Year 2016-17

Liget Park Budapest. Analysis of the concept.

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FINAL CAREER PROJECT - ESTEL·LA ESTEVE AMORÓS

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Summary

The next final career project, consists not only to describe directly the building of four new buildings and the refurbishment of one in the Liget of Budapest (the most important park of the Hungarian capital city) destined to museums, but to study and estimate the construction costs, the planning process and the duration of the construction works as well as the benefits and profit that the 5 new buildings in the Liget Park are going to offer Budapest. It also develops the risks and possible solutions for them that can occur in big projects with high budgets.

El siguiente trabajo de final de grado en Arquitectura Técnica, consiste en no solo la descripción de cuatro edificios nuevos y la rehabilitación de uno ya existente en el Liget de Budapest (el parque más importante de la capital Húngara), destinados a ser museos una vez construidos, pero también el estudio de los costes de las construcciones, el proceso de planificación y la duración de los trabajos de construcción, igual que los beneficios y el provecho que estos puedan ofrecer a Budapest. También se desarrollan los riesgos y las posibles soluciones para ellos que pueden ocurrir en un proyecto de semejante envergadura y presupuesto.

Keywords:

Liget, Risk, Refurbishment, Project Management, Risk Matrix.
Liget, Riesgos, Rehabilitación, Gestión del Proyecto, Matriz de Riesgos.

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Acronyms used

BIC: Bionics Innovation Centre

BIM: Building Information Modelling

GDP: Gross Domestic Product

GMP: Guaranteed Maximum Price

RMP: Risk Management Plan

UIA: International Union of Architects

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Chapter 1.

Introduction

1 Section 1 [Abstract]

The next Final Career Project in Technical Architecture focuses on the renewal action that it's going to carry out in the Liget, Budapest most famous City Public Park. The liget is an urban public park for relaxation and entertainment. It contains museums that contribute to cultural knowledge, and provides leisure activities to citizens. Actually it also attracts every year a great number of tourists and visitors to the park by a large green built area (cca 100 hectars) and open air bath, Zoo and Circus as well. The Városliget Park is one of the most popular target for families with children in weekends.

The facts mentioned above become valuable social, cultural and economic benefits to Budapest economy in the past and in the future.

Nowadays most of its institutions are in need of refurbishment such as most of the park, in order to increase its Green areas and a decrease the pollution formed there due to the thousands of vehicles that go through the park all days. That's why this 150 year old park needs a general renewal, not only by the construction of 4 new museums to increase the cultural heritage but also by the increase of green areas and refurbishment of the actual institutions and facilities there.

That's why in 2013 an international design competition was announced by the governmental sector; this included the building of four new institutions in the park:

- The House of Hungarian Music
- The New National Gallery
- The Museum of Ethnography
- City Park Theatre

The design competition also included the renewal of the existing building of the Hungarian Transport Museum and transport system of the park in general, increasing its green areas and making it more accessible for the citizens.

My project final objectives are not only to describe directly the project but to study and estimate the construction costs for the four new buildings in the Liget of Budapest. Furthermore, it would be examine the planning process of entire project and the duration of the construction works as well as the benefits and profit that the buildings are going to offer Budapest.

1 Section 2 [Approach and methodology]

To collect data and arrive to the final results of this final degree project, various tools have been used.

First of all the risk analysis has been done with Budapest's and surroundings statistical information, this has been deeply described in chapter 7 and a summary of the statistics can be found in annex 3.

1 Section 3 [Liget Project]

1.3 Subsection 1 [Background, overview and objectives]

The preparation of the liget Budapest project started in 2011 with the introduction of some institutional reforms, the Hungarian Government finally decided to back up the project.

They planned to open a two stage design competition for the new museum buildings, held in cooperation with the UIA; the will of the competition was to find the architects for five art museum buildings that include in equal parts design, ecology and functionality. Those museum buildings have been in the core of a whole development.

The international architecture design competition started in February of 2014; it was available for all of those interested on it and gave the contestants three years to complete the preparatory works and the agreements with museum organisations.

The Lieget Budapest Project is aimed at the complete renewal and development of the capital's City Park. The investment will result in the parks extended Green areas, as well as new cultural institutions and recreational activities. The Project will raise the attractive profile of the city park and its surrounding, making it one of Budapest's leading tourists and cultural destinations, such as leisure park known all over Europe.

The Project is composed of four new buildings in the city park:

- The New National Gallery
- The Museum of Ethnography

- The House of Hungarian Music
- The City Park Theatre

Figure1. Liget Map. (Source: ligetbudapest.hu, consulted 20/2/17)

An ensemble of public institutions cooperating one with another will be established within the framework of the Liget Budapest Project, providing a wide range of high quality opportunities for recreation.

The proposal also includes the renovation of the landscape and green built areas, which will include the refurbishment of the parks green areas, removing unnecessary concreted surfaces increasing its green areas from a 60 percent to a 65 percent in total.

The old institutions in the City Park like the Capital Circus of Budapest, the Zoo, the Hungarian Museum of Science, Technology and Transport, and Vajdahunyad Castle will also be developed. Such as the renovation of the abandoned and old Szabolcs Street hospital, as well as an investment in the framework of which the National Museum Restoration and Storage Centre will be built.

The final objectives of the Liget Project in Budapest, is that the city park becomes one of the most claimed destination for the tourists, the individual historical, natural and institutional qualities of the almost 200 year-old City Park combined with the new museums to be built will result in a world standard family-friendly cultural and recreational park that can be compared to ones in the leading cities of the world.

These facts, hopes and as well as projected extern and intern influences of completed project assigns this project into the centre of public attention. To not mention yet the huge amount of forecasts expenditures.

Chapter 2.

City Profile: Budapest

2 Section 1 [History and Background]

2.1 Subsection 1 [Regional and urban settings]

Hungary was founded in the year of 1000 a.d. as a kingdom. Budapest is the symbolic heart of Hungary as far as its political, economic, administrative and cultural functions are concerned. More than one-third of the national GDP is produced in the city, and nearly half of the foreign direct investment arriving into the country after 1989 was realized here.

Most of the global companies settling in Hungary have their headquarters in Budapest, all the main national institutions have their seat in the city which serves as the main economic pole and transport hub for Hungary, and beyond. The relative geographical position of Budapest and its metropolitan region has altered significantly since the take apart of the called Iron Curtain in the year of 1989. From the outsides of Moscow, the city and its hinterland became one of the new political, economic and cultural centres of the central part of Europe.

Being part of a Central European development axis which connects the city with Vienna, Prague, Dresden and Berlin, as well as Cracow and Warsaw, Budapest is a significant location in this secondary European

urban network, because it lies in the conjunction of different development zones

Over the last one-and-a-half century, the metropolitan region of Budapest has been the target of different political aspirations. In this aspect we can distinguish, on the one hand, periods when national politics considered Budapest and its metropolitan region as an engine of economic and social modernization and policy goals were set accordingly.

On the other hand, there have also been periods when the political power saw a challenge in the weight and role of Budapest and its region and formulated distributive policies and strategies in order to achieve a more balanced territorial development in Hungary.

In 2012, the national government started to elaborate the new National Development and Territorial Development Concept for the period of 2014–2020. The new development concept was passed in 2014.

Regarding urbanization the concept emphasizes the importance of liveable and sustainable cities where urban development is based on creative, innovative and competitive economy and accessibility. Urban areas appear as fundamental units of spatial development in this new approach. The concept recognises that cities cannot be interpreted as independent entities anymore and they should be handled together with their catchment areas.

It foresees the development of a multi-centred settlement system with decentralized and network-based spatial structure decreasing the excessive weight of Budapest. The connections between a city and the surrounding area can be coordinated by multi-level governance: the

framework, rules and institutions of territorial organization must be defined centrally, coordination at the medium level, by counties, will support territorial organization, but local level must also be involved in territorial organization in order to achieve functioning development territories.

2.1 Subsection 2 [Location, situation and connections]

Budapest is important in terms of traffic, since it's a very central town; all major railway lines and European roads lead the city from East to West and vice versa.

Figure2. Hungary location in Europe (Source: Daine.tk, consulted 1/3/17)

Budapest has marked topographical contrasts; its total territory is 525 km^2, with 25 kilometres long from north to south and 29 kilometres wide in the east-west direction. It consists of two parts: Buda and the plain Pest territory divided on two sides by the Danube River. Its deepest point is the level of the Danube River, which at normal level is about 90 metres above sea level, and its highest point is at Janos-Hill with 529 metres.

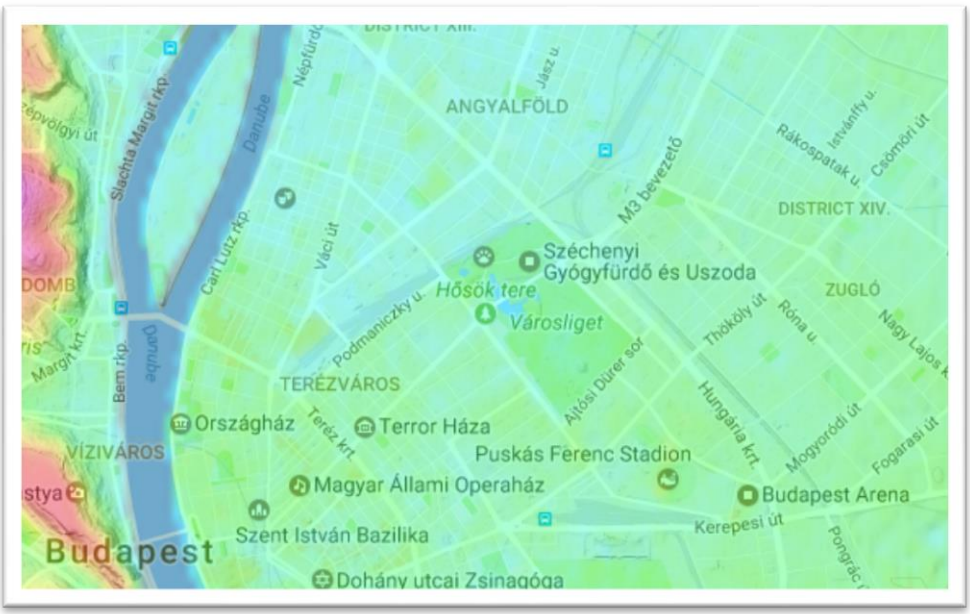


Figure3. Situation of Varosliget in Budapest. (Source: topographic-map.com, consulted 20/2/17)

With Buda built on the higher river terraces and hills of the western side, while the larger Pest side, where we can find the Liget, spreads out on a flat sand plain on the rivers opposite bank, although its terrain rises with a slight eastward gradient, so the east parts of the city end up laying at the same altitude as Buda's smallest hills.

Buda side is generally recreational and residential zone as well as industrial areas in faraway southern and northern parts, while Pest offers massive housing, commercial and industrial areas.

2.1 Subsection 3 [Population and visitors]

Like many countries in the European Union, by now in 2017, Hungary is facing a demographics crisis with a population that is slowly contracting. Hungary has the second-worst negative growth among European countries.

The capital and largest city of Hungary is Budapest, which is also one of the European Union's largest cities. Budapest has an estimated population of 1.74 million, down from its peak of 2.1 million in 1989, due to its growing suburbs. The larger Budapest Metropolitan Area has a population of 3.3 million people. More than 4.4 million people visit Budapest each year, which makes it Europe's 6th most popular city.

The borders of the country existing today were established after World War I which caused Hungary a loss of 71% of its area and 58% of its population, including one-third of its ethnic Hungarians.

2.1 Subsection 4 [Economic profile]

Budapest is a significant economic hub, classified as an Alpha-world city in the study made by the Globalization and World Cities Research Network and it is the second fastest-developing urban economy in Europe as GDP per capita in the city increased by 2.4 per cent and employment by 4.7 per cent compared to the previous year in 2014. On national level, Budapest is the primate city of Hungary regarding business and economy, accounting for 39% of the national income, the city has a gross metropolitan product of more than $100 billion in 2015, making it one of the largest regional economies in the European Union. According to the Eurostat GDP per capita in purchasing power parity is 147% of the EU average in Budapest, which means €37.632 ($52.770) per capita. It was also named the city was named as the 52nd most important business centre in the world in the Worldwide Centres of Commerce Index.

It became Hungary's main industrial centre in the late nineteenth century, first a centre for food processing, then manufacturing agricultural machinery and automobiles. By 2008, more than 50 percent of Budapest's factory employees work in metalworking and engineering, producing railroad equipment, buses, and river craft. The remainder work is based in textiles, electronics, chemicals, and in food processing.

Tourism employs nearly 150 thousand people in Hungary and the total income from tourism in 2008 was of 4 billion euros. Focusing on Budapest, it’s the most visited region, attracting 3, 61 million visitors every year.

The most attractive factors for the visitors and citizens of Budapest are the Buda Castle and the banks of the Danube that were included in the UNESCO list of World Heritage Sites. Also Andrassy Avenue (including the Millennium Underground Railway, Hősök tere, and Városliget) was added to the UNESCO list in 2002.

Budapest has the largest synagogue in Europe, Dohány Street Synagogue,the largest medicinal bath in Europe, Széchenyi Medicinal Bath, and the third largest Parliament building in the world, which contains the Hungarian Crown Jewels.

Castle Hill and the Castle District have three churches, six museums, and various interesting buildings, streets and squares. The former Royal Palace is one of the symbols of Hungary. It now contains two impressive museums and the National Széchenyi Library.

The nearby Sándor Palace contains the offices and official residence of the President of Hungary. The 700 year-old Matthias Church is one of the most touristic spots of Budapest. Next to it there is an equestrian statue of the first king of Hungary, King Saint Stephen, and behind that the Fisherman's Bastion.

