment based on a tender procedure, and the protests of environment protection organizations. On the other hand, an important factor is the manner of financing an investment. In the case of the projects executed with the use of EU funds, there appears the necessity to settle and finish the investment within the exactly defined time limits, which largely reduces the possibility of modifying the investment execution time. The next thing is the answer to the question of who executes the given investment – a private company, a commune, many communes, an association. In the case of a private company, it may be certainly assumed that a very important role is played by the cost of investment execution and, for example, many decisions made during the execution will be associated with the possibility to save certain expenses. If the investor is from the public sector, the economical factor is often of secondary significance, while the primary factor is the social and political effect obtained due to investment execution.

Among construction investments there also exists one more division, differentiating them in terms of risk assessment, i.e. cubic and linear investments.

Cubic investments have very clearly specified area, easy process of identification of which plot or plots are necessary for executing the task. Usually the spatial jurisdiction of the decision-making authorities, connected with the investment, is easy to determine, as well as the process of obtaining the necessary construction permits and environmental arrangements. The logistics process is easier and cheaper.

### 3. SPECIFICITY OF WATER SUPPLY AND SEWAGE PROJECTS

As for linear investments, such as water supply and sewage projects, the situation is completely different. The basic difference is the area covered by the investment – it can be the area of one commune, several communes or the whole county. Such a situation often causes a number of execution problems. For example, at the preparatory stage the investor, instead of one construction permit, needs to apply for several or a dozen such permits. The same problem appears in terms of environmental arrangements. It may be treated as the first risk factor.

Also, the manner of managing the investment changes because practically always the investor is from the public sector. Often there are several units of self-government which have to determine the manner of managing the project, whether it will be an inter-commune agreement, an association of communes, or whether there is the need to establish a company in which the communes will have their representatives. The selection of the legal form determines what resources the investors will have the possibility to apply for, if any (Arn & Friedrich, 1994).

The next risk factor is the determination to what degree the respective communes are interested in the investment. What needs to be taken into consideration is the fact that the aims of the respective communes aren't always completely consistent with the aim of the project.

In the case of execution of water supply and sewage projects, executed by the self-governments of small communes, what is significant is the answer to the question: is the project cost-effective? It should be remembered that the most important effect is the social one, i.e. providing water allowing sewage channelling from the areas where it had been impossible.

The next factor is political risk. Linear projects, in particular water supply and sewage projects, are executed over a long period of time and that is why it is important to reach an agreement on a political level, not only at the stage of investment planning, but also a consistent execution of the investment by the respective ruling teams – if there appear changes due to elections. A destabilization of that arrangement can cause serious execution problems, and even suspension of the project.

A long time of investment increases the legal risk. Gigantic problems are caused by the changing interpretation of tax provisions, e.g. as regards the

changes of the level of VAT tax. The changes with regard to qualified costs in the case of investments co-funded from the European Union, can often reduce or stop investments due to exclusion of the given cost from co-financing.

The water supply and sewage investments are characterized by a high level of the risk associated with the involvement of the citizens of the commune, in particular the owners of the lands where the investment is to be executed. There appear frequent situations where the investment is executed on the lands of the owners who are not citizens of the commune and who are not interested in participating in the project. At the stage of execution of those investments there often appear more significant difficulties (blocking the road lanes, organization of detours, etc.) for the citizens than in the case of other construction projects.

#### 4. AN EXAMPLE OF A WATER SUPPLY AND SEWAGE PROJECT

An example of the project with all kinds of threats characteristic for such types of investments is the project entitled “Complex protection of the underground waters in the Kielce agglomeration”. At an early stage, the project was assuming the extension of the sewage treatment plant with a sewage network and of a part of the water supply network in the territory of the city of Kielce and three communes: Sitkówka-Nowiny, Masłów and Zagnańsk, adjacent to Kielce, and comprising the Inter-Commune Water Supply and Sewage Association. Due to the size of the undertaking, it was divided into two projects as early as at the preparatory stage of the planned works. The first project covered the modernization of the treatment plant located in the territory of the commune of Sitkówka-Nowiny, and the second project – “Complex Protection of the Underground Waters of the Kielce Agglomeration” which assumed the modernization and construction of a water supply and sewage network in the territory of the four communes.

The project assumes the achievement of the following aims:

- Execution of the arrangements of the Access Treaty which requires that until 2015 all the agglomerations in Poland be equipped with a sewage system that allows to eliminate the load of biodegradable waste, constituting 100% of the whole load of such wastes from the agglomeration (Directive, 1991).

- Resumption of the quality of surface and underground waters to the condition resulting from the planned manner of using them, and from the needs associated with their ecological functions.
- Direct protection of the surface and underground waters used as a source of drinking water, and their indirect protection by limiting its use for industrial purposes.
- Improvement of the quality of life of the citizens of the region by creating the suitable technical infrastructure (Presentation..., 2012).

