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# Risk of Delays in Implementation of Building Investment in Urban Conditions in the Aspect of Historical Background of its Location

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**Abstract.** The implementation of a construction investment in urban conditions is extremely complex, and at the same time exposed to a high risk of a specific character. In case of construction investment located in the historic part of the city, the possible accumulation of many unfavourable factors, which in course of its implementation, may constitute a serious source of delays and disruptions, should be taken into account at the preparation stage of the project. Therefore, the aim of the article is to present the main factors that have a significant impact on the construction site located in the historic part of the city, i.e. they are the cause of risk in the course of works and, as a consequence, affect the time of investment implementation. On the selected example of the facility located in the historic part of Gdańsk Old Town, the authors indicate the reasons for construction investment duration time extension. The authors also analyze the scope of resulting time delays between planned and actual values. The aim of the analysis is to draw investors' attention to the need of taking into account time contingency already at the preparation stage of construction investment, which results from the specific and unique nature of this type of projects. The article is a continuation of the authors' analyzes on the risk of cost overruns in implementation of building investment in urban conditions in the aspect of historical background of its location.

## 1. Introduction

The completion of a construction project within the limits of the planned budget and time can be considered as an indicator of its success. In practice, however, many construction projects are seriously affected by these parameters [1]. This problem in Poland is confirmed by the audit results carried out by the Supreme Audit Office [2]. It is indicated that investments carried out in Poland in 2010-2014 related to the construction and modernization of road infrastructure were characterized by significant delays and an increase in the assumed costs. Bearing in mind the scale of the problem, it is therefore important to analyze, assess and classify the main reasons of the above discrepancies in order to limit them in the future [3].

In the literature, it is emphasized that long-term and high-volume projects are much more likely to extend time and increase costs. This specificity fully reflects the nature of public investment. As a consequence, it can be stated that public investment is at the highest risk of delays [4]. NIK [2], indicates the following reasons for extending the planned time of the investment completion:

- unfavourable weather conditions,
- failure to take into account the time reserve when drawing up the schedule,



- defects and deficiencies in the project documentation provided by the ordering party and the resulting need to carry out projects and additional works,
- changes regarding project assumptions for planned investments,
- insufficiently recognized geotechnical conditions at the construction site,
- late submission of the construction site to the contractor,
- insufficient recognition of the area in terms of archaeology, the need for additional archaeological research,
- prolonged process of obtaining administrative decisions,
- lack of proper management and organization of investments causing interruptions in its implementation,
- insufficient coordination of the course of related investment tasks,
- frequent changes and lack of coherence in legal provisions regulating the investment process – e.g. introducing additional requirements for an already prepared investment, lack of uniform interpretation of regulations, changes in regulations, e.g. in the field of environmental protection, in the scope of tax and insurance rates,
- prolonged public consultations, protests of residents, sometimes resulting in the need to change design assumptions,
- negligence in management and organization at the stage of investment preparation by the contracting authority,
- the lack of proper organization and coordination of activities undertaken by the contracting authority/contractor in the course of works implementation,
- the lack of clearly defined competences and tasks of participants in the investment process,
- problems with the flow of current information,
- imprecisely constructed provisions of the contract for construction works,
- the lack of reliable verification of the financial condition and the possibility of potential contractors at the stage of conducting the tender procedure, the selection of the contractor without adequate experience, human resources, technical potential, qualifications, etc.

The consequences of delays should be considered from a broad perspective - an investor, contractor and subcontractor of construction works, a financing institution, as well as future users. For the investor, a delay means that it is not possible to start using the facility within the set deadline, i.e. no possibility to obtain benefits. For the contractor, the delay causes the necessity of incurring additional costs (in the form of contractual penalties for failure to meet the milestones and the entire investment deadline), the increase in the costs of employment, the construction equipment and maintenance of the construction site. In practice, the additional effect of failure to meet the deadline for the implementation of the investment by the general contractor is the withdrawal from the contract of subcontractors, the need to pay them contractual penalties and problems with the further works implementation. In a broader context, the effect of the delay is the deterioration or loss of a good image of the general contractor in the construction market in the eyes of current and potential contractors [5], [6].