In Pest, the most important sight is Andrássy út. Such as Saint Stephen's Basilica, also located in Pest, named in honor of Stephen, the first King of Hungary (c. 975–1038), whose mummified fist is preserved in the reliquary. There are Roman remains at the Aquincum Museum, and historic furniture at the Nagytétény Castle Museum.

Heroes' Square is dominated by the Millenary Monument, with the Tomb of the Unknown Soldier in front. To the sides are the Museum of Fine Arts and the Palace of Arts, and behind City Park, the one which we are carrying the project for opens out, with Vajdahunyad Castle. One of the jewels of Andrássy út is the Hungarian State Opera House.

Budapest has continental Europe's oldest underground railway, most of whose stations retain their original appearance.

All of these are some of the reason which impulse tourism over to the capital city.

2.1 Subsection 5 [Climate]

The climate in Budapest is humid continental, this means that from December until early March is the coldest and cloudiest time of the year, at this time snowfall is usual in most years and at nigh time temperature can usually get to -15°C.

In the spring months from March to April, you see variable conditions and a rapid increase in the average temperature. The summer that lasts from June till September, is the warmest time with most summer sunshine, this period can be compared to the Mediterranean climate.

The local climate circumstances take that the city park is almost crowded by people from early spring to late autumn.

2 Section 2 [Pattern of urbanisation and growth]

2.2 Subsection 1 [Land use plan]

Focusing on the Hungarian capital, according to the Act of 1991 on Local Governments, twenty three district government's function in Budapest, plus a twenty-fourth, the municipal government of Budapest, which is the local government of the entire city. The responsibilities are divided between the municipal government and the district governments and are determined by the 1991 Act on the Capital. The division of responsibilities is complicated since the district governments are not subordinate to the government of the entire city. This situation is reflected in the planning system of Budapest as well.

According to the act on planning and building of 1997 (Codes of Built Environment), special provisions are applicable for Budapest. To resume the "zoning power" is divided in Budapest between the city and its districts. This is a major difference from the previous situation, when the city possessed all zoning authority and districts could establish detailed plans only if their regulations were in conformity with citywide zoning or if the municipal government accepted districts proposed by district plans.

The 1997 act introduced a special binding plan under the authority of the municipal government of Budapest—the "framework regulatory plan"—and an ordinance for the entire city, while the districts are authorized to establish their own "district regulatory plans" and ordinances. Contrary to the equal policy-making authority of the city and its districts, urban plans of the districts are subordinate to the citywide plan.

In these days the planning process is initiated by a decision of local elected Board of Representative of council. Based on this decision the local government enters into a contract with a professional planner. If the initiative comes from a private developer for the amendment of a Regulatory Plan, the municipality enters into another contract with the developer about the financing of the planning work and also about the selection of the planner. Recently, a new legal instrument the "municipal contract" was introduced, by a modification of the 1997 Act, in order to facilitate the inclusion in this contract of other more substantive elements of planning as well.

In bigger cities, such as Budapest, the on-going planning work is managed by the municipal chief architect, responsible to the Planning Committee and the Council as a public servant. Although in most cases their professional background is architecture the chief architect's/planner's role ends with the management of planning. Their function is strictly separated from that of the building authorities. They may operate local architectural and planning juries but their say in building permission procedures is only advisory.

Chapter 3.

Development of Budapest between 2015-2023

Over the last years in Budapest, rumours of construction works has been heard, there is a period of construction renewals and proposals for the future. In the next part we are going to study the various developments that have been going on and the ones that want to be made in the city. Also the analysis of the most important buildings from each refurbishment or construction made and how it influences our project, since the Liget Budapest, is one of the most important institutions and development made in Budapest in present and future.

3 Section 1 [Prominent development of urban spaces]

One of the first ideas that takes place in the whole of Budapest's renewal, is the complete refurbishment of the Buda castle, one of the most important institutions in the city of Budapest and probably the one that more tourists attract during the years, with it the renovation of several buildings damaged and demolished with in World War II, could be refurbished according to the Hauszman Plan.

Csikós Court and it surroundings could also be rebuilt, this includes the ornate riding hall, the main guard´s building and Stöckl stairs, and the

tower of Karakas Pasha, that a part from the facelift that they need, new functions would be introduced, such as new elevators and the improving of the city transport links and more parking spaces.

The Danube shore could also be affected by a renovation, a design competition has been also proposed, and this should include the replacement of cars and crash barriers by pedestrian friendly walkways, the part in the Pest side of Elisabeth Bridge wants to be transformed in to a waterside space with bike areas separated by green areas instead of cars.

The reconstruction of the famous Chain Bridge (built in 1850) is also planned, wanting it to be a one way river crossing so that more space for pedestrians can be provided, since it's one of the most touristic places in the city.

In terms of transport areas, changes could occur to two of Budapest's railway stations, Nyugati and Déli, in the past huge spaces in the rail station where needed for docking of carriages, but in our days and for the future, that areas became unused, so there is the example of some cities that have turned their railways in to green areas, the plan for Nyugati unused rail ways, is to destine the area to people by adding running tracks, sledding and Ping-Pong areas.

The other rail way station that could be affected, is the Déli Railway station, the idea is to close it and to redirect Buda rail traffic to Kelenföldi Railway station although this idea is in the air and has to be studied carefully since it's difficult to reconnect railways to a central station.

The Corvin Promenade (in the heart of Pest) has also been developed and nearly on its end, the new building in corvin of technology and science park, will become one of the country´s largest IT and telecommunications research and development centre.

The historic building, Eiffel Hall is going to be refurbished, since it's unused. This steel structure building was done in 1886, so after a complete reconstruction of it, its original function of a railway building will then become one of the country's most prominent centres of classical music.

Now focusing on the project of the Ludovika Campus, with a building reconstruction already completed at the beginning of this period, we know that it will continue its renovation with other things, but mostly with the historic riding hall, that has refurbishment plans so that it can become accessible to people. Its Orczy Garden will also be refurbished by the end of the project, such as its sport fields and lake. A new university school building will be constructed in place of the demolished bazaars the new building will have 21,000 square meters and will include two large lecture halls. There will also be a new dorm that will have a capacity of accommodation for 600 students.

The BIC will be built on a previously vacant plot under Balassa Street and it will be a significant research base in the modern, international scientific scene of bionics, which is on the border of biology and electronics.

Continuing with the universities building developments but in long terms we have the Moholy-Nagy University of Art and Design

(MOME) that is going to be developed in two phases by 2017. The first step of the investment, a three-part building complex will be built, the Technology Park (Workshop House, Studio House, Media House), designed by architects Zsófia Csomay and Tamás Németh, based on the previous concept of architect Péter Reimholz, followed by the construction of a building housing a research institute and knowledge centre. At the same time, various buildings of the campus will be completely refurbished, including the Academy building, the Main building, and the internationally popular pub of "Gondűző".

The development of the campus of Central European University near the Basilica has already begun, so the university buildings, previously scattered around the city, will be concentrated at one place near the main building in Nádor Street in the future.

The Hungarian Academy of Sciences, research centre for the Humanities, is near its finish, is also being built by the plans of Teampannon, near the Millennium City Center and ELTE's Lágymányos campus. The researchers, working at inefficiently operated buildings scattered around the city, will be moved to three new blocks. Therefore the representatives of musicology, archaeology, literary studies, ethnography, art history, historical science, philosophy, political science, jurisprudence, sociology, minority studies, and economics, as well as various archives and a huge library, will also be housed in the new building blocks.

The National Széchenyi Library could move to the Palace District although this is a long term idea. The building located in the Castle

requires a complete technological renovation, but the institution would get much closer to the university district.

The reconstruction of Palatinus Bath on Margaret Island has also begun. The facade of the Bauhaus-like main building's entrance, showing the Italian modernism and holding unique value, will be restored by the original plans of István Janáky. In the basement, spa and fitness facilities will be established, the original changing cabins will be renovated, the restaurant block next to the main entrance will be reconstructed and expanded, and the thermal pool will be covered, so the bath will be able to open all year round in the future.

The popular Paskál Bath in the Zugló district will be renovated, also. According to the plans and like the one mentioned before, the bath will be open all year round, and in addition to the baths, there will also be a rooftop terrace, a water bar, and a wood-heated Russian-style sauna. The architectural plans were made by Szántó & Mikó Architects Ltd.

A new swimming pool is being built in the area of Dagály as the main place of Swimming World Championship in 2017. The gold and pompous facade that reflects the water's waves can be a new attraction of the capital's Danube riverside, and the view from the inside also promises to be rather unique: through the two-meter windows, we can see an incredible view of the city from Gellért Hill to the Pilis Mountains.

The urban landscape will be changing on the outskirts of the map, as well, with the beginning of the new market hall and cultural events

center's construction at Újpest**.** A two-floor underground garage and a roof garden will also be connected to the building.

The facade of the eclectic apartment building located in Andrássy Avenue will be renewed with the installation of four loft apartments. The plans were made by the Archikon Architect Studio. The estate under this Avenue will be renovated inside and out by the plans of Archikon, as well.

The reconstruction of the building located in Dorottya Street has already started. The designer of the run-down office building, István Medgyaszay, used to be one of the greatest architects of the first half of the 20th century. Although it cannot be seen because of the post-war reconstructions, the façade was decorated with sculptures. The building was seriously damaged during the Siege of Budapest, and its ornaments were not replaced. Now, a 120-room hotel will open in the building, we expect that the façade will be restored to the original design.

At last mention the office buildings and facilities along so called Váci corridor in Pest and Infopark district and Graphisoft park in Buda side. Both of them are continuously developed area giving local headquarters space for several worldwide successful corporations.

By this listing we can observe, that Budapest includes in its present and future lots of construction plans that are expected to offer Hungarian citizens more modern spaces in the city for leisure and recreational activities, such as the improvement of transport and some university institutions, which expect to rise Budapest to a higher quality city with in Europe.

Chapter 4.

Liget Budapest project concept

4 Section 1 [Project need]

As mentioned before the park is one of Budapest's attractions for tourists and Hungarian citizens since it's one of the biggest green areas inside Budapest, besides that it needs a general face lift that makes it more attractive, since it's been a long time from the last intervention in the park.

That is how the Liget project came up, with the willing from the governments part to modernise the park and make it even more attractive for visitors, although the idea is the refurbishment of the hole park, there is a special focus on the buildings we have been working with during this project, since there modern functions and their environmental design, brings them to the top of developments in Budapest from an architectural point of view.

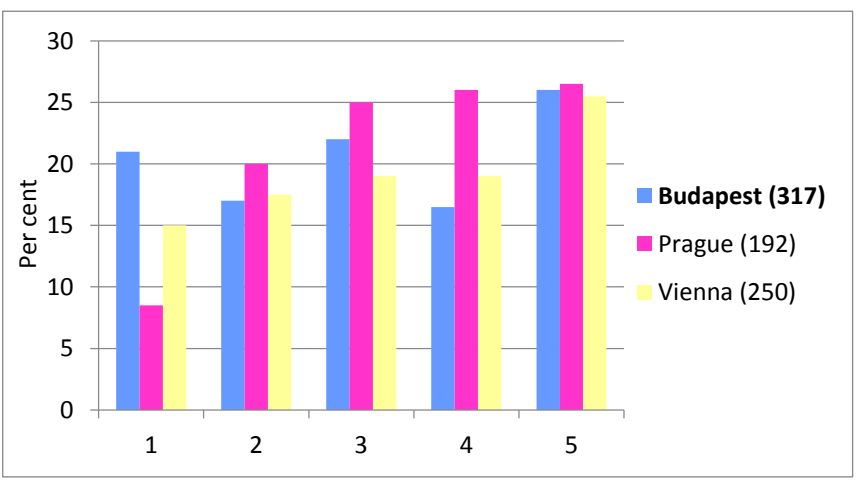
The whole project need is basically to give a modern shift up to the whole city which has been a long time forgotten, and is full of classic architecture, that although gives a special touch and is so characteristic of it, some modern interventions and repairs need to be done, and continue attracting visitors to the Liget Budapest, by providing them with modern installations and an increase of green areas.

4 Section 2 [Existing situation of cultural and leisure activity in Budapest]

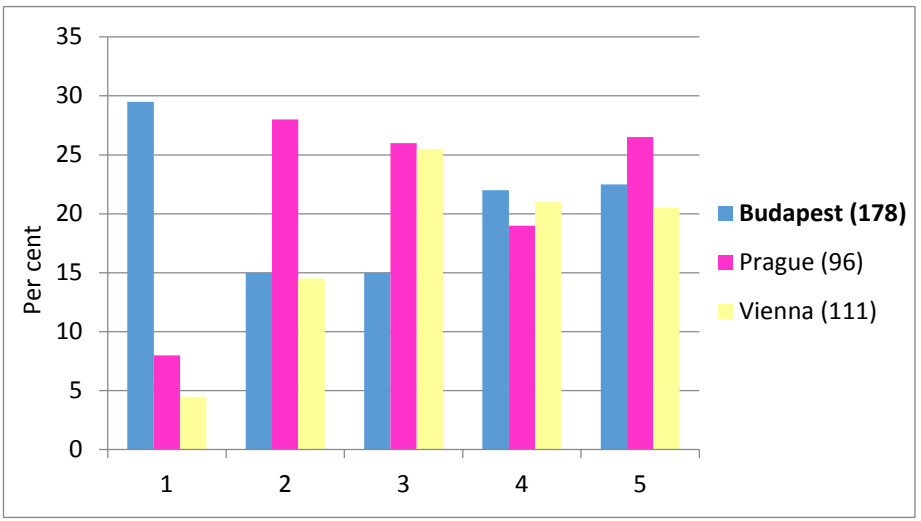
One of the reasons for the refurbishment in the City Park is the number of people that it attracts every year to its installations, for recreational activities. This means that the future plans expect to create an improved space for its citizens to enjoy, since it's one of the most important institutions on the present in Budapest.

Budapest generally disposes of a busy nightlife and offers various recreational spaces during daytime, such as green spaces inside the capital being one of the most important the Varosliget.