Since 2004 the Kielce Waterworks (“Wodociągi Kieleckie” [in Polish]), as a beneficiary of the EU resources, assumed the obligation of financing, together with the EU, the program of protecting underground sources of drinking water. Thanks to the efforts of the authorities of the Company, the project was introduced into the list of the key projects for the development of Poland. The Construction Works associated with the Project were executed from January 2010. On 5 October 2010 there was signed an Agreement on Co-Financing with the National Fund for Environmental Protection and Water Management. On 5 December 2011 the European Commission made the decision to grant a donation from the resources of the Cohesion Fund for the execution of the Project entitled “Complex Protection of the Underground Waters of the Kielce Agglomeration”.

The project covers 184.8 km of a new sewage network, 9.2 km of a modernized sewage network, and 5.7 km of a modernized water supply network. The actual execution of the project required the conclusion of 13 contracts for construction works, 3 contracts for the services of Contract Engineers, and 7 contracts for the services of Technical Support. The planned number of people to be connected to the sanitary sewage system constructed within the Project will be over 15,000 people, while over 1,000 people will be connected to the water supply network constructed within the Project. The European Union will cover almost 85% of qualified expenses. The remaining part will come from the own resources and credits of the Project beneficiary, the Wodociągi Kieleckie (Kielce Waterworks) Company (table 1).

Table 1. Costs of project execution (Skorupka &amp; Korona, 2014).

Components of the project	Cost in the millions of U.S. dollar (approximately)
The planned total gross cost of the project	76.57
The amount of co-financing from the Cohesion Fund	41.47
Own funds of Wodociągi Kieleckie (Kielce Waterworks)	35.10
Including VAT tax	13.79

Project execution calendar:

a) Project "Modernization of the Sitkówka Sewage Treatment Plant:

- 21 May 2007 – Signing an agreement with a Contract Engineer
- 20 May 2008 – Signing a Contract with the Contractor of construction works
- 25 February 2009 - Obtaining the construction permit for the I stage of works
- 26-27 October 2010 – Obtaining the ecological effect in the sewage path
- 30 June 2011 – Completing the works for the sewage part of the treatment plant

b) The Project "Complex Protection of the Underground Waters of the Kielce Agglomeration":

- 5-7 October 2010 – Signing the Agreement on Co-Financing the Project.

During the TIWS International Fair taking place on 5-7 October 2010 in Kielce, there was signed the Agreement on Co-Financing by and between the National Fund for Environmental Protection and Water Management in Warsaw and the Beneficiary – "Wodociągi Kieleckie" Sp. z o. o. The agreement was associated with co-financing the project "Complex Protection of the Underground Waters in the Kielce Agglomeration" within activity 1.1 Water supply and sewage management in the agglomerations above 15,000 PE, priority: Water Supply and Sewage Management of the 2007 – 2013 Infrastructure and Environment Operating Program.

- 20 April 2011 - The Stage sewage and water supply for the peripheries and centre of the city of Kielce.

On 20 April 2011 "Wodociągi Kieleckie" signed an Agreement on a public tender entitled "Replacement of the Water Supply

Network together with Connections in the Centre of Kielce, in the following Streets: Duża/Czerwonego Krzyża, Kapitulna, Mała, Warszawska". On the basis of the concluded contract there were executed the construction works consisting in replacement of the water supply network, and replacement of the water supply connections, fed from the project network, in the streets of the very Centre of Kielce. The works were conducted in 3 stages, completed in the 3<sup>rd</sup> quarter of 2011

- 10 December 2012 - Agreement on execution of the Masłów contract.

The agreement on execution of the Masłów Contract was signed on Monday, 10 December 2012, in the headquarters of Wodociągi Kieleckie. It is the largest contract, worth almost about \$ 16.27 million, within the project of the Complex Protection of the Underground Waters of the Kielce Agglomeration. The scope of the agreement covers the construction of about 72 kilometres of a new water supply network in the territory of the Masłów commune until June 2015. The first excavators started the works in spring 2013. As a result of that investment, the new sewage system will be provided to the following municipalities: Wola Kopcowa, Domaszowice, Masłów Pierwszy and Drugi, Mąchocice Kapitulne, and the water supply network – to Nademłyn, Marczakowa Dolina, Brzezinki, Ściegna, Barcza, Dąbrowa Łąki, Ciekoty. The Contractor is the consortium selected in the tender, with the less construction company from Chodcza as the leader, which consortium undertook to execute that task for \$ 16.12 million. The contract engineer is the consortium with Group Company from Warsaw as the leader. Both companies are responsible for the started construction of the sewage system in the suburbs of Kielce and in the commune of Sitkówka – Nowiny, within the same EU project. 17 January 2013 - Zagnańsk Sewage System. Agreement with a contract engineer.

