ANALYSIS AND ASSESSMENT OF RISKS ASSOCIATED WITH CONSTRUCTION OF THE ROAD INFRASTRUCTURE IN SLOVAKIA

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Abstract: The article analyzes the risks associated with the process of constructing the road infrastructure. It´s showing us how many different types of risks threats this process and what can happen if we ignore them. In the article are these risks divided in different groups according to the place in this process where they arise, they are also singly defined and described. In the end of the article is possible to find different proposals for the elimination of these risks and also there are mentioned a few reasons why is building of the road infrastructure in Slovakia so slow.

1 Introduction

Risk is danger of creation of adverse events, such as loss, damage, failure, with some probability with which these events may occur.

Risk = uncertainty x adverse effect

Risk = danger / preventive measures

From these relations, we can understand that risk can´t be zero. Awareness of risk reduces this risk and with implementation of preventive measures we can successfully even more reduce this risk[1].

1.1 The general process of risk assessment

General process of risk assessment is possible to define via this algorithm.

The first step is defining the system in which we operate and in which some risks and dangerous situations can arise. The second step is identifying dangers in this system and they´re possible consequences if they are fullfilled, what means identifying the hidden attributes of some objects or activities which can cause damages.

If we defined the possible consequences properly the next step is risk assessment which is a function of probability of an undesirable situation and the severity of consequences if the danger is fullfilled.

The next step is risk rating and considering if the risk is acceptable for our situation and whether we are willing to continue the process with this risk. If the risk is acceptable the assessing ends and realisation of the project can start. If it isn´t, the task is to find appropiate measures to reduce the risk and after aplication of this measures the algorithm starts again with new inputs.

This algorithm can be recurrent until the risk reducing measures will not bring us the wanted results and until the risk doesn´t become acceptable.

This algorithm is ilustrated there:

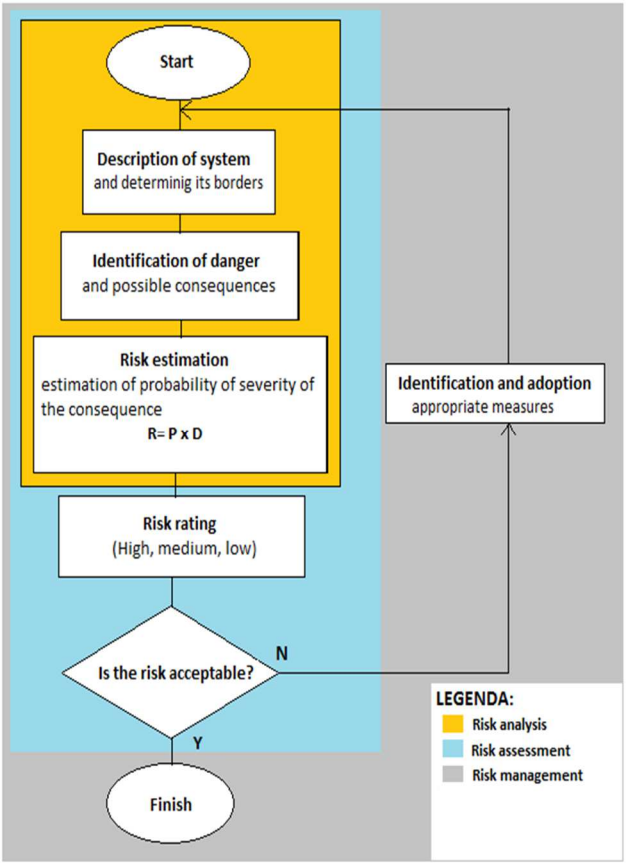

Figure 1 Algorithm of the general process of risk assessment
Author: *Dávid Šimko*

1.2 Crisis management

Crisis management as an actiity is a set of measures and acts focused on solving emergency situations by using specific principles, methods and procedures to overcome its adverse effects and restore original functions of the system [2].

Crisis management as an institution is a system of workers or authorities who analyze the possibility of crisis situations in this system, their causes and possible

consequences as well as finding methods and measures for crisis prevention and elimination existing crisis situations[2].