## **2. The risk of construction investment in the historical area of the city – legal requirements**

The preparation and implementation of construction works in historical areas and the resulting conditions make this process much more difficult and longer than in the case of a "typical" investment.

This applies to procedures related to obtaining administrative decisions. In the case of the intention to conduct works in a building listed in the register of monuments or in an area entered in the register of monuments, prior to issuing the building permit, it is necessary to obtain a permit for works carried out by the appropriate Provincial Conservator of Monuments (pl. WKZ).

In accordance with the provisions of the Act on the Protection and Maintenance of Monuments [7], before planning for utility purposes immovable monument entered into the Register of Historic Monuments for utility purposes, the owner is required to obtain:

- the conservation documentation describing the condition of the immovable monument and the possibility of its adaptation, taking into account the historic function and value of the monument,
- the conservation work program, agreed with the WKZ,
- the immovable monument development program along with the surroundings and further use of this monument, taking into account its value,
- optionally, at the request of the owner of the monument, the WKZ presents conservation recommendations, specifying the manner of using the monument, its protection and performing conservation works, as well as the scope of acceptable changes that may be introduced in the facility.

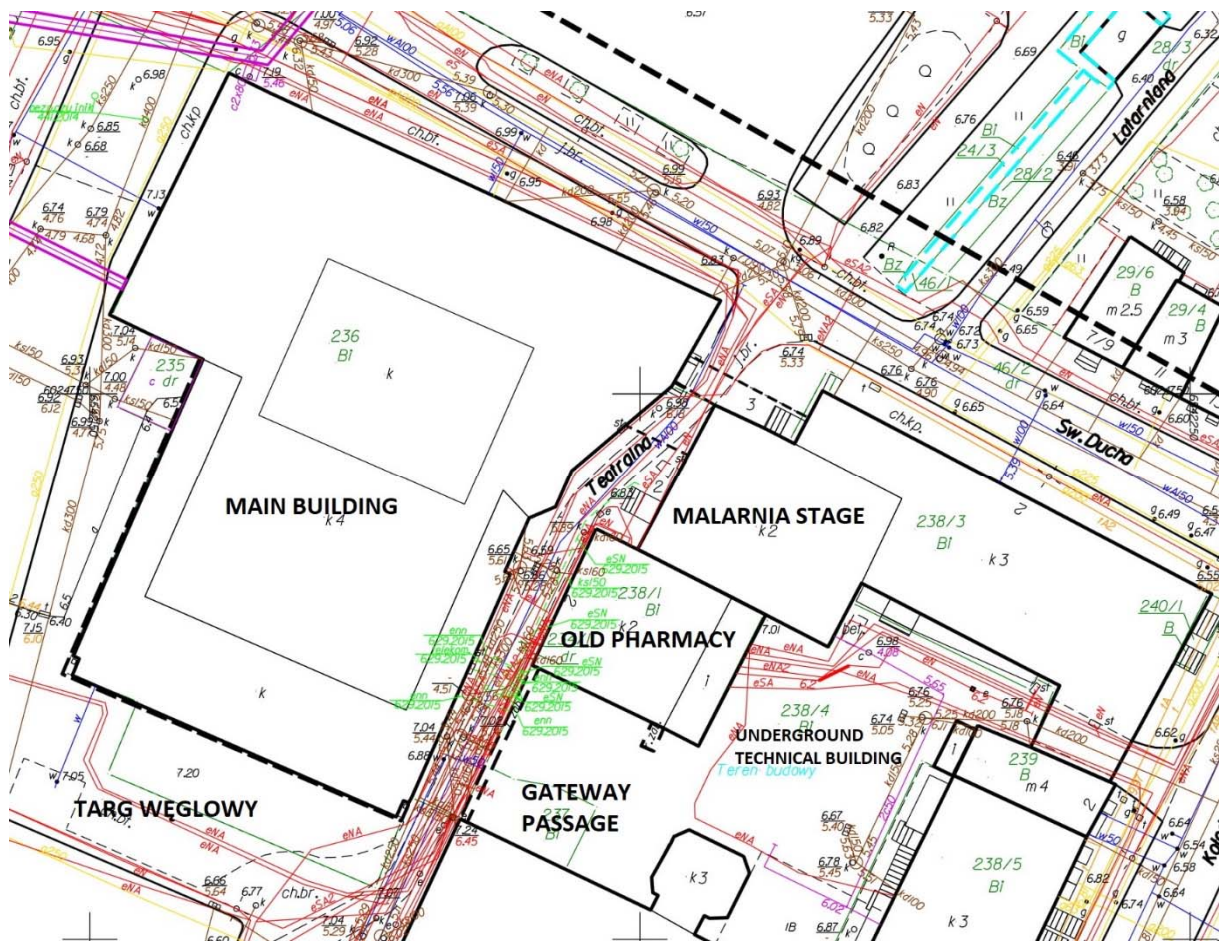
In many cases, before issuing a decision authorizing the conducting of works, WKZ gives its opinion regarding preliminary design solutions. It also has the right to conduct inspections during ongoing works and make changes to the previously approved project. Investments in historical areas also carry additional obligations, resulting from executive acts to the Act on the Protection and Maintenance of Monuments [7]. It is an obligation for the investor to carry out conservation, restoration, conservation research, architectural and archaeological research [8].