In the next part we can see a comparison of tourism between Eastern Europe (Prague, Budapest and Austria) such as the residents of each place for the last five years.



Graph1. Ranking of cities by visitors. (Source: Budapest regional statistics, consulted 6/4/17)



Graph2. Ranking of cities by residents. (Source: Budapest regional statistics, consulted 6/4/17)

In the previous graphs we realise how Budapest visitors have increased but in a more moderate way that its neighbours Prague and Vienna, on the other hand we have the chart of residents of the city that has been gradually decreasing on the past years, this could be the result of the price increase in life in Budapest or the low employment so citizens are moving out for more opportunities.

Although the increase of visitors it's positive, the increase has been really low, this is why the new constructions in general and specially the one taking place in the City Park are expected to bring new tourism to the Hungarian capital.

4 Section 3 [Targets and advantages of Liget development in short and long term]

The main focus of the renewal of the liget, is to increase the number of visitors, but as all projects it counts with advantages and disadvantages.

In short term we can see most of the advantages occurring, since it will be a new part of the city that will attract a large amount of visitors to it, this means that economy will be positively influenced by the number of tourists visiting it. The new buildings will also have a positive impact on the existing ones, since people that go to the park attracted by its museums and cultural activities, could also discover its recreational already existing buildings such as the Széechenyi baths, and give an economical impulse to the whole area.

Its architecture is also inspiring in terms of environmental buildings and their capacity of being part of the park creating an all in one with nature. Its positive results should encourage further constructions to be environmentally friendly, from the materials used in the construction of them to the technology applied and the fact of introducing nature in the proper building. So as an advantage its hoped that by this environmental friendly buildings at least the rest of public future constructions also include these constructive aspects.

Although as a short term factors we can see the economic advantages, it's well known that these may not occur at long term, for instance, the refurbishment of the whole park, Involves a great inversion of money due to the big cost of the five buildings, so the money that they can

produce in the first years will have to be used on paying the construction of this.

It also doesn't count with the security that it will continue producing money at long term, because as a new construction the acceptance of the people at the beginning its expected to be positive, but it's uncertain that they are going to be producing money in a long term, since it wouldn't be the first case that a great building with lots of expectative has failed in time and hasn't reached the objectives for what it was produced, the more money its inverted in those buildings the worst it's the failure as an outcome.

4 Section 4 [In the focus: the five museums buildings development]

[House of Hungarian Music]

Sou Fujimoto, the winners of the design competition for this building, want to create an environmental friendly building that produces a harmonious transition between the Natural Park and built environment. This is going to be the first institution that presents the comprehensive heritage of Hungarian music.

It will be built in the inner area of the city park by the lake, the design of the building made by the Japanese architect will have a translucent structure with side walls made of special glass to create the feeling of openness, and the building will offer many modern and green solutions, especially in the areas of ventilation, and the use of rain water and electricity.

[New National Gallery]

The world-class building is designed by the Japanese Pritzker Prize-holding SANAA, it's aimed to be completed by 2019 and it will provide a brand new exhibition venue for the fine art works from the 19th century till today. It will be the largest museum in Hungary to document the modern history of the development of Hungarian and European fine art.

[The Museum of Etnography]

This new museum building is going to be designed by Napur Architect and the characteristics that will stand out at first view, is its simple lines harmonised with the park environment and communicating with the surrounding urban area. Sixty percent of its structure is under ground level, but it will have light entering in to it thanks to the transparency of sections over the ground. The incorporation of a grass covered roof area will also help the integration of the building with nature, such as the increase of the green areas in the liget.

[City Park Theater]

In 1909 there already was a City Park Theater in the Liget, but it was demolished in 1951 due to the new building of Felvonulási Square (Promenade Square for state ceremonies).

Now that the new theatre is going to be rebuilt there is the purpose of using its original design of a Secessionist building on its exterior, but in the interior it will be equipped with the modern stage technology that it deserves in our times.

[Hungarian Transport Museum]

This building is going to have a refurbishment done by the hand of Mérték Achitectural Studio; its original design of the year 1896 was made by Ferenc Pfaff, for the events of Millenium Aniversay Year. Its new function will be the offer of unprecedented views over the renewed city park.

The idea of the refurbishment, is to double the floor space of the original building, exhibition and service areas will also be refurbished to meet the technical requirements of our times, and the most important part as mentioned before, is the iconic dome of the original design, that thanks to modern construction techniques it will be converted to the city Parks viewing tower.

Chapter 5.

Liget project construction Budapest: Way ahead

5 Section 1 [What happened till now]

[2011]

The idea was born for the need of renewal of the liget, about 100-hectare area of park, the start of plans included the park refurbishment, building renovation and opening of new museums.

[2013]

A design idea competition was announced for the renewal of the liget and for selecting the sites of the new institutions. Legislation specifically devoted to the renewal of the liget passed by the Hungarian National Asssembly and named the Liget Budapest Project, a priority development from this point onwards.

[2014]

The establishment Városliget Co. to execute and manage the Liget Budapest Project.

[2015]

Finalisation of the architectural programme of the Liget Budapest Project, including the renewal of the Transport Museum, the Olof Palme House and the Vajadahunyad Castle; the enlargement of the Budapest Zoo by adding the Pannon Park with Biodome; the construction of the House of Hungarian Music, the New National Gallery, the Museum of Etnography and the Városliget Theatre; as well as the establishment of the National museum Restoration and Storage Centre and the renewal of the Capital Circus of Budapest in the vicinity of Városliget.

They start of the realization of the plans for the National Museum in Szalablocs Street.

The winners of the international architectural competitions for the design of the new buildings were:

Sou Fujimoto Architects for the House of Hungarian Music
SANAA for the New National Gallery
Napur Architect for the Museum of Etnography

[2016]

The park will be renewed according to the plans of Garten Studio, winner of the landscape-architecture competition of Liget Budapest Project.

[2017]

This year the Liget Park Forum series launched, allowing more than 150 civil organisations to share their recommendations in connection with the park´s renewal.
March: Building operations of the House of Hungarian Music, the Transport Museum and the Pannon Park.
July: Building operations of the Museum of Ethnography and the City Park Theatre.
August: Beginning of the full-scale renewal of the City Park Theatre green areas and infrastructure, according to Garten Studio´s landscaping design.

By now all the works that where expected in the Park by 2017 are stuck in the 2015 phase, the finalisation of the architectural programme, all the designs of the new buildings and refurbishments have been done, and the rest of phases should have started by now.

The constructions in the House of Hungarian Music, the Transport Museum and the Pannon Park should be started the same as the building operations in the Museum of Ethnography and the City Park theatre, and there isn't any sign of it or of any start of preparation for the construction.

This means that the start of the constructions that was supposed to be by 2017, has at least two years of delay by now, from 2015 till now, the presumption is that the project is having a slow development, and at this point of the construction, one of the problems that we assume that could be happening are licence problems for the buildings which could be delaying all the works.

The Gantt that we produce in this project already includes the delay that has occurred in the beginning of the constructions of the project.

5 Section 2 [Characteristics of the new museum buildings]

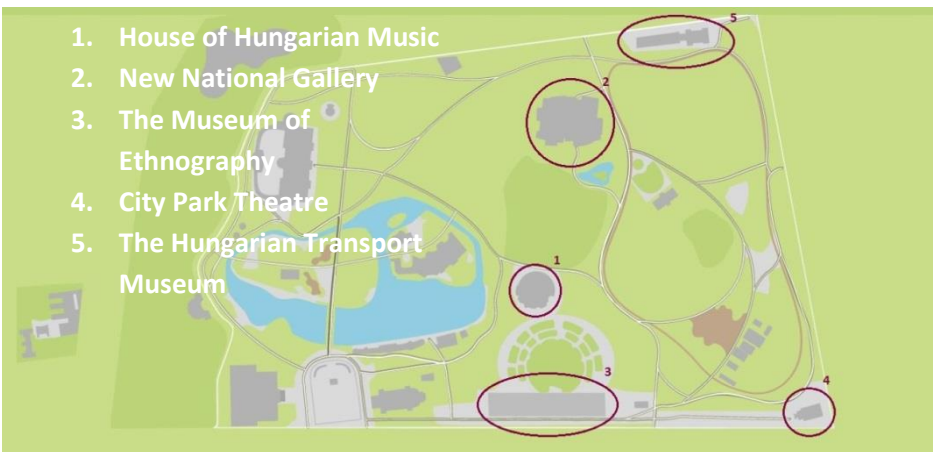


Figure4. Situation of museums inside Liget. (Source: ligetbudapest.hu, consulted 4/3/17)

The map of the park shown just above marks the location inside the Liget of Budapest of the new buildings that are going to be constructed or refurbished depending on the case.

We are now going to evaluate the technical characteristics concerning the buildings that we are going to study.

[1. House of Hungarian Music]

Design: Sou Fujimoto
Total floor area: 10 099 m^2
In-built area: 2 565 m^2

Its design emphasizes the fact of the designers willing of preservation of the environment and the integration of its building with the surroundings, this is accomplished by saving as many trees as possible, and it minimizes the strong visual impacts using a transparent ground floor, such as keeping the buildings height similar to the height of the trees its surrounded by.

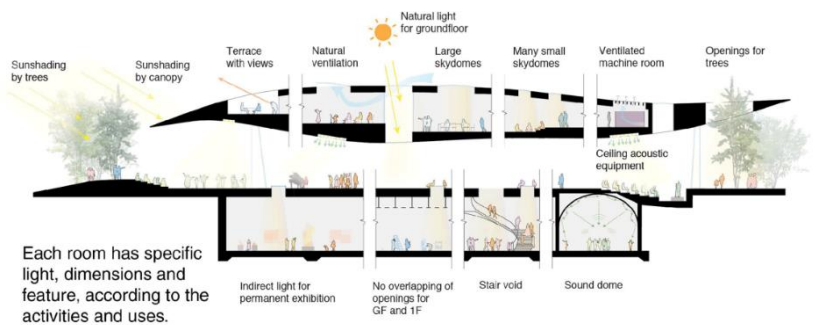


Figure5. Interior distribution of House of Hungarian Music (Source: afasiaarchzine.com, consulted 3/4/17)

In the previous image we can see the use of natural light through the various sky domes in the building and its different use depending on the part of the building that you are situated.

Event Hall
Hall type: Shoe-box
19mx29m in plan, celling height 7-9m
Walls are inclined outward with 7 degrees
Noise criteria: 25 dB

Lecture Hall
Hall type: Shoe-box
14,5mx24m in plan, celling height 7,5-10m
Walls are inclined outward with 5 degrees
Noise criteria: 25 dB

Structure
The structure is roughly divided in three zones vertically, as you can see in the image below:
The floating volume, smart roof, defined as trusses acting 3 dimensionally, contributing to the structural efficiency.

On the ground-floor, the floating volume is supported by randomly positioned columns (to create an echo to the surrounding trees) and a core clad with reflective material to keep the transparency of the ground floor.
Its basement it's the simplest and more economical part since it carries the vertical loads from above directly to the foundation and the horizontal loads to the retaining walls on the perimeter via ground floor slab.

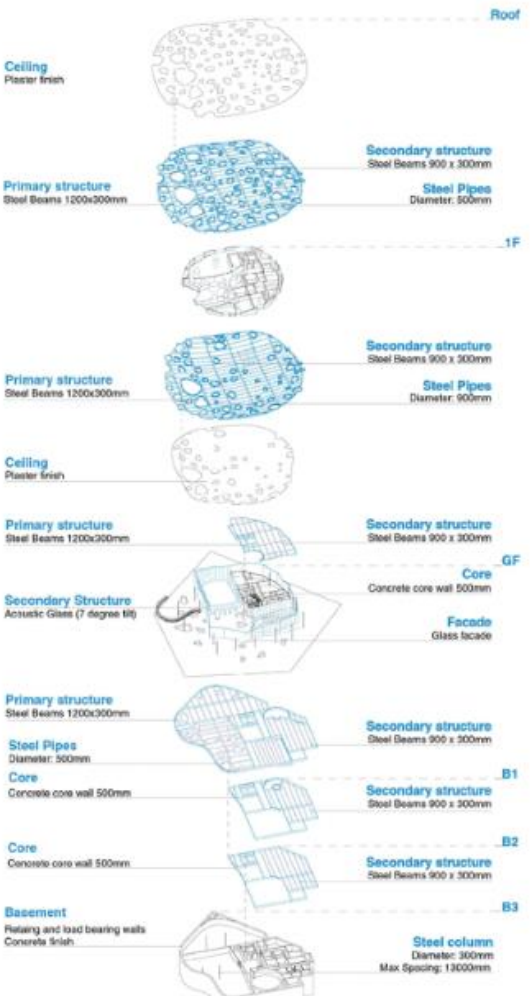


Figure6. Volume of different parts of the structure (Source afasiaarchzine.com, consulted 3/4/17)

[2. The New National Gallery]

Design: SAANA
Total floor area: 51 950 m^2
In-built area: 9 095 m^2

The new national gallery will become one of the biggest museum buildings in Budapest, as the others it's combined with the nature of the city park, although in its case less than the house of Hungarian music or the Museum of Ethnography. Although its sustainable design and environmental friendly characteristics makes the building as modern as the other ones in terms of technology.

A difference that it will have beside the other constructions is that its building is not going to have a ground floor, so it will all be constructed above floor surface.

Its main characteristics are its completely white structure, and the different inclinations of its roof tops, some of them used as a view spot, offering the visitors another perspective of the park. Most of the walls are made completely from glass or have most of it from it, giving as the other buildings a complete view from the outside and interior light, integrating completely the park in to the building.

[3. The Museum of Ethnography]

Design: Napur Architect
Total floor area: 32 615 m^2
In-built area: 13 411 m^2

The Museum of Ethnography building, is going to have a recreational use for all the visitors, it has most of its operative space under ground, as you can appreciate in the section bellow, that will create less impact on the landscape of nature in its surroundings, such as the garden roof that includes completely the building in harmony with the nature of the place.