Basic tools of crisis management:

- Crisis thinking
- Crisis management system
- Crisis planning
- Crisis communication

Crisis thinking

One of the most important tools of crisis management is crisis thinking. It understands the necessity of creation crisis situations and accepts the necessity spending funds on preventive measures and removing negative effects of crisis situations. Forming of the crisis thinking, its success with solving crisis situations and the crisis communication level depend on crisis management. Crisis thinking together with crisis communication creates a functional connection between company and crisis management [3].

Crisis management

Is formed by horizontal and vertical structure of managing and executive authorities, their function and scope, connection and mutual relations, activities, legal environment, tools and technical and technological equipment. Crisis management performs preventive function and also implementation function. Some of its elements works permanently, others only during solving crisis situations [3].

Crisis planning

The aim of crisis planning is to collect all the needs and requirements that are necessary for dealing with crisis situation but also to create an overview of available resources and compare them with the identified requirements. With this, crisis planning creates good conditions for successful intervention and minimalization of damages [3].

Crisis communication

On the one hand, it has an important role in true and full informing right persons about emergency preparations and on the other hand in informing about emergency situations and their course. There must be also some kind of backup communication and information system to preserve the continuity of ongoing processes in case of failure of the primary communication channels[3].

1.3 The general procedure of road construction

The whole process of construction of the road infrastructure from the first step can be summarized in following points:

1. **Pre-investment preparation:**
   - **a.** Process of engineering research
   - **b.** Process of EIA (Enviromental impact assessment)
   - **c.** Development plan
   - **d.** Reporting on the evaluation report, final attitude of the EIA process
   - **e.** Route stabilization in spatial plans of municipalities and higher territorial units
2. **Investment preparation and project preparation:**
   - **a.** Preparation of building project and documentation for zoning
   - **b.** Zoning decision about the building location
   - **c.** Documentation for planning permission
   - **d.** Decision about permanent set-aside of agricultural land and forest land
   - **e.** Ownership and legal settlement (purchase and expropriation)
   - **f.** Planning permission
3. **Realisation and construction:**
   - **a.** Tender documentation
   - **b.** Choosing a construction contractor through tender
   - **c.** Transfering the building place to construction contractor
   - **d.** Complex regulatory activities of construction works
   - **e.** Designer´s supervision
   - **f.** Acceptance procedure
   - **g.** Documentation of actual state of the finished building
   - **h.** The building approval procedure
   - **i.** Final technical and economic assessment of the completed public work
4. **Transfering the stewardship or ownership**
5. **Using [4]**

1.4 System of construction of the road infrastructure

Proper operation of the this system depends on proper operation of all its elements, as shows the following figure:

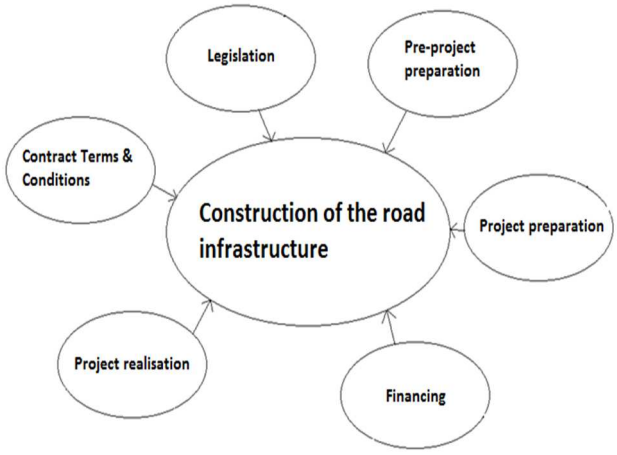

Figure 2 System of the construction of the road infrastructure
Author: *Dávid Šimko*

2 Schedule of risks associated with construction of the road infrastructure

Following shedule shows how many risks are associated with contruction of the road infrastructure through PPP projects and in which category they belong:

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1. **CONSTRUCTION, TECHNOLOGICAL AND PROJECT RISKS**
   - **1.1 Construction and project risks**
     - **1.1.1.** The risk of project documentation
     - **1.1.2.** The risk of construction / building
     - **1.1.3.** The risk of construction costs overruning
     - **1.1.4.** The risk of contamination of the environment during project implementation
     - **1.1.5.** The risk of project impact on the environment during the projects lifetime
   - **1.2 Risks of locality**
     - **1.2.1.** The risk of an existing object
     - **1.2.2.** The risk of availability of the locality
     - **1.2.3.** The risk of the locality ownership
     - **1.2.4.** The risk of locality condition
     - **1.2.5.** The risk of an existing utilities in the construction locality
     - **1.2.6.** The risk of the zoning plan
     - **1.2.7.** The risk of the planning permission
     - **1.2.8.** The risk of cultural or archaeological heritage
     - **1.2.9.** The risk of protected natural area
   - **1.3 Risks of faulty technologies, utilites and related services**
     - **1.3.1.** The risk of mistakes during project realisation
     - **1.3.2.** The risk of mistakes during the projects lifetime
     - **1.3.3.** The risk of faulty technology
     - **1.3.4.** The risk of technological inadequancy
     - **1.3.5.** The risk of an unexpected power, tilities or support system failures
2. **CREDIT RISKS**
   - **2.1 The risk of liquidity**
   - **2.2 The risk of failure to fulfill obligations/availability risk**
     - **2.2.1.** The risk of failure to fulfill the obligations by private sector
     - **2.2.2.** The risk of failure to fulfill the obligations by public sector
     - **2.2.3.** The risk of failure of the cuonterparty
     - **2.2.4.** The risk of concentration
     - **2.2.5.** The risk of partnership rejection
3. **MARKET RISKS**
   - **3.1. The risk of demand**
   - **3.2. The risk of favoring the rivals**
   - **3.3. Other market risks**
     - **3.3.1.** The risk of foreign currency
     - **3.3.2.** The risk of inflation
     - **3.3.3.** The risk of interest rate
4. **EXTERNAL RISKS**
   - **4.1. Political risks**
     - **4.1.1.** The risk of election and changing the government
     - **4.1.2.** The risk of governmentfailure
     - **4.1.3.** Transnational political risk
   - **4.2. Force majeure risks**
     - **4.2.1.** The risk of natural disaster
     - **4.2.2.** The risk of terrorism
     - **4.2.3.** The risk of military conflict
   - **4.3. Other external risks**
     - **4.3.1.** Tax risk of general character
     - **4.3.2.** Tax risk of specific character
     - **4.3.3.** The risk of additional concessions
     - **4.3.4.** The risk of situation in the sector
5. **OPERATIONAL RISKS**
   - **5.1. Risks associated with equipment**
     - **5.1.1.** The risk of inputs (material)
     - **5.1.2.** The risk of maintenance, repair, modifications and adaptation
     - **5.1.3.** The risk of low residual value
   - **5.2. Risks associated with manpower**
     - **5.2.1.** The risk of non adequate manpower / the risk of irreplaceability
     - **5.2.2.** The risk of lack of manpower
     - **5.2.3.** The risk of labor disputes
     - **5.2.4.** The risk of human error
   - **5.3. Security risks**
     - **5.3.1.** The risk of fraud or illegal dealings
     - **5.3.2.** The risk of technological system´s safety
     - **5.3.3.** The risk of damage or theft
6. **STRATEGIC RISKS**
   - **6.1. Contractual risks**
     - **6.1.1.** The risk of liability to third parties
     - **6.1.2.** The risk of changes in the contract
     - **6.1.3.** The risk of breaking the generally binding regulations
   - **6.2. Other stategic risks**
     - **6.2.1.** The risk of strategic decision
     - **6.2.2.** The risk of reputation[5]

2.1 Construction, technological and project risks

These risks are directly related to the characteristics of the building, its construction and project preparation, construction works, implementation and operation of the

infrastructure. As for transport, there is a set of international rules to clearly identify the scope of accountability, responsibility and risk sharing for each counterparty. In transport it´s called INCOTERMS and in building sector exist so-called FIDIC books for similar purposes as INCOTERMS.