An important element of the investment preparation phase implemented in the historic part of the city is the design and analysis of documents, including historical ones, related to the area where construction works are planned - mainly earthworks and demolition works. This is particularly important in the aspect of possible discoveries of historic elements and related disturbances in the course of works (the ability to suspend works). At the stage of preparing the Specification of Essential Terms of Contract (pl. SIWZ) and formulating the content of a construction contract, it is necessary to foresee and include in the content of the documents events that could potentially occur during the construction works and, consequently, cause delays. The anticipation of new circumstances related to the implementation of the subject of the contract and the possibility of changing the planned date is also important from the Public Procurement Law point of view [9] and the contract for construction works signed by the parties. Changing its content related to the necessity of performing additional or replacement works requires the contracting authority to provide justification in the form of e.g. the Necessity Protocol. In the case of projects co-financed from EU funds, the change of the planned date also requires the consent of the Managing Authority[10].

### 3. The case study

The subject of the research presented in the article is the analysis of time deviations associated with the revitalization and reconstruction of the historic object of the Wybrzeże Theater - the 17th-century Old Pharmacy and the construction of a new stage in the place of the former Gateway Passage. These facilities are located within the Main City of Gdańsk, and the purpose of the construction activities undertaken was to adapt the existing buildings to the cultural and tourist functions. As part of the investment, a new stage will be created with a rehearsal room and an observation deck in the Gateway Passage and a foyer in the Old Pharmacy. The goal of the investment is to preserve valuable, historic objects, use their potential, improve aesthetics and increase the attractiveness of the city of Gdańsk. The scope of the project is divided into 5 stages:

- Stage 1 - Old Pharmacy
- Stage 2 - Gateway Passage, I.1-I.5 axes
- Stage 3 - Gateway Passage, I.5-I.9 axes
- Stage 4 – Connector
- Stage 5 - Transformer station



**Figure 1.** A fragment of the map for design purposes (source: own study based on the map for design purposes)

The entity implementing the investment is Wybrzeże Theater. The investment was co-financed by the Regional Operational Program for the Pomorskie Voivodeship for 2014-2020. In a broader sense, the investment is part of a comprehensive project of reconstruction and extension of the Wybrzeże Theater facilities. The scope of the project includes the Main Building, Underground technical building, Old Pharmacy and the New Stage in the former Gateway Passage, the Malarnia stage and the adjacent area, i.e. the modernization of Teatralna Street and the fragment of Targ Węglowy Street (Figure 1).

According to the design, all objects are connected to each other. There will be two terrestrial connectors and one underground, running under Teatralna Street. In 2015, the design-cost-estimate documentations was prepared for the entire project.

