Risk management of warehouse and manufacturing facility construction investment projects

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Abstract
The risks management is a very important part of investment decision making. Investing in warehouse and manufacturing facility construction projects is complex and it carries different risks factors, this article reviews the existing construction project risks classification and uses the Global CEO survey to answer the questions if there are specific risks in investing in warehouse and manufacturing facility construction projects and if the risk register for these projects can be created. With analysis the Global CEO survey and literary research the risk register is created for warehouse and manufacturing facility construction investment projects. The created risk register classifies the risks in different categories, shows the frequency per risk perception of the investors, risk owner and the control or mitigation actions.

Keywords
Risk, risk register, risk management, manufacturing and warehouse facilities, construction investment, risk countermeasures, risk mitigation.

Abstrakt
Řízení rizik je velmi důležitou součástí investičního rozhodování. Investice do stavebního projektu skladových a výrobních prostor je složitá a nese s sebou různé rizikové faktory. Tento článek posuzuje stávající klasifikaci rizik výstavbových projektů a přezkoumává globální průzkum CEO, aby odpověděl na otázky, zda jsou investice do výrobních a skladových prostor spojeny se specifickými riziky a zda lze vytvořit registr rizik speciálně pro tento typ projektů. S analýzou průzkumu Global CEO a předchozí rešerše je vytvořen registr rizik pro investice do stavebních projektů výrobních a skladových prostor. Vytvořený registr rizik klasifikuje rizika do různých kategorií, ukazuje frekvenci vnímání rizika ze strany investorů, vlastníka rizika a kontrolních nebo zmírňujících opatření.

Klíčová slova
Riziko, registr rizik, řízení rizik, výrobní a skladové prostory, stavební investice, protiopatření proti rizikům, zmírňování rizik.

1. Introduction

The construction and operation of buildings is a very complex process with many activities and many entities that participate in the activities in individual phases of their life cycle. One of the basic requirements of investors when deciding on the implementation of construction works is their proven economic efficiency. For the projects to achieve the planned effectiveness, it is also necessary in the pre-investment phase to identify activities that may carry potential risk factors that can affect

the revenues and costs of the projects in the individual phases of their life cycles. Many projects fail due to the errors in initial investment decisions. In the investment decision-making process of large-scale projects, many risk factors can cause decision failure [1]. Large differences between planned and realized outputs represent a serious investment and mostly financial problem for the investors. Therefore, decision support systems are of great importance to investors in the construction industry [2]. Investors aim to not only prevent projects' failures but also select the best alternatives among available investment projects to gain more benefits and reach better results [3].

Risk management takes place in several successive steps, from the identification of risks, through their assessment, ascertaining their impact on the project, to the creation of a set of measures to mitigate or eliminate them [4, 5]. Measures to reduce risks can be divided into two large groups, namely preventive measures, and measures to reduce the negative impact of the risk, if it occurs.

Several general risks are associated with construction projects, which can be classified according to different classifications.

According to [5], the following risks can be distinguished:

- Technical-technological,
- Manufacturing (operational),
- Economic, market, sales, price,
- Financial, credit,
- Legislative, political, environmental,
- Associated with the human factor (management risks, employee losses, etc.),
- Informative,
- Force majeure interventions (accidents, natural disasters, terrorist attacks, etc.)

Other types of risks that affect business are [6]:

- Corporate governance risk, business risk, reputation risk,
- Business continuity risk, strategic risk,
- Risk of information security, fraud,
- Health and safety risk,
- Project risk.

Unforeseen events can also affect the development of construction projects, the impacts of which are mentioned by [7] who focuses on “black swan events”, which are rare and unpredictable events that can have a significant impact on investments. Construction projects have recently faced, for example, problems arising in connection with the COVID-19 pandemic.

According to [4] risks in construction projects can be classified based on their likelihood and According to Holt and Edwards [8] risks in construction projects can be classified into the following categories: financial, technical, managerial and environment risk. Flanagan, and Norman [9] classified the risk for these projects into the following categories: physical, financial, legal, political, social, technological and management risks.