However, road infrastructure projects are specific in that, it is impossible to itemize all the risks definitively to each counterparty. Problem is, that we can estimate the composition of the bedrock, rock or hill, where we want to build the road infrastructure but the actual conditions may be quite different.

2.2 Credit risks

Their nature is based on the fact that one of the counterparty breaks or fails in fulfilling the conrtract conditions. Consequences are increased cost or project delay.

2.3 Market risks

Formation and rate of these risks are affected by macroeconomic indicators but they may also occur because of the low rate of demand for public services.

2.4 External risks

They are not the result of fault by one ofthe actors of the project but arise from influence of external factors and external environment of the project. Their management is problematic. These risks can have business and financial impact on both. On private sector and also on public sector.

2.5 Operational risks

Operational risks are directly related to execution of works on the project and organization of human resources.

2.6 Strategic risks

Strategic risks are those risks that have a relation with intention of the company and the results of correct or incorrect decisions may have serious consequences for the future of the company.

3 Proposals of various methods for elimination these risks

There are a few proposals of various methods how these risks can be eliminated and how construction of the road infrastructure can become safer.

3.1 The double-envelope system for evaluating the tenderers

One of the possible improvements in decision making process could be for example The double-envelope system for evaluating the tenderers. It´s based on separation the offered quotation from technical solution. In this system each tenderer delivers 2 envelopes. The first contains anonymous technical solution of the building and the second the quotation for this technical solution.

The first phase is about opening the envelopes with technical solutions, scoring of tenderers in each evaluation criteria and then determining the weight of each criteria by independent expert jury. This way the most appropiate technical solutions are chosen. Tenderers whose technical solutions do not achieved the minimum qualifying criteria are eliminated in the first round of the tender.

In the second round the envelopes with quotations are opened publicly and they are evaluated by similar scoring system as technical solutions in the first round. Finally there are assigned weights to points for the price and for quality. Price mustn´t get bigger weight than quality. Company with highest rating wins.

Critical point in this process is proper determination of weights in each category for quality and price but the result is professional and impartial evaluation of the technical solution even in a country with higher index of corruption.

3.2 Elimination of construction, technological and project risks

Pre-project and project preparation is the basis of whole construction process. High quality project preparation can eliminate a lot of construction risks. That is why is so important to have enough financial resources ready for reliable companies which guarantee quality terrain maping, project of good quality, preparation of researches, technical documentations, site preparation, budgeting and building. With these activities the company prepares documents about project realisation which warn realisation teams against various dangers. Project must be designed properly for the first time because re-making or making new project requires a lot of additional funds and takes a lot of time.

Regular collection and disposal of construction and dangerous waste are important for elimination the risk of contamination the environment around the construction site.

Very important is also choosing the right technology in order to its performance and benefits meet the requirements on the section where the technology is going to be used. That eliminates the risk from over or under-sizing the technology.

3.3 Elimination of credit risks

Credit risks associated with the construction contractor can be partially eliminated in the tender where all tenderers solvency is examined. Companies that aren´t solvent are discarded and the tender continues only with companies which are not supposed to become insolvent.

The risk of fail to fulfill obligations can´t be eliminated but in contract can be mentioned consequences which one of the counterparty abide in case of default.

Elimination of the risk of concentration is very simple and it´s based on cooperating with more than just one supplier. So if one of the suppliers fails, we can cooperate with another immediately.

3.4 Elimination of market risks

An important thing after the road opening is the correct setting of charges for its use and adequate complementary services (gas stations, quality parkings and rest areas, SOS phones, etc.) which will increase interest in its use. Disproportionately high charges and poor services could discourage motorists from using this road which would cause reduction of demand and low income.

The foreign currency risk can be partially eliminated by choosing the most stable currency in which counterparties will trade.

The risk of interest rate can be quite successfully eliminated by stipulation of the fixed interest rate throughout the repayment period.

3.5 Elimination of external risks

These risks are also known as “vis major”. That means on their formation is not participating none of the counterparties and are difficult to eliminate them. It´s necessary to have prepared emergency plans if there would be a fulfillment of one of them and it´s necessary to behave according to these plans. For example it is evacuation in case of fire, flood or another natural disasters.