### 3.1. Historical background

The building of the Old Pharmacy is entered in the Register of Monuments of the Pomeranian Voivodeship at No. 465, it was constructed in 1636 on a quadrangular plan as a detached building. At that time it served as a laboratory for the gunpowder and ammunition factory. In 1945, the building was completely ruined. In 1966, it was rebuilt as a warehouse for the Wybrzeże Theater. Only external walls survived from the pre-war period, with the exception of the gable wall from the yard, which was completely destroyed during the war and was not reconstructed. The interior of the Old Pharmacy building has been rebuilt many times. The external walls were made of stone with the use of stone elements at window frames and the entrance portal. The internal supporting structure of the building

consisted of masonry and reinforced concrete walls and steel poles, on which Klein-type ceilings were based. The communication system between the floors was reinforced concrete and slab stairs. The roof was steep, gabled, collar beam, covered with tile roofing. From the side of the yard to the building of the Old Pharmacy, a small transformer building was attached in the 1960s. Frequent interference in the building and warfare caused that it lost its historical value.



**Figure 2.** A top view of relics of brick architecture, a fragment of a medieval tower under the Old Pharmacy (source: material made available by the architect Wojciech Narloch)

Historical documents show that the building of the Old Pharmacy was built in the place of a tower built in the middle of the 14th century and destroyed in 1636. In 1952, the Gothic foundations of the tower built of the Wendish system brick were unveiled. It is assumed that the building of Old Pharmacy was located on a fragment of one of the towers (Figure 2, Figure 3), located between the Słomiana Tower and Szeroka Tower and Szeroka Gate [11].



**Figure 3.** The concept of adaptation, along with the reconstruction, of the towers foundations in the planned space of the Gateway Passage building (source: Author's Jacek Bułat Architectural Studio)

### 3.2. Results and discussion – the analysis of delays in the investment implementation – a case study

According to the assumptions of the contract signed between the investor and the general contractor, the construction works had to be completed within 177 days (26 weeks) from the date of signing the contract. As a part of the demolition works, a demolition of the transformer building was planned after the transfer of the transformer substation to the underground technical building. The transformers were located in a small building adjacent to the eastern wall of the Old Pharmacy.

In the place of the existing transformer station (intended for demolition) was planned the construction of a three-story building with a reinforced concrete structure, including one underground and two above-ground stories. The demolition of the transformer station building was scheduled for March 2017.

The transfer of transformers was delayed, which is why the demolition works started in August 2017. During the demolition works, historic foundations were discovered. The Investor, in accordance with art. 32 para. 1 of the Act on the Protection and Maintenance of Monuments [7], informed the Pomeranian Provincial Monuments Conservator (PWKZ). He controlled the discovered foundations and ordered the suspension of works, the protection of relics and carrying out, at the investor's expense, archaeological research. A separate decision of the PWKZ was required to conduct archaeological research. In order to obtain it, the Investor was obliged to submit an application to the PWKZ to issue a research permit. The application should indicate who will be the head of the research team. This meant that before submitting the application, the Investor was obliged to conclude an agreement with an Archaeologist with appropriate qualifications. The archaeologist employed by the Investor prepared the Research Program, which was attached to the application. From the day of submitting the application for conducting archaeological research, 25 days passed until the date of obtaining the PWKZ decision. The decision was the basis for the archaeologist to start work.

On the basis of the conducted research, in consultation with the author's supervision, a technical expertise was drawn up, which showed that the condition of the walls is poor, the foundations have numerous cavities and debris, do not represent historical value, and the low curtain wall between the foundations is contemporary. After completing the archaeological research, the Investor submitted to the PWKZ an application for the issue of a permit for the demolition of the walls. However, PWKZ did not allow demolition of walls. In the explanatory memorandum to the decision, he pointed out that exposed walls constitute the gothic foundations of the medieval tower, demolished medieval tower in the modern period under the Old Pharmacy, replaced by the building of the Old Pharmacy.