In the next image we can see the distribution of the different levels in the building and the use for each one of them.

The deepest part is found at level – 6,75 m, it's the basement of the building and also the part that has a bigger surface built area, it will contain the main exhibition places, artefact handling and building spaces. The next floor is at level -3,30 and it consists of a very small area that will contain the library storage level. At 0,00 m the visitor centre and the principal entrance of the ethnography museum.

On the above levels the next rooms are located, the research with lecture hall (4,50 m), the museum for children (5,10 m), offices at various levels , event hall (10,20 m) and finally the panoramic café at 14,85 m. All the areas that are above 0,00 m have direct connection with the garden.
The next image shows clearly the division of the various spaces just mentioned.

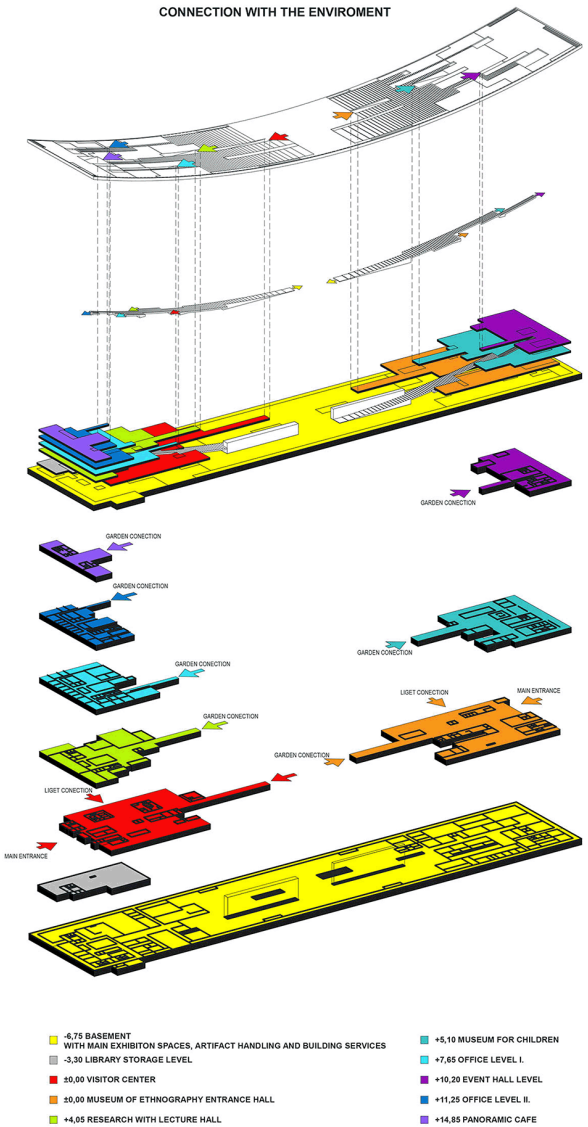


Figure7. Volume of levels of Museum of Ethnography (Source: dezeen.com, consulted 5/4/17)

[4. City Park Theatre]

Design: they want to take the original design for the old city theatre, but no designer confirmed.
Total floor area: 3 300 m^2
In-built area: 1 333 m^2

The theatre's design and structure will be based on the original structure from the popular Varosliget Theatre built in 1870, but its interior will be equipped with the most modern stage technology.

Its exterior structure won't have the modern aspects that define the other buildings, but will remain simpler, with a rectangular based floor, although some areas at its side will outstand from it, and vertical long windows in most of its walls will let the necessary light in trough some areas of the theatre.

As mentioned in the previous listing, the city park theatre doesn't actually have a studio chosen for its design, but the government's idea for it its original structure as mentioned before.

[5. The Hungarian Transport Museum]

Design: Mérték Architectural Studio
Total floor area: 19 430 m^2
In-built area: 3 795 m^2

In a willing to keep the original architecture of Budapest, the Transport museum such as the above Varosliget Theatre, will keep its original design, but in this case it won't be a constructions that starts from new, but a refurbishment of the original existing building in the City Park.

Its interior as in the case before will also be modernised to make it as sustainable as the rest.

The most interesting change they are going to do to it, is the new function that the dome will offer, since it will be converted to a viewing tower from which you can appreciate the entire park.

5 Section 3 [Management Procedures]

The project management in construction is a relatively new professional discipline which separates the management function of a project from the design and execution functions, especially for larger or more complex projects, such as the Liget, will need separate management which has resulted in the evolution of project management.

It could be defined as the overall planning coordination and control of a project from inception to completion aimed at meeting a client's requirements in order to produce a functionally and financially viable project that will be completed on time with authorised cost and to the required quality standards.

A project manager organisation structure should identify arrangements and procedures for monitoring and controlling the relevant administrative details. It should be updated, if changes occurred, during the project lifetime, and should allow project objectives to be communicated and agreed by all the people concerned in the teamwork.

In the next part, we list the most important management project procedures to complete a construction successfully and with no possible setbacks.

1. Formulate a project program.

a. Master plan process (mission + specific goals = facility needs)
b. Inputs to the program definition.
    i. Constraining the desires and dreams of the users to fit the budget.

ii. Creating a consensus amongst the users and administration.

2. Create a project management team
a. Needs vary by Phase (Programming, Design and Construction).
b. Options for to consider:
    i. Do it yourself.
    ii. Assign to existing staff.
    iii. Hire new staff.
    iv. Hire outside Construction Management firm.

3. Set realistic project goals.
a. Time for completion (design, reviews, permits, weather)
b. Budget (design, construction, F&E..)
Maximum impact on cost made during programming, then design, and least of all during construction.
c. Quality (durability, impact on time and budget)

4. Fund raising impact on the project.
a. Fund raising
b. Issues related to choice of designer & timing of construction.

5. Select a designer.
a. Design or design-build
b. Who is really going to design the project (not the principals)
c. Fee and reimbursable costs.
d. Who are the Mechanical, Electrical & Plumbing designers?

e. How will the designer administer the field construction work?
f. Evaluate prior project references
    i. Timely, cost control, quality, cooperation, paperwork processing.
g. Level of comfort dealing with the designer?

6. Design criteria.
a. Minimize maintenance and spare parts.
b. Impact of being too restrictive (money).

7. Different stages in a design and what should you look for.
a. Schematic
b. Design Development (interior design too)
c. Construction Documents

8. Select the General Contractor & Form of Contracting
a. Types of contracts (lump sum, design and build, CM)
b. Bidder list
    i. Pre-qualified or open list
c. Negotiate sole source (appointed subcontractor)
d. Value engineering before award.

9. Building permits
a. Zoning approval
b. Utility impact
    i. Water, sewer, storm water (governmental approval)
    ii. Electricity, gas, telephone (availability and fees.)

c. Plan review by governmental agency
    i. City, county, state depending of type of project.
d. Fees and application

10. Control Progress, Time, Cost, & Quality during construction
a. Progress control (measure completion in percentage)
b. Time schedules making up-date
i. MPM, PERT chart for work (include owner activities)
ii. Submittals for material & testing
- List of what is to be submitted
- Identify long lead items (you can't build it if it's not there).
iii. Progress meetings (resolve issues quickly and document decisions).
c. Cost control
    i. Change order logs (pending estimates and final values)
    ii. Total budget tracking (tele/data, F&E, PP…)
d. Quality control
    i. Testing labs
    ii. AE inspection
    iii. GC quality controls
    iv. Other agencies inspections (county building dept.).
e. Coordination between parties
    i. On campus activities (security, parking, events)
    ii. Physical Plant (UG utilities, keys)
    iii. Tele/data (separate contractor?)

11. How to obtain final occupancy
    a. Certificate of Occupancy Inspections
        i. Building, MEP, Health, Fire, Elevator, Water/sewer...
    b. Punch list process with GC.
    c. Guarantee contracts and O&M training for maintenance.

This phases look complex, but they assure that even the smallest projects can get the benefit from each of these management processes. Although it has to be considered that the extent to which this activities are carried out, should be based on the nature, size and complexity of the project or the level of the project management expert.

Integration Management
The objective of integration management is to coordinate the various interrelated processes of a project. To properly manage these activities a project manager needs to do the following:

- Develop a project plan
- Acquire approval of the plan
- Manage the implementation of all the activities described in it
- Update the plan as changes occur
- Communicate the changes to key project stakeholders

5 Section 4 [Application of BIM concept]

BIM concept of Liget Budapest project
Building Information Modeling (BIM) is an intelligent 3D model-based process that equips architecture, engineering, and construction professionals with the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure. In the case of the Liget is a very useful tool due to the size of the project.

Tools and tasks of BIM depend of Client's and participant's need.

- Design control and Clash Detection to reduce errors
- Materials Quantity Takeoff
- Scheduling and resource management on the base of building elements, Site plans - 4D schedule
- Cost Plan (Bill of Quantity) on the base of BIM architecture parametric model, building elements
- 5D schedule

In order to carry out their job the following participants need special skills to perform their duties:

- Portfolio and project management

Making spacial organisation-4D schedule

- Design management

Coordination planning

Crash test

Material quantity detection

- Chief architect

BIM make a model, check the model

Coordination nature plan review

Interference Analysis

Direction of material

- Contractor

About the state of affairs BIM providing a model

- Property /Operation/Facility Management

A BIM use of the model for operational purposes

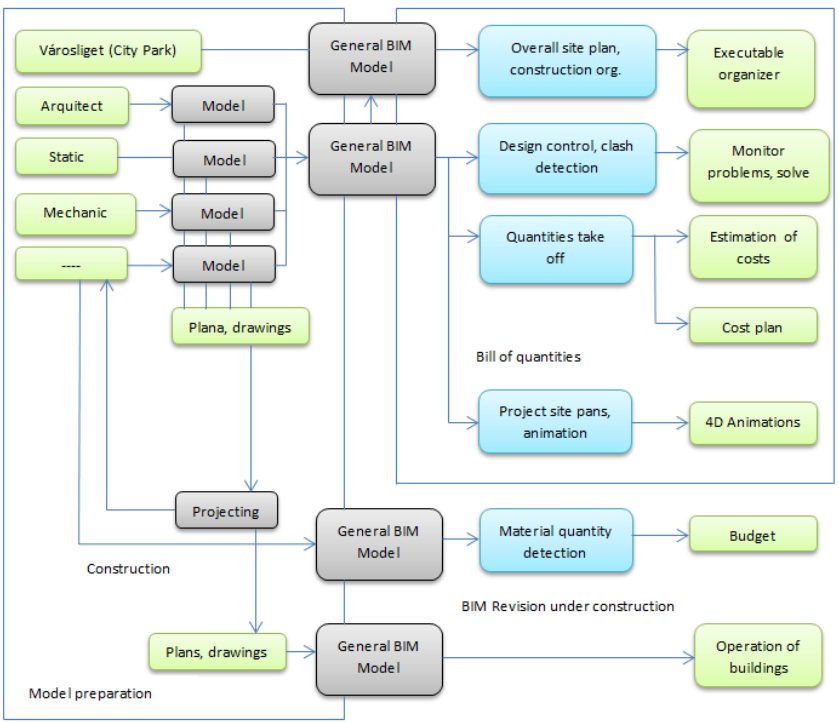


Figure8. BIM Logical framework-connections (Source: Liget Budapest-BIM Concept, consulted 5/5/17

What BIM offers different stakeholders depending on the specific needs that the project has. As our project moves form phase to phase, the information contained with the BIM has to evolve in a progressive way.

The following are a list of the most common applications of BIM.

Existing Conditions Modelling
It's a process in which a project team develops a 3D model of the existing conditions of a facility. The model can be developed in various ways depending on what is wanted and it's more efficient. This can be applied for either a new construction or a modernisation project.

With the existing conditions modelling, we can obtain:
- Document existing building for historical use
- Provide documentation of environment for future uses
- Enhance efficiency and accuracy of existing conditions documentation
- Provide location information
- Aids in future modeling and 3D design coordination
- Use for visualization purposes

Site analysis
BIM is used to study the properties of a determinate area and figure out the most optimal site location for the project. The data collected of the site is used to select the site and the position of the building based on the criteria.

Programming
Spatial program is used to assess design performance, due to spatial requirements. It allows the project team to analyse the project space and understand its regulations. The critical decisions are mostly made in

this part of design, and client's needs and options are analysed in this part to arrive to the best approach.

Engineering analysis
BIM uses the best engineering method based on design specifications, this information is the based that will be given to the owner or operator for the use of the building systems, it provides an energy efficient solution, faster returns on investment and improved quality of the design analysis.

Design authoring
They connect the 3D model with the database properties, quantities, costs and schedule.

Sustainability evaluation
They can be applied in the four phases of a construction project, planning, design, construction and operation; this will become more effective if it's done in the design stage and applied in the construction phase.

Design review
This is the part in which the 3D modelling is used to evaluate the program and set criteria like layout, security, ergonomic, acoustic, texture and colour so that trials can be done with high detail and various design alternatives can be studied.

Code validation
Code validation software is used to check the model parameters with the project specific codes, its advantages are the validation of the

design of the building with specific codes, the reduction of design error and omissions in the project, a risk that we will talk about.

Clash detection

Used during the coordination process, it determines conflicts in the field making a comparison of 3D models of building systems. Its main objective is to eliminate major system conflicts in relation with installation.

Cost estimation

It generates in the phase of design process an accurate start off quantity and cost estimate, it also provides cost effects of additions and modifications with the aim of saving money and avoid overruns due to the modifications done during the evolution of the project.

Construction system design

3D design software is used to analyse the construction of a complex building and ensure that this building can be constructed, increase the construction productivity and increase the safety awareness of the building system.