On Thursday, 17 January 2013 in the headquarters of Wodociągi Kieleckie, there was signed the agreement of the value of almost 1 million PLN, with the engineer of the contract for the sewage

system for the commune of Zagnańsk, within the EU project of Complex Protection of the Underground Waters of the Kielce Agglomeration. The subject of the agreement is holding the function of the contract engineer for the following undertakings: Contract No. VI/1 – Construction of the sanitary sewage system in the area of the commune of Zagnańsk – stage I, Contract No. VI/2 – Construction of the sanitary sewage system in the commune of Zagnańsk – stage II. Stage I covers the following municipalities: Samsonów Ciągłe, Samsonów Piechotne, Samsonów Komorniki, Goleniawy, Samsonów Dudków, Chrusty, Zachełmie, Kościelna Górka, Ściegna, Siodła, Jaworze and Kaniów II. It is predicted that 29 kilometres of the sewage system will be built. The works are planned to be completed in the fourth quarter of 2014. Stage II of the sewage system for the commune of Zagnańsk covers the following municipalities: Kołomań, Umer, Tumlin Dąbrówka, Tumlin Węgle, Tumlin Zacisze, Tumlin Osowa and Belno.

- 21 June 2013 - Agreement on constructing the sanitary sewage system in the commune of Zagnańsk.

Within the project of the Complex Protection of the Underground Waters of the Kielce Agglomeration, on 21 June 2013 in Zagnańsk there was signed a contract. The tender for that contract was won by the one of the largest construction companies from Warsaw. Until the fall of 2014, in the commune there will be 29 kilometres of the new sewage system. The tender was organized within the EU project Complex Protection of the Underground Waters of the Kielce Agglomeration. That part of the investment covers the construction of a sewage system in the following municipalities: Samsonów Ciągłe, Samsonów Piechotne, Samsonów Komorniki, Dutków, Bartków, Goleniawy, Kaniów II, Zachełmie, Kościelna Górka, Chrusty Małe, Chrusty Duże, Ściegna, Jaworze and Siodła. It is predicted that 29 kilometres of the sewage system will be built under the agreement. Contract

execution time: start - 3<sup>rd</sup> quarter of 2013, completion - 3<sup>rd</sup> quarter of 2014.

- 26 June 2013 - The agreement on execution of the water supply and sewage system in the commune of Masłów.

The agreement was signed on Wednesday, 26 June 2013, in the headquarters of Wodociągi Kieleckie. It is a part of the “Masłów” contract, for which the responsibility will rest upon the one of the largest construction companies from Warsaw. The company will be executing Contract “Construction of the sanitary sewage and water supply system in Masłów – the northern part”, within the project of Complex Protection of the Underground Waters of the Kielce Agglomeration. In the tender there were submitted eight bids, which were opened on 25 March 2013. This construction company offered the execution of the contract for \$ 1.89 million. Within the project there will be constructed new sections of the sewage system in the following municipalities: Wiśniówka, Dąbrowa Łąki and Domaszowice and a water supply system in Ciekoty. In total, there will be constructed 7.39 km of a sewage network and 4.8 km of a water supply network, together with equipment and the remaining infrastructure. The completion of the construction is planned for June 2014, and of the whole KOWPAK project – for December 2015 (Figure 1).