It was also found that the condition of the walls allows to read the original function of relicts and reconstruction of the tower's foundation. From the day of the archaeological research to the date of the above decision passed 27 days. Taking into account the information contained in the PWKZ decision, i.e. the discovered relicts have a historic value and scientific value (they constitute an original historic substance, whose chronology dates back to the XIV-XV centuries, it is a unique discovery), the investor was forced to adapt discovered relicts in the designed space. This involved the development of replacement projects that the author's supervision performed for a separate remuneration. The need to adapt the exposed walls resulted in a number of functional, utility and constructional changes in the designed building.

In addition to the replacement project, the Investor was obliged to develop a conservation program and a temporary wall protection project. During the archaeological research, historic foundations were uncovered completely, which is why the Investor, waiting for the design of a replacement construction project, ordered a temporary support of historic foundations in the form of a steel grate, as recommended by PWKZ. His task was to protect the relicts from possible destruction. This solution had to be approved by PWKZ. The support of the walls was made by the contractor of basic works for a separate remuneration. After reinforcing the walls, the contractor proceeded to earthworks in order to obtain the ordinate of the foundation slab. After receiving the designer's drawings from the designer, the contractor resumed work on the construction of the building in the I.5-I.9 axes.

125 days had passed since the date of suspending works (4 months and 3 days). This time was devoted to archaeological research, protection and reinforcement of discovered foundations and introduction of changes to the project documentation. Table 1 presents planned and actual, i.e. taking into account the above-mentioned, unforeseen and existing circumstances causing delays in the execution of construction works.

**Table 1.** Planned and actual deadlines for individual stages of construction works

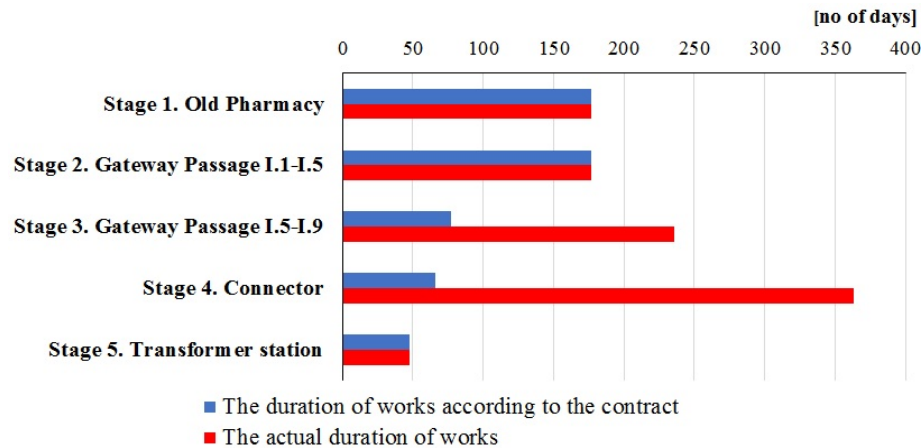
Stage of works	The duration of works according to the contract [no of days]	Period of implementation according to the contract	The actual duration of works	The actual implementation of the works	Difference
<b>Stage 1</b> - Old Pharmacy	177	10.12.2016-06.06.2017	177	10.12.2016-06.06.2017	0
<b>Stage 2</b> - Passage Gateway I.1-I.5	177	10.12.2016-06.06.2017	177	10.12.2016-06.06.2017	0
<b>Stage 3</b> - Passage Gateway I.5-I.9	77	20.03.2017-06.06.2017	<b>236</b>	06.08.2017-30.03.2018	159
<b>Stage 4</b> - Connector	66	01.04.2017-06.06.2017	363	01.04.2017-30.03.2018	297
<b>Stage 5</b> - Transformer station	48	10.02.2017-31.03.2017	48	10.02.2017-31.03.2017	0

<sup>a</sup> source: own work based on the original and updated material and financial schedule, annexed to the contract for the execution of construction works