Phase planning

In this part of the process BIM is used to plan the occupancy in a renovation, retrofit, addition or to show the construction sequence and space requirements in the building site. This part in which 4D modelling is introduced, we can see how useful it is to give the project team or owner of the building a better understanding of it.

Digital fabrication
This process uses machine technology to prefabricate objects directly from BIM, the model is spooled into sections and input into prefabrication equipment for production of system assemblies.

Record modelling
It offers a complete representation of environmental, physical conditions and assets of a facility. It mainly contains information relating to the most important architectural elements. The record model should contain information about the depiction of space with a link of information to serial codes of all the components of the building; this will allow the owner to monitor the project relative to the specifications provided.

Asset management
This last phase consists that the physical building, systems, equipment and surrounding environment of the project has to be maintained, operated and upgraded with an efficiency that will result satisfactory for owner and user at the lowest cost possible.

Time schedule of construction and yearly cost as 4D and 5D schedule for Liget Project.

Logical scheme to set and prepare schedule and cost baselines in general:

Identify activities and tasks needed to produce each of the deliverables identified in the scope baseline. How detailed the task list needs to be depends on many factors, including the experience of the team, project

risk and uncertainties, ambiguity of specifications, amount of buy-in expected, etc.

- Identify resources for each task, if known.
- Estimate how many hours it will take to complete each task.
- Estimate cost of each task, using an average hourly rate for each resource.
- Consider resource constraints, or how much time each resource can realistically devote to this one project.
- Determine which tasks are dependent on other tasks, and develop critical path.
- Develop schedule, which puts all tasks and estimates in a calendar. It shows by chosen time period (week, month, quarter or year) which resource is doing which tasks, how much time each task is expected to take, and when each task is scheduled to begin and end.
- Develop the cost baseline, which is a time-phased budget, or cost by time period.

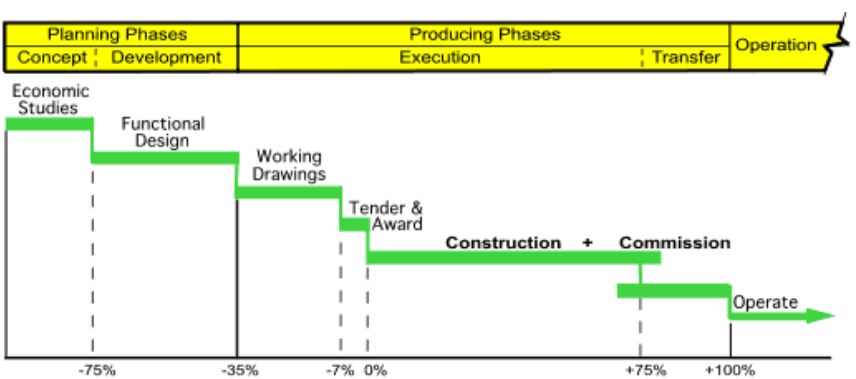


Figure9. Approximate Percentages of Construction and Commission Time (Source: Liget Budapest-BIM Concept, consulted 5/5/17)

In the case of the Liget of Budapest, BIM technology is practically necessary to feature the entire project due to the big volume of it and the fact that there are five individual constructions taking place in the same space that although it's not small it will need control over it so it dost suppose an increase of time and money to the project in general.

5 Section 5 [Forecast according to the project]

[2018]

February: Ending works of the refurbishment Museum of Fine Arts.
April: Building operations started of the New National Gallery.
September: Completion of the National Museum Restoration and Storage Centre.

[2019]

May: Ending works of the House of Hungarian Music.
September: Ending works of the City Park Theatre, the Museum of Ethnography and the renovation of the transport museum.

[2020]

October: Opening of the New National Gallery and the Pannon Park.

As mentioned before, this is the timetable of the original project works, meanwhile no construction of any building have started, so a new schedule of works based on what our predictions of the beginning of the constructions will be has been made to supply this.

Chapter 6.

Project financials in general

In the next part we are going to analyse the various methods we have to consider for the correct financial of public projects.

The cost of the projects is basic to determine the budget, cost baseline and earned value management, because it makes a comparison between the value planned at the beginning with the real cost.

The part of making an estimation of the cost consists on making an accurate approximation of the monetary resources that will be needed to complete the entire project, to do this correctly we should be able to know the expenditure level or the basic requirements to monitor the state of the project it will go through the process of control costs.

For the financial part of the project, as it normally occurs, the owner will determine the viability that the project has, and the form of the project that will produce the more profitable results (feasibility study). The financial management will let the process acquire and manage the financial resources of the project. The major processes that are implied in a construction from a monetary point of view are the financial planning, financial control and administration and records, some of which will see next.

To start off we will look at the general planning phases, in this part the works have to be identified, placed on a time scale and quantified, by this point resources should also start to be considered.

This process is stated in the *Construction Extension to the PMBOK Guide-2000 Edition* is considered to have the following as inputs (PMI, 2003, p 160):

1. Source of funds
   It's normally obtained from the company's central financing system, which is a combined system borrowed from financial institutions, retained profits, financial reserves and progress or down payments expected from the client, in the case of the public park it would be normally expected that the source of funds will be done by the issue of commercial paper, bank loans, public debt offerings, private placement in the market and government entity loans.
2. Contract requirements
   They show the client the expected cash flow for the project and the legal implications that may occur.
3. Economic environments
4. Estimated construction cost
   It's based on the initial cost of the project.
5. Project duration
6. Tax benefits
7. Financial advisor
8. Risk factors

To gather this process purposes we will have to take in to account this tools and techniques: the feasibility study, financial advisor, sensitivity analysis, provisions for added financing and test the financial plan.

For an accurate planning of the financing a financial control and a financial administration and records should be done.

The financial control makes sure that the cost control and financial control are executed in an effective way to make sure that works are in the budget and financial administration assures that the information is administrated and the recording of it is correctly done.

Apart from this technique mentioned before, feasibility studies, is the key for the financing of the projects, it includes this variables, investment, cost of operation and benefits of operation. Although the problem occurs when it's time to calculate the values just mentioned and it has produced many studies, calculating the numbers for the finance methods of analysing costs depends on the correct maths of them, but the difficult part comes on projecting these on the time line.

Cost and investment projections are very difficult to project. Operational costs of the project could be influenced by future events, and something that has been initially projected may not occur in the way it was intended at the start of the project, that is why investment at the beginning in a use of project management tools and techniques is becoming more correctly projected but the operational costs still aren't.

To conclude projecting operational costs implies the ability to anticipate the direct, indirect, and financing and ownership costs that the project

may produce, either to operate itself or to be able to produce the expected results.

This means that is necessary to develop a cost idea early on in the project, since the cost is the total amount of subcontractor invoices, all the utilities necessary, rent and other property costs, personnel costs, management costs and others that may require an initial amount of money to make the product of the project operate.

Chapter 7.

Identification of risks

In our days an effective risk management is a critical component for the economy of our project.

In projects, the risk project management should include:

- Risk management planning
- Risk identification
- Qualitative risk analysis
- Quantitative risk analysis
- Risk response planning
- Risk monitoring and control

This is probably the most complicated aspects to deal of project management, since a project manager should be able to recognize and identify the root causes of risks and to trace and palliate these causes through the project. Furthermore, risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives. The use of risk management from the early stages of a project, where major decisions such as choice of alignment and selection of construction methods can be influenced, is essential. The benefits of the risk management process include identifying and

analyzing risks, and improvement of construction project management processes and effective use of resources.

Construction projects can be unpredictable. Managing risks in construction projects has been a very important process in order to achieve project objectives in terms of time, cost, quality, safety and environmental sustainability. Project risk management is an iterative process: the process is beneficial when is implemented in systematic manner throughout the lifecycle of a construction project, from the planning stage to completion.

As we have mentioned, the total refurbishment of the city park is a big project of high cost this is why we should pay more attention to the risks that can occur in it. Because of the evolution of big projects the interest in risk management has also increased, books about how to deal with it have been written, such as *A Guide to the Project Management Body of Knowledge* (PMBoK® Guide), *Project Risk Analysis and Management Guide* (PRAM), *RAMP: Risk Analysis and Management for Projects* guide and the British Standards Institution guides. As well as tools and techniques have been developed for a more accurate RMP.
In the process below we can see the four basic sub-processes located in the context of clearly defined project objectives which are looped through the project life cycle.

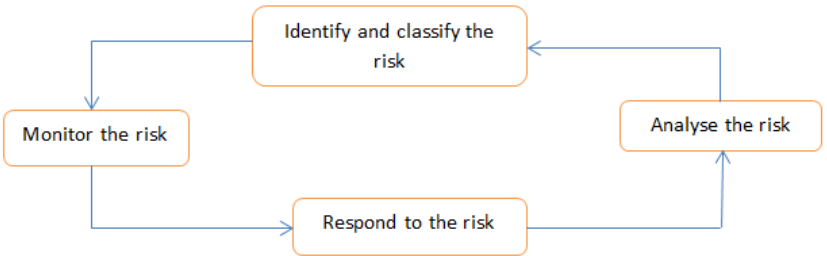


Figure10.Project objectives (Source: Construction Risk Identificatio, consulted 22/5/17)

This sub-processes show us the procedure that we should follow to develop the solutions to the risks that can appear during the project development.

7 Section 1 [Identification and risk analysis]

Construction projects carry complex risks for all of the parts involved in it; this includes owners, consultants, contractors and suppliers, which can increase when construction takes place near an active facility or congested area. Risks include geological or pollution-related conditions, interference with on-going operations, construction accidents, as well as design and construction faults that may negatively impact the project in construction and when the project is completed.

Generally two broad categories, qualitative and quantitative analysis are distinguished in literature on risk assessment. A qualitative analysis allows the key risk factors to be identified. Risk factors may be

identified through a data-driven (quantitative) methodology or qualitative process such as interview brainstorming, and checklists. It is considered as an evaluation process which involves description of each risk and its impacts or the subjective labelling of risk (high/medium/low) in terms of both risk impact and probability of its occurrence. Qualitative risk analysis assesses the impact and likelihood of the identified risks and develops prioritized lists of the risks for further analysis or direct mitigation

Risks of construction project can be split mainly in to two major groups:

- Internal risks: are the ones that depend on contractors, consultants and clients.
- External risks: are the risk elements that are not in control of the key stakeholders.

Risks and uncertainties, involved in construction projects, cause cost overrun, schedule delay and lack of quality during the progression of the projects and at their end. Generally poor cost performance of construction projects seems to be the norm rather than the exception, and both clients and contractors suffer significant financial losses due to cost overruns.

The impact quantifies the risk over the objectives of the project (scope, time, cost and quantity). A good estimation of the monetary expected value can be obtained from the benefits or costs expected from an event that carries risks if its multiplied by its probability of happening due to the impact (monetary value expected = probability x impact) the unknown risks or unforeseen can occur without having predicted them. These events depend of an unusual combination of factors that couldn't

be detected with anticipation; in this case for the known and identified risks a monetary reserve for unpredictable factors can be estimated that's part of the base cost of the project.

To organise the risks that can occur in our construction project, the planning of the risk management has to be done, to start of a scope, schedule, budget and communications should be considered and meeting for planning and analysing the possible risks, in our case the tools used for risk analysis are a survey of Hungary's most common risk factors on construction, looking at statistics and asking construction companies, experts opinion in risks in construction and publications of the theme occurring in near areas of Hungary in which risks are similar like the potential risks where adapted from studies done by Chapman and Ward, Perera et al, Baloi and Price, Pinto et al, Tah and Carr, Mbachu and Nkado, Kartam and Kartam, Lahdenperä and Mitkus and Trinkünienė.

In the next part we are going to identify the risks, perform a qualitative and quantitative risk analysis and plan risk responses.

They are going to be organised in matrix of definition of impact and from there to a risk matrix.

IMPACT	Very Low 1	Low 2	Medium 3	High 5	Very High 10
COST (million HUF)	<3	3-9	9-30	30-60	> 60
SCHEDULE (Delay in months)	<1	1-4	4-6	6-8	>8
SECURITY (Injuries)	Low	Minor	High	Incapacity	Death
ENVIRONMENT	Local	Provincial	National	European	Worldwide

Table1. Definition of Impact (Source: Unidad 12, Gestión de Riesgo, consulted 7/6/17)

Impact						
	Very High 10	5	10	15	25	50
	High 5	4	8	12	20	40
	Moderate 3	3	6	9	15	30
	Low 2	2	4	6	10	20
	Very Low 1	1	2	3	5	10
		Rare 1	Occasional 2	Somewhat frequent 3	Frequent 4	Very frequent 5
				Probability		

Table2. Risk matrix (Source: Unidad 12, Gestión de Riesgo, consulted 7/6/17)

The risks categories where identified according to their potential effect on the construction projects, the internal risks that result of this where:

- Construction risks
- Design risks
- Project management risks

The assessment of internal risks in the project is shown in Table 1 Risk priority is used during the planning response and risk monitoring. It's important to understand the priority of the risks, since it allows the people implicated in the project the relative importance of each risk.

Table 3 shows the controllable risks and its probability and impact for constructions in Budapest.