3.6 Elimination of operational risks

Because this category is mainly about risks occurring and related with work on the construction site very important is responsible recruitment of competent subcontractors who meet all the prerequisites for responsible supplying materials or services in required quality.

Contractor´s responsibility is to ensure the proper functioning of the technology on the construction site. That can be ensured by regular controls and maintenance which eliminate the risk of technology breakdown or accident. Technology breakdown could cause serious material damages, injuries, financial losses or time delay.

The risk of non adequate manpower, the risk of irreplaceability or the risk of human error are closely interrelated and their elimination shouldn´t be taken lightly. Many of the tragedies on Slovak D1 highway happened just because there wasn´t present competent construction supervisor who could stop works performed in unsuitable conditions.

The main tool of these risks elimination could be strict control, which would not allow performing some works in case of absence of the person competent to do that work or absence the competent supervisor. Important thing is also to have more competent people to perform one work and if any of them are indisposed do not replace him by untrained worker. This kind of replacing is a sign of lack of manpower. In this case are all risks focused on a small group of workers who are entrusted with plenty of challenges and this leads to human error.

The easiest way how to eliminate the risk of damage or theft is hiring a private security service which will protect the workers, materials and technology against attack, damage or theft. It can also does a random checks among the workers on the construction site to check if they are not involved in any illegal activity or if they aren´t under the influence of alcohol.

3.7 Elimination of strategic risks

The strategic risks include for example the risk of changes in the contract. Both counterparties lawyers care about elimination of this risk and it starts already in the initial contract negotiations.

Strategic decision has often strong impact on the future of the company and that is why are all strategic decisions considered carefully. Final decision is chosen after considering all possible options.

Every contract which company accepts as well as its public appearance have strong impact on its reputation. The only option to eliminate the risk of bad reputation is building a reputation based on probity, reliability, responsibility and quality work, good public appearance and customer service.

4 Accidents during the construction of Slovak D1 highway

Slovak D1 highway is still under construction but many serious accident have already happened. All of them are results of wrong organisation on the construction site or low quality of delivered materials or services. A few of the biggest accidets are subscribed here.

4.1 Collapse of the bridge construction near Kurimany

In 2012 collapsed the bridge construction near Kurimany and 4 workers died. As the investigation has shown there were 2 reasons which collaborated on forming of this situation. An effort to save money by using less props and incompetent construction supervisor who authorized the works even when there were less props. Construction supervisor authorized the concrete pouring although there were used less props than was originally planned. The maximum length of the props below the pouring point increased from 4,7 m to 18,4 m which caused that the strenght of the construction decreased 15,3 times. Therefore the construction collapsed after pouring 330 cubic meters of concrete of total 500 cubic meters.

Figure 3 Collapse of the bridge construction near Kurimany in 2012 [6]
Author: *TASR*

4.2 The fall of 4 workers near Martin

In 2013 near Martin 4 workers fell from bridge construction during 6 months. Rudolf Kubica, chief labor inspector of the Labour inspectorate in Žilina, commented the situation on the construction site: " The main function, the coordinator of safety and health at work, isn´t working here very well. Contractor has to appoint this coordinator, and this coordinator then coordinate each subcontractors. There should be a health and safety plan. But we find out, that the subcontractors, who perform works on the construction site, have no project documentation, so they do not even know what and how can they actually do."

Figure 4 The fall of 4 workers during 6 months near Martin [7]
Author: *SITA, Ľudovít Vaniher*

4.3 Explosion in Šibeník tunnel

Big tragedy happened in The Šibeník tunnel in august of 2013. Shotfirer was killed when he went to check the explosion which several times failed to explode. When he was handling the explosive it exploded and rocks swamped the shotfirer. The first results of investigation said that was a human error, but the right cause may extend to higher circles and it seems to have failed the entire work organisation. According to shotfirer´s family the subcontractors force the workers to work several shifts in a row without free days and they´re breaking a law with that.