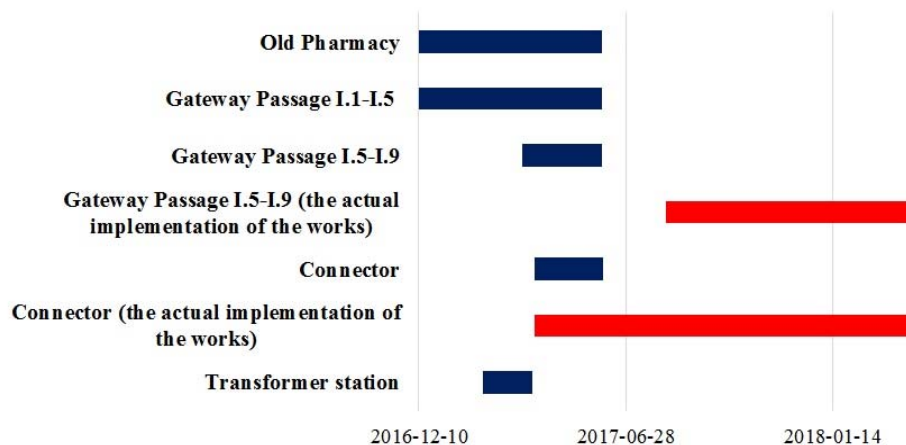
Despite serious disturbances, all robots, except Stage 3 and Stage 4 (Gateway Transition, I.5-I.9, Connector) were carried out in accordance with the original version of the schedule (Figure 4, Figure 5). Figure 4 indicates the stages in which there was a delay in implementation. In the case of Stage 3, it was not possible to start the works in the originally set date. The implementation of stage 3 lasted 236 days, 159 days longer than expected (Table 1). Due to the fact that stages 3 and 4 are interrelated, the implementation of stage 4 was also delayed, and extended from 66 to 363 days, by 297 days. It should be emphasized that the detailed terms of the contract did not refer to intermediate dates ("milestones"), but only to the final deadline. The contract has been delayed compared to the original date, although some work steps were completed in accordance with the schedule (Phase 1, 2, 5). The planned date of completion of the works was originally 177 days (26 weeks), the actual implementation time was 474 days (86 weeks). The delay in the entire contract amounted to 297 days



(42 weeks). The time of implementation of stage 3 was extended three times (over 300%), while the duration of works for the entire contract was 267% longer than originally assumed.



**Figure 4.** The schedule of works taking into account the planned and actual duration of individual stages of works (source: own work based on the original and updated Material and Financial Timetable, constituting an annex to the contract for the execution of construction works)



**Figure 5** Planned and actual time of completion of individual work stages (source: own work based on the original and updated Material and Financial Timetable, constituting an annex to the contract for the execution of construction works)

The analyzed example concerns the execution of the basic state of the buildings of the Old Pharmacy and Gateway Passage. In the first stage of construction works (before the delay), the investor conducted the proceedings and concluded a contract for the subject of finishing works in the facility. It should be noted, therefore, that such a long delay resulting from the implementation of the unfinished state, resulting in the inability to perform further activities in the facility, is the cause of the further delay. In practice, this means that the next contractor will not be able to implement the scope covered by the conditions of the signed contract.

#### 4. Conclusions

The analysis carried out in the article justifies the formulation of the following conclusions and statements.