Origin	Categories		Probability	Impact
Design risk	D1	Design errors and omissions	4	10
	D2	Design process takes longer than planed	3	5
	D3	Stakeholders request late changes	3	3
External Risks	EX1	Public objections	1	3
	EX2	Laws and local standards change	1	3
	EX3	Tax change	1	5
Environmental Risks	EN	Environmental incomplete analysis	2	5
Organisational Risks	O1	Inexperienced staff	3	3
	O2	Absence of protection	2	5
Project management risks	PM	Organisation errors or contractor delays	4	5
Right of way risks	R1	Construction permissions are temporary expired	1	5
	R2	Contradictions in construction documents	2	3
Construction Risks	C	Higher construction cost than expected	4	5

Probability: 1(rare)-5(very frequent)
Impact: 1(very low)-10(very high)

Table3. Resume of Risk Probability and Impact (Consulted 20/6/17)

When all the problems that can occur are identified a risk matrix can be done to show visually the combination of impact and probability of the problems that can turn out during the construction

Impact						
	Very High					
	High				PM, C	D1
	Moderate			D3, O1, O2	D2	
	Low			R2	EN	
	Very Low			EX1, EX2	EX3, R1	
		Rare	Occasional	Somewhat frequent	Frequent	Very frequent
				Probability		

Table4. Risk matrix of Liget Budapest (Consulted, 20/6/17)

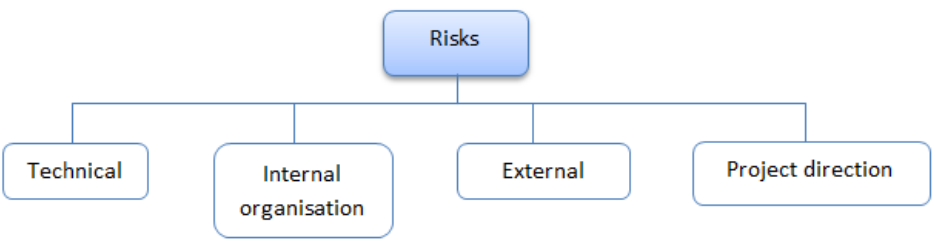


Figure11. Categorisation of risk (Source: Unidad 12, Gestión de Riesgo, consulted 7/6/17)

To categorise the risks of our construction project and be able to see clearly how to mitigate them and bring them down to a safe zone (green areas).

Score	Priority	Strategy	Objectives of the strategy
1-2	Very Low	Passive Acceptance	Do nothing
3-4	Low	Passive Acceptance	Leave written what is going to be done when the risk occurs
5-10	Moderate	Mitigate	Actions to reduce the probability or impact
11-24	High	Transfer	Transfer the risk to thirds.
25-50	Very High	Avoid	Don't move on with the project till the score hasn't decreased.

Table5. Categorisation of risk (Source: Unidad 12, Gestión de Riesgo, consulted 7/6/17)

7 Section 2 [Assessment of risks (long term risks)]

Focusing on the Liget Budapest project we have various long term risks that we should handle with. Due to the size of the project any type of error or delay could be a big problem for the whole of the buildings.

The most important risk that is affecting in this project is the time program, by this time, in the initial plan, the construction of the buildings should be started and it hasn't, and the delay of one of the buildings, causes a delay in all the construction, the first building operations as the first time schedule marked should have started in 2016 with the start of the house of Hungarian music.

Although this could be one risk, we shouldn't focus only on it, since there are also other factors altering the normal way our constructions should take, for instance we are going to analyse the ones that in the table 4 are more probable to occur and that would suppose a higher negative impact for the five new museum buildings.

The next part details the most dangerous risks mentioned for our construction project that can normally take place in the area of Budapest and the possible solutions that could be applied to mitigate that risk.

D1. Design errors and omissions

They occur frequently in construction projects due to a lack of communication of the project team or the fact that the initial design is not able to be put on practice in the building site. This produces an increase of the cost of the project due to the fact that a new design or changes have to be done quickly, since these errors are normally seen once the construction has started, it also affects its quality since the solutions that can be carried out are scarce and companies try to invest the least money in this changes, as a result of this we obtain the bad quality problem.

The probability of occurring is of 4 and the impact it has on the project of 10, giving a monetary expected value of 40, this puts D1 risk on a dangerous part of the risk matrix that we have to immediately avoid, the responsibility of informing of this risk should be given to the project direction who control in detail the plans of the construction and evolution of the construction of the building.

The proposal for avoiding this action is the implementation of BIM in big projects like this, since a tracing of the building and input of information of it avoids later problems of errors and mistakes. Another approach, would be to introduce a design/build team from the beginning, since to have both parts working together from a start can reduce considerably later errors for the fact that there is more than one controller of the plans and a point of view of how things will go on at the stage of the building can stop from the beginning this late errors.

PM2. Organisation errors and contractor delays

Another of the risks that have to be directly avoided are the organisation errors, which affect directly the cost and schedule, that as we have seen before are two of the worst consequences originated by project risks, its probability of happening is of 4 in a scale of 1 to 5 and has an impact of 5, this means that its monetary expected value will be of 25 putting this risk immediately on to a strategy which you have to avoid.

To get to a previous solution for this risk, what should be implemented is to carry out a schedule from the beginning of the construction project; this should be reviewed every month to identify the potential delays, if delays are seen corrective action should be initiated immediately.

This risk has been one of the ones that has appeared in Liget Budapest from the beginning of the operations, since initially the construction was planned to start at the beginning of 2016 and it has already suffered a delay of two years till 2018 when the house of Hungarian music is planned to start, an organisation error of this magnitude can't be considered once the construction of the buildings has started, since it could increment widely the cost of the entire project.

C1. Higher construction costs than expected

The fact of the final construction cost of the project being higher, is a risk that supposes a monetary expected value of 40 since the probability of it of occurring is of 4 and the impact to the project is of 10, this also makes it to be classified as a risk that has to be avoided

immediately, or it will affect the cost and quality of it, the risk should be monitored by the project direction, since they have to have control over the projects budget plan.

First of all to completely avoid any problems related with problems due to quality what should be done is to work together with companies which you already know that they offer a service of quality and that they work with a fair budget, this will avoid any high prices or problems that can raise the initial budget. If any latter surprises occur in the construction related to external factors, external risks as an example, a percentage of the initial budget should be destined to these problems, the fact of having stated this percentage from the beginning will avoid an increase of costs through the project.

D2. Design process takes longer than planned

Another of the common errors during a construction project is the delay in design process, this is a crucial part in the project that generally has to be taken with lots of care for avoiding later problems, the impact for the project is of 5, and the probability of happening of 3, this puts its monetary expected value in a number of 15, so a transfer strategy has to be implemented, transferring the risk to thirds, the responsibility of it being controlled is of the architect in charge of the design of the project.

The best practices for project scheduling, would be to identify from the beginning items that have a direct schedule impact (an example of this is a specialized fabrication of replacement materials) and indirect

schedule impact. With this points identified, the team should review the project details early in planning to ensure that the potential risks are identified and adequate the time allowed in the schedule for successful implementation.

D3. Stakeholders request late changes

Changes in the project are always probable to happen specially the ones done by the parts involved in it, normally when the construction has started and you can start to visualise really the design, it's also the point when its worst to introduce any type of change in the design. This has a probability an impact of three and its monetary expected value is of 9, it's not one of the worst risks, but is one that should be mitigated if they don't want to affect cost and schedule of the project.

The actions applied if we want to reduce the probability of the impact of this risk is to implement a BIM framework from the beginning since its 3D models, can help the stakeholders of the project, that are probably not used to the simplicity of 2D models and not having the capacity of seeing it in 3D, that is why a real model would be very useful for the interested parts, since they can see a virtual completed building from which if they are not convinced changes can be done in the initial phase so no delays happen later.

O1. Inexperienced staff

This risk has a probability of occurring of 3 and an impact of 3, having inexperienced staff in the project will affect directly the quality and cost of the project, this means that the risk has to be mitigated, the intern organisation of the project should be aware of the team they are employing.

This risk has to be avoided from the beginning, and big projects like this one are not good to experiment with new companies with who you have never worked before. The ideal state would be to build up your team with who you have already worked and know that they are a competent business, if this wasn't possible due to the project, because it's too big or they don't work with the materials this company's work with a recommended company should be contracted and still make sure from the beginning that they operate with qualified staff which can complete the project in the time and quality required.

O2. Absence of protection

With a probability of 2 and an impact of 5 it's producing a monetary expected value of 10, putting a risk on a mitigation point; although the probability of occurring is low the consequences of this risk are very high affecting mostly the quality and security of the construction.

Although it's an obligation to have always all the security papers of the project and construction site on date with all the necessary protections on it, most of the time this isn't occurring leaving space for a lot of security dangers to happen. During all the project development and construction works, a prevention coordinator should be working in the

construction site and checking all the protections are used and in their place, if any problems happen this should be informed directly to who they are relevant and legal papers of the project and the needed in the construction site should be always up to date.

EN. Incomplete environmental analysis

An incomplete environmental analysis can produce lots of problems to the project direction, just as the risk mentioned before its probability is low, of two, but if it occurs it produces a big impact (five).

The ideal for this case would be to avoid this from the beginning of the project, because obviously it's no use if the incomplete analysis is seen at the middle of the project, a control of all the documentation at the beginning of the project should be done and a check list for all the necessary documents of the project, such as if they are completed or not, if this list is not complete with all the documents works can't start.

Chapter 8.

Project contract strategies/structures

8 Section 1 [Design-build turnkey]

The next diagram shows us the usual flow in construction contracting, and the various people involved in it.

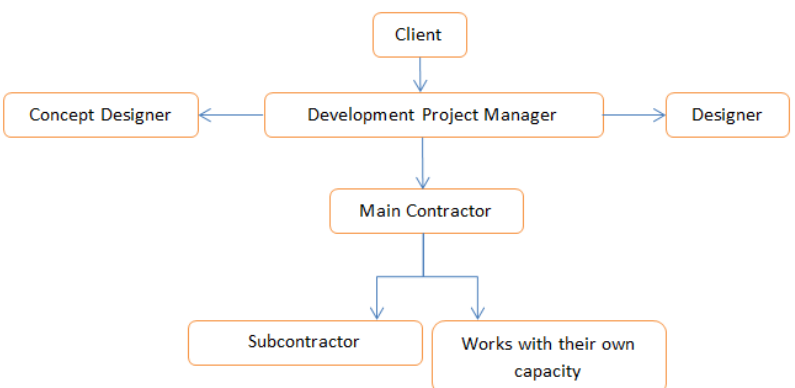


Figure12. Flow of construction contracting (Source: Project management book, consulted 9/5/17)

Possible organisation forms:
- Integrated design-build Company (home architect/professional engineer/executives)
- Leading constructor. Architect/specialty subcontractors or conductor, contractor, subcontractor
- Design-build joint venture (architecture/professional engineer and executives)

8 Section 2 [Pricing methods]

General Contracting is known as method to determine cost and price within the entire construction.

The General Contracting method of project delivery allows for two accounting and payment methods; General Contracting on Negotiated Basis and General Contracting on Lump Sum Bid Basis.

General Contracting Negotiated Basis

With or without a GMP. In this scenario, the Owner selects the General Contractor on the basis of the actual cost plus a fixed or percentage fee. On a GMP basis, the Contractor guarantees that a maximum price will not be exceeded and that excess cost will be borne by the Contractor.

Often, when final costs and fees are less than the amount guaranteed, savings are shared by the General Contractor and the Owner.

General Contracting Lump Sum Bid Basis

In this scenario, the General Contractor provides a fixed price for construction based on a complete set of plans and specifications and awards the work to the lowest bidder. This agreement is to perform the work on one fixed price regardless of the cost to the Contractor.

Chapter 9.

Key factors to success

9 Section 1 [Key stakeholders, winners-losers]

In all public projects with an ideal of city renewal, there will be detractors of it, and people supporting the idea, in this part we analyse who are the interested ones of the realisation of the project and the real interests it can produce.

The promoter of the project is the government of Budapest; they are the interested part that the project takes place, the Liget of Budapest means for them a great investment from which they are expecting to get a big profit.

Since the project is only at an initial phase we can only make suppositions of its profit or failure on the future. The area has normally lots of visitors, and what would be expected after the construction of the five museums is the visitors to increase, so the money invested in the project could be returned and even give benefits to Budapest's government.

In the other hand we know, that it's not the first time that lots of money has been expected from a big construction and it has failed on

its proposal in long terms, due to a bad management, in the case of this project we have to cosier that lots of citizens are against the construction of the museums, there opinion is that they are going to take out lots of space of green areas and the money is not being well managed by the government so a refusal of the Budapest population of visiting this area could happen, and with it an economical decrease for getting the money inverted on the buildings back.

Although we don't know with certainty what can happen, the special pressure made by the citizens is going to affect the project financing at long term, with a decrease of visitors.

Chapter 10.

Summary

The project of the park renewal offers lots of advantages and disadvantages as a construction project to Budapest, firstly because it's a great investment for the city, investment that not all citizens accept due to the misinformation provided by the government.

People in Budapest are generally against this renewal due to the information that has arrived to them such as that there is going to be a great loss of space of green areas very important for big cities such as this one and the fact that government is investing a great amount of money in a project that dost really assures them completely to be recovered in long terms.

In the other hand we can state from an optimist point of view that this project apart from being from a very modern architecture not only from an esthetical point of view, but also from an environmental and structural part, this brings us to say that it's a great investment for the old city park of Budapest that really needs it, in the initial plans an increase of green areas is also stated, another point in favour to the project.

The problem that we have with this project is the fact that it includes five new buildings in the park, it's a big construction in which lots of

problems that result delays or cost increments can happen, this becomes specially a problem if it happens in the initial constructions, from there delays and cost increments can only get worse every time.