According to the CTP annual report [10] the company that builds and owns multiple warehouses in Europe mentioned that climate change-related risks can be split into three types from the risk management perspective:

- Environment risk under the category strategic risk / ESG (Environmental, Social, and Governance), this captures the ethical element of doing the right thing to help mitigate an environmental catastrophe as a company responsibility,
- Climate risk category under operational risk is designed to capture the potential physical damage to the property that could result due to extreme weather phenomena related to climate change,
- Climate change related to risks in other risks category, examples include customer behaviour change risk, pandemic/acts - of force majeure risks, reputation risk, business continuity risk, regulatory noncompliance risk and regulator change risk.

The classification of risks depends on projects in question, time when the project is being planned and the region. Each period and each region run their risks, which are reviewed in this article in the Global CEO survey.

According to [11] the business risks which may happen during the construction of projects are:

- Risk on project documentation,
- Risk on construction and other permits,
- Risk of cost change,
- Finance risk,
- Legal risk.

The following figure shows the risks in construction project investment in every stage of the construction project cycle.

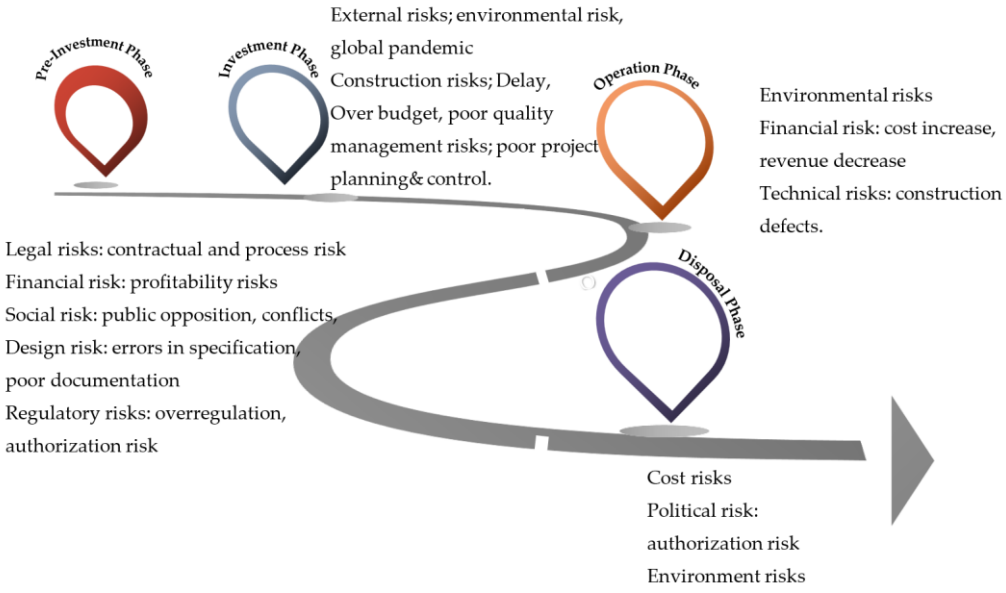

Figure 1. Investment risks in the construction project cycle [author's own work]

2. Materials and Methods

A specific risk register was created based on the authors' previous research, the SWOT analysis and subsequent risk mapping of 12 manufacturing and warehouse facility construction projects located in Europe [12], 12 projects initiatives designated to mitigate the environmental risks for manufacturing and warehouse facility construction project located in Europe, America, and Asia [13] and the global survey CEO that is elaborated in this article.

Global CEOs (the Chief Executive Officers) of the large companies represent most decision makers for construction investment in manufacturing and warehouse facilities.

The survey was conducted on a sample of CEOs from 105 countries around the world, but some questions were interpreted only for Czech CEOs. In the survey, the CEOs were asked to bring their key business risks forward when investing and the question had 2 planning horizons of next 12 months and next 5 years [14].

Over the next 12 months, CEOs feel most exposed financially to inflation, economic volatility, and geopolitical risk. All three are immediate, headline-grabbing issues that can reinforce and

compound one another, as, for example, the war in Ukraine pushes up prices, encouraging central banks worldwide to intervene through growth-dampening interest rate hikes. The picture changes for CEOs' medium-term (five-year) outlook.

Question: How much do you believe your company will be exposed to the following key threats next 5 years?