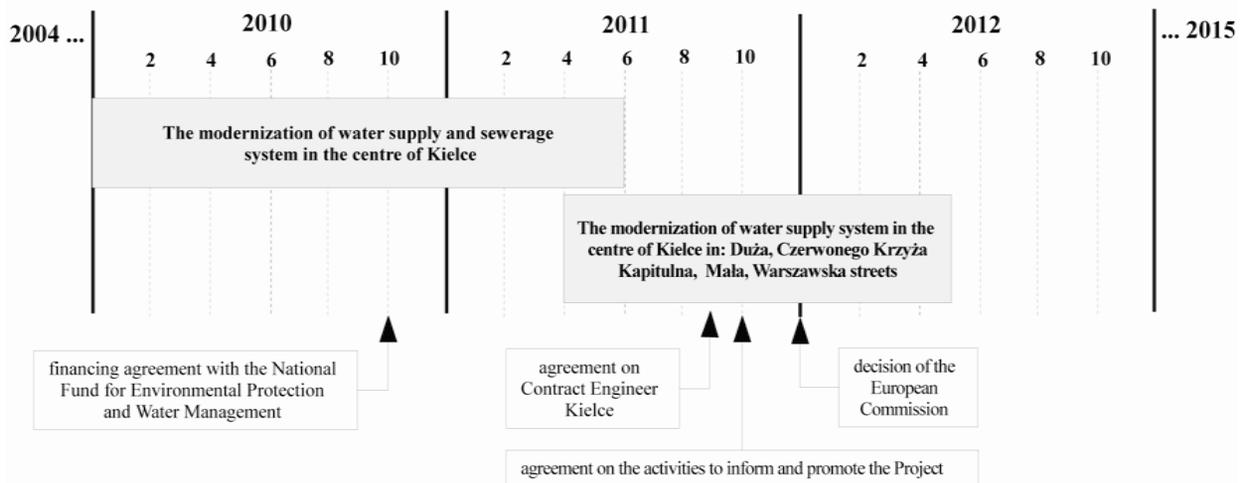


Fig. 1. Schedule of project execution (Presentation ..., 2012).

### 5. INITIAL SPECIFICATION OF RISK FACTORS IN WATER SUPPLY AND SEWAGE PROJECTS

With the example of the project described above, we may distinguish between the following risk factors for water supply and sewerage projects:

- a) The risk associated with the exact specification of the degree of interest and needs of the respective investors.

In the case of that project, the communes benefited from that project to a various degree. The commune of Masłów was the biggest beneficiary in terms of the length of the constructed sewerage and water supply system. The commune of Zagnańsk was second, but on the other hand, by connecting the largest number of people to the network, both communes achieved the ecological effect at the level required by the European Union which co-financed the project in 85%. The two remaining communes would have been able to execute their scopes independently, but they would have to engage only their own budget resources. The suitable balancing, at the preparatory stage, of the respective interests of the communes participating in the project, was a key factor in the execution of the project.

- b) Risk of changes of provisions and their interpretation

During project execution, the European Commission changed several times the rules of qualifying the costs of water supply connections to qualified or non-qualified costs. In the first period the connection was to be built 1m behind the borderline of the plot, and the rest was to be performed by the land

owner. In turn, the commune was to execute that performance from the owner. During the execution of the project the interpretation of the provisions changed and the commune could co-finance the construction of connections by land owners. The quoted risk factor affected not only the cost, but also the duration of the project. As some of the decisions were made in Brussels, any explanations or protests extended significantly the time of execution of the undertaking.

- c) The risk of achieving the assumed level of the ecological effect

Another factor directly associated with the conditions imposed by the financing institution was the risk of failure to achieve the ecological effect, i.e. the specified number of citizens connected to the network. That risk made the communes take into account the actual threat of returning some of the resources. As a result, in the stage of the first tenders, upon the initiative of the less interested communes there was made the decision to limit the project by the northern part of Masłów.

- d) Process risk

In that investment there appeared the risk associated with the structure of project management. In that case the communes make up an inter-commune association, in which Kielce has four representatives, and the remaining communes two representatives each, thus establishing the meeting of the association, i.e. the resolution-passing authority. The management board consists of the president and all the commune heads. They constitute the meeting of the partners of

the Wodociągi Kieleckie Company. This causes a situation where the potential initiative of any commune, or the problems submitted by it, need to pass several decision-making levels.

- e) Risk of social protest  
It is the risk associated with the necessity of disturbing daily life caused by road and land works, cutting off the utilities, etc.
- f) Political risk  
In the described project it was a critical risk, because during the stage of tenders there were taking place the self-government elections, and in two communes the authorities changed completely, which resulted in a limitation of the project in the commune of Masłów.

## 6. SUMMARY

To sum up, risk is an intrinsic element of the process of managing any project. Lack of the introduced mechanism of risk assessment and methods of reacting to them, may cause problems, and in the worst case scenario – the abandonment of the project.

Execution of water supply and sewage projects is burdened with risk. The risk factors result from the complexity and specificity of that type of projects.

Risk is associated with:

- the territory on which the project is executed, usually a very large territory,
- the investor, who practically always comes from the public sector,
- the method of financing, i.e. usually from the budgets of local self-government units and EU funds,
- the complex management structure resulting from the execution of an investment by several communes;
- the transfer of emphasis from the financial to social effect of the project.

The presented article is an introduction to the discussion on the issues of assessing the risk of execution of water supply and sewage projects. The intention of the authors was to present the specificity of that type of projects and the general identification of the risk factors accompanying them.

It seems that a necessary condition for the planning stage of projects implemented by the unit of local government is a comprehensive approach to the evaluation of such projects. Most of these

projects are analyzed especially in terms of finance and time. This means that we only analyze whether the project is cost effective and feasible within a certain period of time. In the preparatory process of the project the unit of local government must also take into account the risk factors associated with existing infrastructure of water and sewerage on the basis of which the project will be implemented. An equally important element requiring a risk analysis in such projects will also be the reactions of the local community.

Thus, in the next article the authors will present the possibilities of minimizing the risks concerning the issues raised in this paper.

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