A risk analysis has been carried to get in to detail of the problems that can occur during the project, a summary of the risks of the project that have to be treated has been carried out in the next tables:

Contents	Explanation
Numeration	D1
Risk	Design errors and omissions
Consequences	Cost and quality
Probability	4
Categorisation	Project direction
Impact	10
Score	40
Strategy	Avoid
Action	Implement a BIM framework in the project. Introduce a design/build approach; this cooperative work includes builder and designer on the same team eliminating most of the design errors and omissions.
Responsible	Project direction

Table6.Design errors and omissions

Contents	Explanation
Numeration	PM2
Risk	Organisation errors and contractor delays
Consequences	Cost and schedule
Probability	4
Categorisation	Internal organisation
Impact	5
Score	25
Strategy	Avoid
Action	Carry out a schedule from the beginning of the construction project, this schedule should be reviewed every month to identify potential delays; if they exist a timely corrective action should be initiated.
Responsible	Project coordinator

Table7.Organisation errors and contractor delays

Contents	Explanation
Numeration	C1
Risk	Higher construction cost than expected.
Consequences	Cost and quality
Probability	4
Categorisation	Internal organisation
Impact	10
Score	40
Strategy	Avoid
Action	Save a percentage of the budget for possible problems in the project. Subcontract works to companies that you have been working before and trust.
Responsible	Project direction

Table8. Higher construction cost than expected

Contents	Explanation
Numeration	D2
Risk	Design process takes longer than planed
Consequences	Cost and schedule
Probability	3
Categorisation	Project direction
Impact	5
Score	15
Strategy	Transfer
Action	Plan a realistic schedule of the project from the beginning.
Responsible	Architect responsible of the design

Table9. Design process takes longer than expected

Contents	Explanation
Numeration	D3
Risk	Stakeholders request late changes
Consequences	Cost and schedule
Probability	3
Categorisation	External
Impact	3
Score	9
Strategy	Mitigate
Action	Implement BIM framework or 3D project modelling for the plans of the project.
Responsible	Project Direction

Table10. Stakeholders request late changes

Contents	Explanation
Numeration	O1
Risk	Inexperienced staff
Consequences	Quality and cost
Probability	3
Categorisation	Internal organisation
Impact	3
Score	9
Strategy	Mitigate
Action	Work with a team of who you have good references or have worked with them previously
Responsible	Employers of company

Table11. Inexperienced staff

Contents	Explanation
Numeration	O2
Risk	Absence of protection
Consequences	Quality and security
Probability	2
Categorisation	Project direction
Impact	5
Score	10
Strategy	Mitigate
Action	Risk prevention team should be working actively during all the duration of the project. Risk documentation needed should be done and a coordinator for security of workers and risk prevention always working with it.
Responsible	Technician in charge of organisation in construction site

Table12. Absence of protection

Contents	Explanation
Numeration	EN
Risk	Incomplete environmental analysis
Consequences	Cost and schedule
Probability	2
Categorisation	Project Direction
Impact	5
Score	10
Strategy	Mitigate
Action	Implement a control check list at the start of the project, to make sure all the documentation related to the project exists and is complete.
Responsible	Project Direction/External

Table13. Incomplete environmental analysis

In this tables a summary of the risk that flow between moderate and very high priority of action, the ones that are in the safe space of the matrix (green coloured area) are of low or very low priority and no action should be needed to be taken to mitigate them, a passive acceptance should be applied and the only minor action that should be done is to leave written what has to be done when the risk occurs.

Chapter 11.

Conclusions

The Liget Park of Budapest it's a very special point of the city due to its centric situation and area of green spaces in the metropolitan city of Budapest, it attracts tourists and citizens offering them leisure activities like the museum of the park and a very big area of green spaces in the capital city of Hungary.

Although it's still a very visited area of the city a complete refurbishment of the whole park needs to take place, since the buildings are old and don't provide the functionality that we can find in modern buildings these days, this is why for new museum buildings are going to be done and a refurbishment of the Transport Museum is going to take place, green areas of the park are also going to be increased.

The renewal will provide Budapest of a completely renovated City Park which is expected to return the money invested by the city in it. The fact that the renewal of the whole park is such a big project it has presented the need of a risk analysis of the problems that could occur during the whole project duration, since an approach to the risks from the beginning and solutions for them to stop happening should be obliged for all projects, but specially for this one that is already carrying a delay of two years from the initial plan.

This project has been useful for me not only for the fact of helping me know the story and background of a city in which I have been living for 6 months but also for the fact of having done a risk analysis that from my point of view should be essential in construction for the capacity of solving the problems by completely avoiding them. Risk management should be studied deeper for all the benefits it provides in the construction in terms of money and schedule, problems that are always affecting projects.

Chapter 12.

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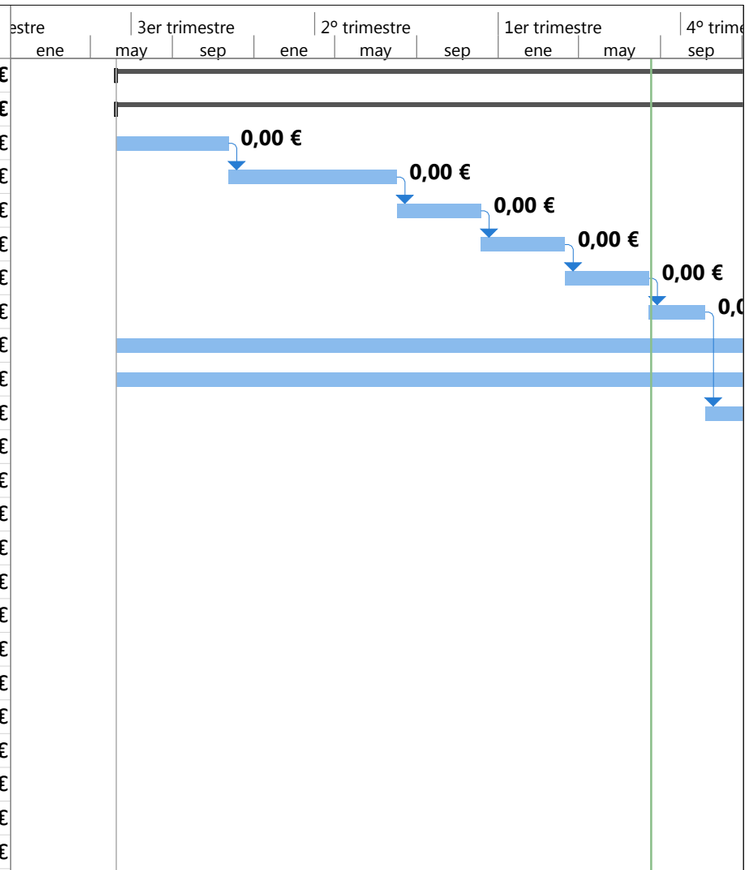
Annex 1[Cost]

Construction cost of museum buildings						
On the base of average costs of the year 2016						
	In-built area/m2	Total net floor level	Minimum average cost/net m2	Maximum average expected cost	Total sum min	Total sum max
House of Hungarian Music	2565	10099	1490	1713,5	15.047.510,00	17.304.636,50
New National Gallery	9095	51950	1490	1713,5	77.405.500,00	89.016.325,00
Transport Museum	3795	19430	1490	1713,5	28.950.700,00	33.293.305,00
Museum of Ethnography	13411	32615	1490	1713,5	48.596.350,00	55.885.802,50
City Park Theater	1333	3300	1560	1794	5.148.000,00	5.920.200,00
					175.148.060,00	201.420.269,00

Annex 2[Schedule]

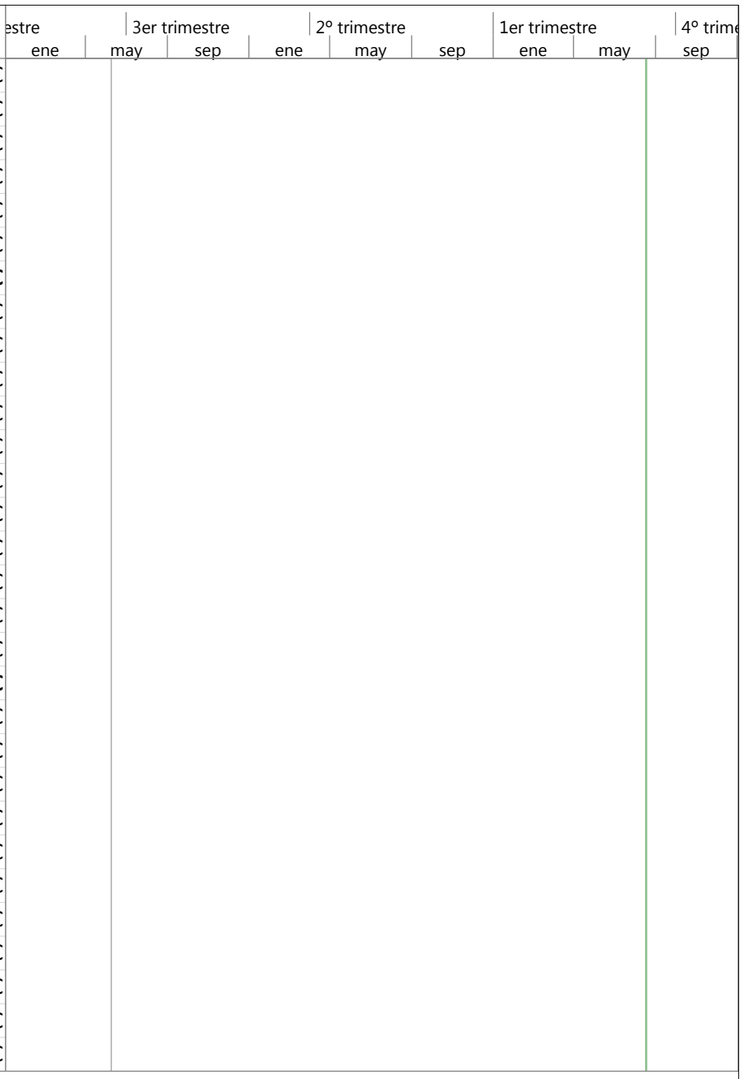
Id		Nombre de tarea	Duración	Comienzo	Fin	Predecesoras	Nombres de los recursos	Costo
1		**LIGET PROJECT CONSTRUCTION**	**2995 días?**	**mar 09/06/15**	**lun 30/11/26**			**201.420.268,99€**
2		**Preparation of entire project**	**2995 días?**	**mar 09/06/15**	**lun 30/11/26**			**0,00€**
3		Appointments of PM Co.	120 días	mar 09/06/15	lun 23/11/15			0,00€
4		Prepare programme and capital	180 días	mar 24/11/15	lun 01/08/16	3		0,00€
5		Devise project strategy	90 días	mar 02/08/16	lun 05/12/16	4		0,00€
6		Establish local building codes	90 días	mar 06/12/16	lun 10/04/17	5		0,00€
7		Confirm design process and	90 días	mar 11/04/17	lun 14/08/17	6		0,00€
8		Confirm design brief by buildings	60 días	mar 15/08/17	lun 06/11/17	7		0,00€
9		Monitor and report progress	2995 días?	mar 09/06/15	lun 30/11/26			0,00€
10		Monitor and control cost budget	2995 días?	mar 09/06/15	lun 30/11/26			0,00€
11		Design cost and project plan by	90 días	mar 07/11/17	lun 12/03/18	8		0,00€
12		Design competion: bidding and	120 días	mar 13/03/18	lun 27/08/18	11		0,00€
13		**HOUSE OF MUSIC**	**1222 días**	**mar 28/08/18**	**mié 03/05/23**			17.304.636,48€
14		Detail design	120 días	mar 28/08/18	lun 11/02/19	12		0,00€
15		Issue building licence	60 días	mar 12/02/19	lun 06/05/19	12;14		0,00€
16		Prepare tender documents	60 días	mar 07/05/19	lun 29/07/19	15		0,00€
17		Prepare tender bid	60 días	mar 30/07/19	lun 21/10/19	16		0,00€
18		Aproval	30 días	mar 22/10/19	lun 02/12/19	17		0,00€
19		Mobilisation of contractor	30 días	mar 03/12/19	lun 13/01/20	18		0,00€
20		Site clearance and ground works	122 días	mar 14/01/20	mié 01/07/20	19		0,00€
21		Construction	200 días	jue 02/07/20	mié 07/04/21	20		6.056.622,78€
22		Finishings and Landscaping	480 días	jue 08/04/21	mié 08/02/23	21		11.248.013,70€
23		Inspection and aceptance of works	30 días	jue 09/02/23	mié 22/03/23	22		0,00€
24		Handing over	30 días	jue 23/03/23	mié 03/05/23	23		0,00€
25		**NATIONAL GALLERY**	**1442 días**	**mar 28/08/18**	**mié 06/03/24**			**89.016.325,00€**
26		Detail design	120 días	mar 28/08/18	lun 11/02/19	12		0,00€
27		Issue building licence	60 días	mar 12/02/19	lun 06/05/19	26		0,00€
28		Prepare tender documents	60 días	mar 07/05/19	lun 29/07/19	27		0,00€
29		Prepare tender bid	60 días	mar 30/07/19	lun 21/10/19	28		0,00€
30		Aproval	30 días	mar 22/10/19	lun 02/12/19	29		0,00€
31		Mobilisation of contractor	30 días	mar 03/12/19	lun 13/01/20	30		0,00€
32		Site clearance and ground works	122 días	mar 14/01/20	mié 01/07/20	31		0,00€
33		Structure	420 días	jue 02/07/20	mié 09/02/22	32		31.155.713,75€
34		Finishings and Landscaping	480 días	jue 10/02/22	mié 13/12/23	33		57.860.611,25€
35		Inspection and aceptance of works	30 días	jue 14/12/23	mié 24/01/24	34		0,00€
36		Handing over	30 días	jue 25/01/24	mié 06/03/24	35		0,00€
37		**MUSEUM OF ETHNOGRAPHY**	**1803 días**	**mar 28/08/18**	**jue 24/07/25**			**55.885.802,51€**
38		Detail design	120 días	mar 28/08/18	lun 11/02/19	12		0,00€
39		Issue building licence	60 días	mar 12/02/19	lun 06/05/19	38		0,00€
40		Prepare tender documents	60 días	mar 07/05/19	lun 29/07/19	39		0,00€
41		Prepare tender bid	60 días	mar 30/07/19	lun 21/10/19	40		0,00€
42		Aproval	30 días	mar 22/10/19	lun 02/12/19	41		0,00€