Figure 5 Exploison in Šibeník tunnel [8]
Author: *SITA, Radoslav Maa*

4.4 Alternative routing of Turany - Hubová section

This problem is here since the idea of connecting Košice and Bratislava with highway was born. There are 3 options of routing this section. The north variant, The south variant and The valley variant. Many of EIA and engineering researches were been made and the best options according to this researches are The north or The south variant because the route would be shorter, the construction and using the road would cause lower impact on the environment and The south variant gives assumptions to improve the railway inrastructure and built a railway corridor in same tunnel with the highway.

But the government wants to realize this section via The valley variant even if there are many negatives. The valley variant crosses 6 protected nature areas, the route is longer, its planned across the area where is high risk of landslides, in winter there is lack of sunlight so there would be high risk of icy on the road etc.

The final option is still not chosen which means the opening of the highway is still in very distant future.

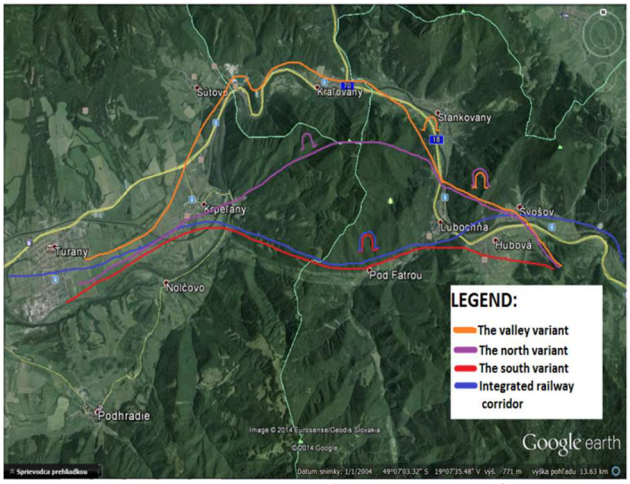

Figure 6 Alternatve routing of Turany - Hubová section
Author: *Dávid Šimko*

Conclusion

As we can see these risks and their consequences are very actual problem. Here in Slovakia is the highway construction too politicizated. Every new government after election thniks that the past government did everything wrong so everything must be stoped, re-projected, re-calculated and must be done according to new government. This cost a lot of funds and time, because eveyrthing have to be started from the bottom.

It is also because when the governments change, people who made decisions about the construction, had connections and stakes in companies that were connected with construction changes too. They are replaced by people from new government who wants to earn money too.

In this times of financial crisis, when states do not have money on unnecessary expenses is the main criterion for making decisison often the price. The combination of lack of state fundings and desire of some people to become multimilionaire often cause poor quality of work, poor quality of used materials, accidents or deaths and often also additional funds to repair the damages.

References

[1] ŠIMÁK, Ladislav: Manažment rizík, University of Žilina, Faculty of special engineering, Žilina, 2006.
[2] Wikipedia – Free encyklopedy [online]. [quated 10-01-2014]. Available on: <http.//www.wikipedia.org/>.
[3] Krízový manažment [online]. [quated 10-01-2014] Available on: http://www.km.weblaho.sk/.
[4] Slovak road administration. [online]. [quated 14-03-2013]. Available on: http://www.ssc.sk/.
[5] Internal documents of PPP centre.
[6] ŽGRAVČÁKOVÁ, Eva: Diaľničné tragédie smerujú na prokuratúru [online]. Pravda. [updated 20-09-2013]. [quated 13-02-2014]. Available on: <http://spravy.pravda.sk/ekonomika/clanok/293596-dialnicne-tragedie-smeruju-na-prokuraturu/>.
[7] Webnoviny.sk: Prekliaty úsek D1, robotník spadol z osemmetrovej výšky. Webnoviny. [updated 16-01-2014]. [quated 13-02-2014]. Available on: < http://www.webnoviny.sk/slovensko/clanok/778856-prekliaty-usek-d1-robotnik-spadol-z-osemmetrovej-vysky/>.
[8] ŽGRAVČÁKOVÁ, Eva: Výbuch v tuneli čoskoro objasnia [online]. Pravda. [updated 02-02-2014]. [quated 13-02-2014]. Available on: <http://spravy.pravda.sk/ekonomika/clanok/307197-vybuch-v-tuneli-coskoro-objasnia//>.

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