- 1) Discussion of a selected case of a construction investment carried out in urban conditions, taking into account the historical conditions of its location, allowed for a detailed comparison of the results of the planned and the actual time of execution of the works. Disclosed in the article the creation of large time discrepancies and as a result also costs, justifies the desirability of the use by investors and contractors in-depth analyzes taking into account the conditions of uncertainty and risk. This approach gives the opportunity to set a more accurate forecast regarding the duration of construction works.
- 2) The analysis of the chosen example indicates that in practice, estimating the time of completion of an investment located in urban historical areas is often subject to a large error, which causes numerous additional problems related to the management at the implementation stage. It should be emphasized that the reason for the occurrence of disturbances in many cases are the negligence of the investor at the stage of investment preparation - the lack of accurate and current investment of facilities in the area of the ongoing investment and inadequate identification of their technical condition [12].
- 3) The implementation of investments in the historical area of the city is connected with the obligation of the investor to obtain a number of additional documents and take actions that do not occur during the implementation of a "typical" project. These include: opinions and administrative decisions, archaeological research, supervision and conservation controls, expert opinions, protocols of necessity, applications and letters to the Managing Authority. The investor, at the stage of investment preparation should therefore take into account the appropriate time reserve for obtaining administrative decisions. Planning the implementation of works in a historic building and in the historical part of the city is burdened with risk in planning time and costs. This is particularly severe in the case of investments financed from public and EU funds, where the delay and increase of scope, and as a result the cost, causes a number of additional formalities.
- 4) Due to the possibility of unforeseen circumstances during construction works in the area of the historical part of the city, both the investor and the contractor, at the stage of formulating basic parameters of the investment project (deadline, budget, scope) should take into account potential delays resulting from the need to perform additional or replacement works.
- 5) Historic buildings, implemented in the districts of historical cities, in many cases are public property. In accordance with the requirements of the Public Procurement Law, the execution of construction works is usually ordered in a tender procedure.
- 6) The assessment of the time and costs of performing construction works in such facilities carries more risk to a greater extent than for buildings carried out in "typical" conditions. Therefore, it requires taking into account specific factors that constitute a source of risk and are the cause of potential irregularities in investment planning. Therefore, the stage of preparation of the investment to be carried out by the contracting authority, including the preparation of the project, should take into account the extensive analysis of historical documents, allowing to obtain information about the area where the works will be carried out. The order documents, including the Specification of Essential Terms of Contract (SIWZ) and the terms of the contract, should include in their contents the possibility of flexible changes resulting from the extraordinary historical conditions of the site.

## References

- [1] K. Ullah, A. H. Abdullah, S. Nagapan, S. Suhoo, and M. S. Khan, "Theoretical framework of the causes of construction time and cost overruns", *IOP Conf. Ser. Mater. Sci. Eng.*, Vol. 271, 2017.
- [2] NIK, "Information about the results of the inspection. Barriers in the process of preparation and implementation of road investments, KIN-4101-006-00/2014, Nr ewid. 53/2015/P/14/034/KIN". *Departament Infrastruktury*, 2016 (in Polish).
- [3] A. Sobotka and P. Jasiak, "Taking into account the risk in the assessment of time in the offer of revitalization of a historic building", *Bud. Inż. Śr.*, no 2, pp. 651–654, 2011.

- [4] A. Leśniak and E. Plebankiewicz, “Delays in construction works”, *Zesz. Nauk. WSOWL*, Vol. 3, no 157, 2010 (in Polish).
- [5] M. Głuszak and A. Leśniak, “Construction Delays in Clients Opinion – Multivariate Statistical Analysis”, *Procedia Eng.*, Vol. 123, pp. 182–189, 2015.
- [6] A. Abderisak, P.E. Josephson, and G. Lindahl, “Implications of Cost Overruns and Time Delays on Major Public Construction Projects”, w *Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate*, 2015.
- [7] The Act of 23rd July 2003 r. on the Protection and Maintenance of Monuments (*Journal of Laws* 162 item 1568, as amended). 2003 (in Polish).
- [8] B. Grzyl, A. Kristowski and E. Miszewska-Urbańska, “Analysis and Risk Evaluation on the Case of Alteration, Revitalization and Conversion of a Historic Building in Gdańsk”, *IOP Conf. Ser. Mater. Sci. Eng.*, Vol. 245, no 8, 2017.
- [9] The Act of 29th January 2004 on Public Procurement Law (*Journal of Laws* 19 item 177, as amended). 2004 (in Polish).
- [10] M. Apollo and E. Miszewska-Urbańska, “Analysis of the increase of construction costs in urban regeneration projects”, *Adv. Sci. Technol. – Res. J.*, Vol 9, no 28, pp. 68–74, 2015.
- [11] A. Bortkiewicz and A. Wańska, “*Preliminary historical and conservation studies of the Old Pharmacy building in Gdańsk*”. Gdańsk, 2015 (in Polish).
- [12] A. Jakubczyk-Gałczyńska, A. Kristowski and R. Jankowski, “Application of support vector machine for determination of impact of traffic–induced vibrations on buildings”, *Adv. Intell. Syst. Comput.*, no 637, 2018.