Proyecto: Antesütemterv
Fecha: vie 18/08/17

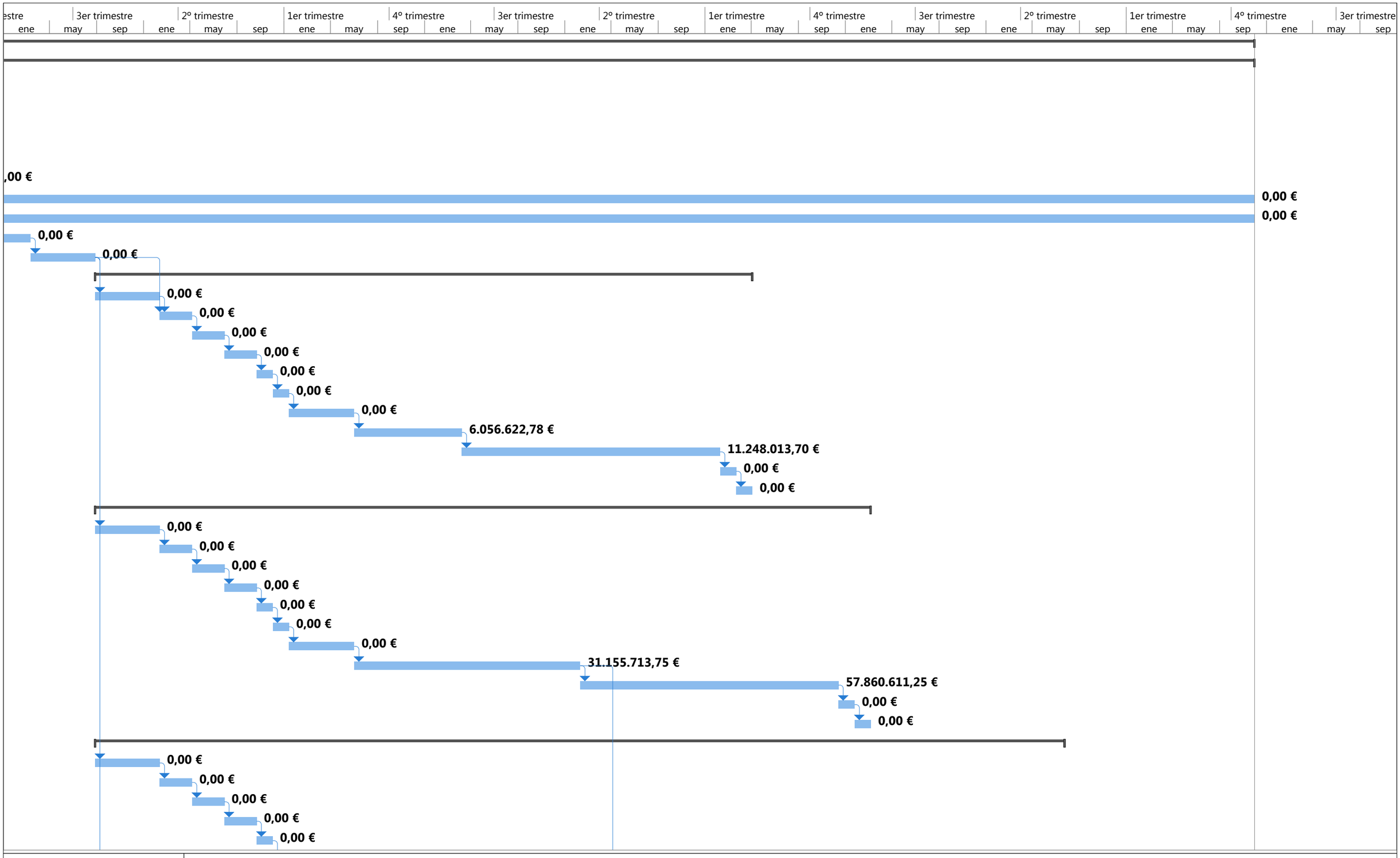
Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha límite
División	Tarea inactiva	solo duración	solo fin	Progreso
Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual
Resumen	Resumen inactivo	Resumen manual	Hito externo	

Id	Nombre de tarea	Duración	Comienzo	Fin	Predecesoras	Nombres de los recursos	Costo
43	Mobilisation of contractor	30 días	mar 03/12/19	lun 13/01/20	42		0,00€
44	Site clearance and ground works	122 días	mié 25/08/21	jue 10/02/22	43FC+60 días		0,00€
45	Structure	300 días	vie 06/05/22	jue 29/06/23	44FC+60 días;33		19.560.030,88€
46	Finishings and Landscaping	480 días	vie 30/06/23	jue 01/05/25	45		36.325.771,63€
47	Inspection and aceptance of works	30 días	vie 02/05/25	jue 12/06/25	46		0,00€
48	Handing over	30 días	vie 13/06/25	jue 24/07/25	47		0,00€
49	**THEATRE**	**1574 días**	**mar 28/08/18**	**vie 06/09/24**			**5.920.200,00€**
50	Detail design	120 días	mar 28/08/18	lun 11/02/19	12		0,00€
51	Issue building licence	60 días	mar 12/02/19	lun 06/05/19	50		0,00€
52	Prepare tender documents	60 días	mar 07/05/19	lun 29/07/19	51		0,00€
53	Prepare tender bid	60 días	mar 30/07/19	lun 21/10/19	52		0,00€
54	Aproval	30 días	mar 22/10/19	lun 02/12/19	53		0,00€
55	Mobilisation of contractor	30 días	mar 03/12/19	lun 13/01/20	54		0,00€
56	Site clearance and ground works	122 días	jue 12/01/23	vie 30/06/23	55		0,00€
57	Structure	90 días	lun 03/07/23	vie 03/11/23	56;45		2.072.070,00€
58	Finishings and Landscaping	160 días	lun 06/11/23	vie 14/06/24	57		3.848.130,00€
59	Inspection and aceptance of works	30 días	lun 17/06/24	vie 26/07/24	58		0,00€
60	Handing over	30 días	lun 29/07/24	vie 06/09/24	59		0,00€
61	**MUSEUM OF TRANSPORT**	**2155 días**	**mar 28/08/18**	**lun 30/11/26**			**33.293.305,00€**
62	Detail design	120 días	mar 28/08/18	lun 11/02/19	12		0,00€
63	Issue building licence	60 días	mar 12/02/19	lun 06/05/19	62		0,00€
64	Prepare tender documents	60 días	mar 07/05/19	lun 29/07/19	63		0,00€
65	Prepare tender bid	60 días	mar 30/07/19	lun 21/10/19	64		0,00€
66	Aproval	30 días	mar 22/10/19	lun 02/12/19	65		0,00€
67	Mobilisation of contractor	30 días	mar 03/12/19	lun 13/01/20	66		0,00€
68	Site clearance and ground works	122 días	vie 19/05/23	lun 06/11/23	67		0,00€
69	Structure	260 días	mar 07/11/23	lun 04/11/24	68;57		11.652.656,75€
70	Finishings and Landscaping	480 días	mar 05/11/24	lun 07/09/26	69		21.640.648,25€
71	Inspection and aceptance of works	30 días	mar 08/09/26	lun 19/10/26	70		0,00€
72	Handing over	30 días	mar 20/10/26	lun 30/11/26	71		0,00€



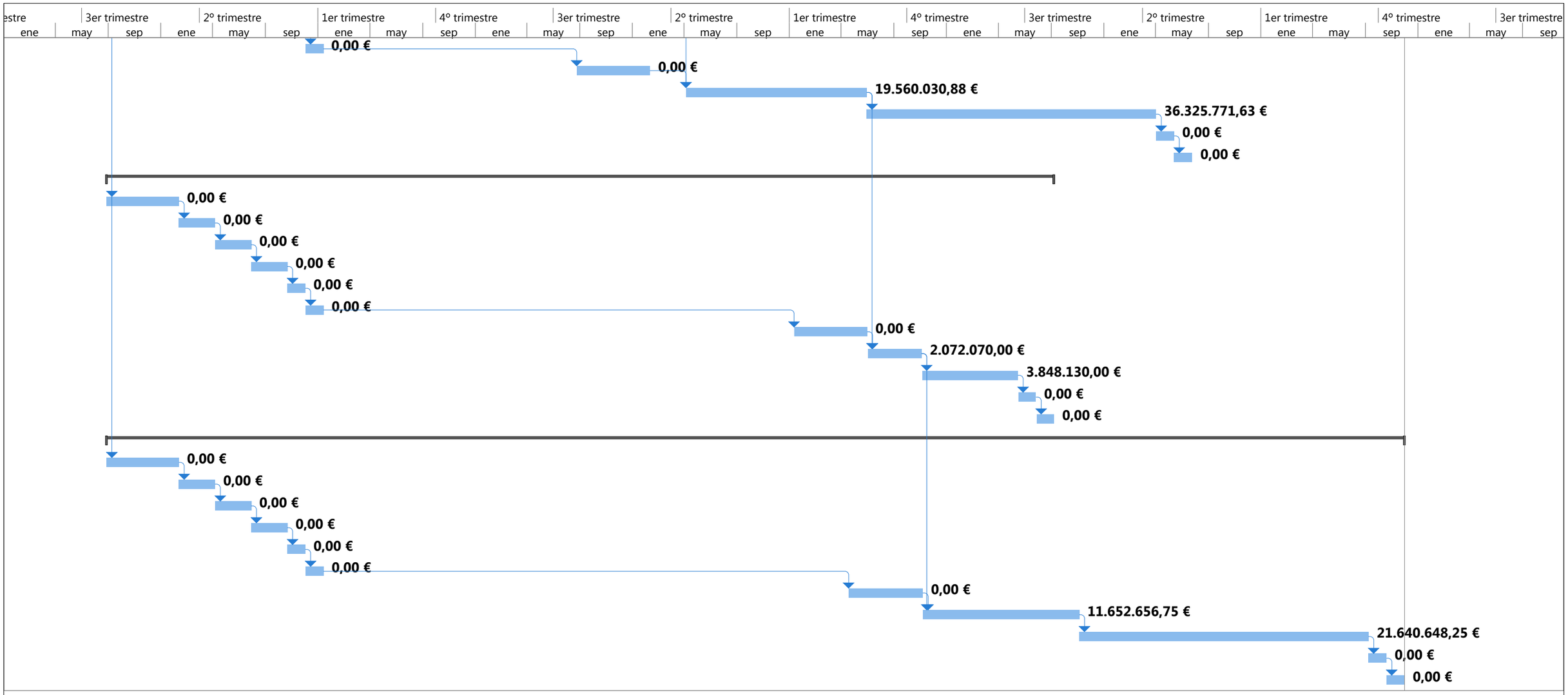
Proyecto: Antesütemterv
Fecha: vie 18/08/17

Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha límite
División	Tarea inactiva	solo duración	solo fin	Progreso
Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual
Resumen	Resumen inactivo	Resumen manual	Hito externo	



Proyecto: Antesütemterv
Fecha: vie 18/08/17

Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha límite
División	Tarea inactiva	solo duración	solo fin	Progreso
Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual
Resumen	Resumen inactivo	Resumen manual	Hito externo



Proyecto: Antesütemterv
Fecha: vie 18/08/17

Tarea	Resumen del proyecto	Tarea manual	solo el comienzo	Fecha límite
División	Tarea inactiva	solo duración	solo fin	Progreso
Hito	Hito inactivo	Informe de resumen manual	Tareas externas	Progreso manual
Resumen	Resumen inactivo	Resumen manual	Hito externo	

Annex 3[Statistics]

Risk	Design errors and omissions	
Impact 10	Cost (million HUF)	74
	Schedule (delay in months)	8
	Security (injuries)	-
	Environment	-
Probability 4	76%	

Risk	Design process takes longer than planned	
Impact 5	Cost (million HUF)	37
	Schedule (delay in months)	4,5
	Security (injuries)	-
	Environment	-
Probability 3	46%	

Risk	Stakeholders request late changes	
Impact 3	Cost (million HUF)	10,8
	Schedule (delay in months)	5,7
	Security (injuries)	-
	Environment	-
Probability 3	55%	

Risk	Public objections	
Impact 3	Cost (million HUF)	25,6
	Schedule (delay in months)	4,3
	Security (injuries)	-
	Environment	Provincial
Probability 1	19%	

Risk	Laws and local standards	
Impact 3	Cost (million HUF)	12
	Schedule (delay in months)	5
	Security (injuries)	-
	Environment	Provincial
Probability 1	10%	

Risk	Tax change	
Impact 5	Cost (million HUF)	32,4
	Schedule (delay in months)	6,4
	Security (injuries)	-
	Environment	Worldwide
Probability 1	9%	

Risk	Environmental incomplete analysis	
Impact 5	Cost (million HUF)	56
	Schedule (delay in months)	7
	Security (injuries)	-
	Environment	-
Probability 2	24%	

Risk	Inexperienced staff	
Impact 3	Cost (million HUF)	28
	Schedule (delay in months)	5,6
	Security (injuries)	-
	Environment	-
Probability 3	46%	

Risk	Absence of protection	
Impact 5	Cost (million HUF)	58
	Schedule (delay in months)	6,4
	Security (injuries)	Incapacity
	Environment	-
Probability 2	37%	

Risk	Organisation errors and contractor delays	
Impact 5	Cost (million HUF)	54,7
	Schedule (delay in months)	7
	Security (injuries)	-
	Environment	-
Probability 4	73%	

Risk	Construction permissions are temporary expired	
Impact 5	Cost (million HUF)	56
	Schedule (delay in months)	7,8
	Security (injuries)	-
	Environment	-
Probability 1	12%	

Risk	Contradictions in construction documents	
Impact 3	Cost (million HUF)	27
	Schedule (delay in months)	4,2
	Security (injuries)	-
	Environment	-
Probability 2	22%	

Risk	Higher construction cost than expected	
Impact 5	Cost (million HUF)	43
	Schedule (delay in months)	6,1
	Security (injuries)	-
	Environment	-
Probability 4	68%	