The following table shows next 5 years global risks to the companies as per CEOs answers.

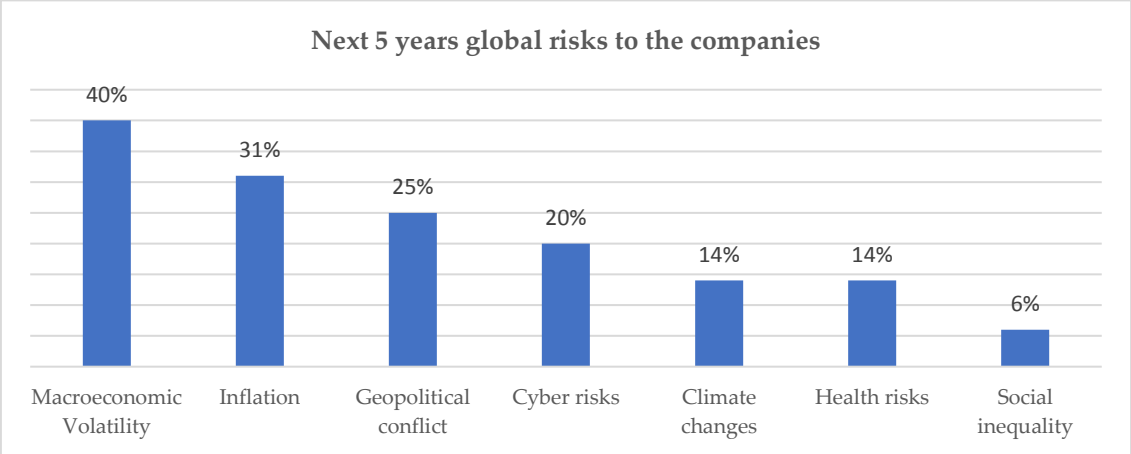

Figure 2. Next 5 years global risks to the companies as per CEOs answers [14]

Over next 5 years, cyber risks and climate change join inflation, macroeconomic volatility, and geopolitical conflict in the top tier of risk exposure.

Climate change is an example of risk that exemplifies a time-horizon challenge that comes into clearer focus when looking at a broader set of external threats to the global economy.

Question: Which of the following actions, if any, is your company considering mitigating against exposure to geopolitical conflict in the next 12 months?

The figure below shows the action that companies are taking to mitigate the geopolitical risk.

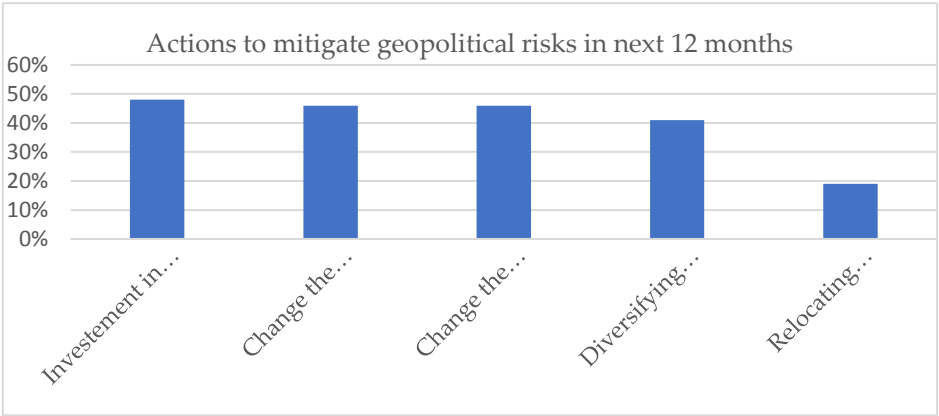

Figure 3. Actions to mitigate geopolitical risks in next 12 months [14]

CEOs are increasing cyber investments, adjusting supply chain, and changing their physical footprint in response to geopolitical conflict. Boosting supply chain resilience has been a growing

priority for many organizations since 2020, when the covid-19 pandemic highlighted the fragility of many tightly wound systems.

Question: Which business risks and threats bother Czech CEOs the most and how has their perception changed in the last five years?

The below table shows the development of business risk perception since 2019.

Table 1. Development of Czech CEOs business risk perception since 2019[15]

Risks and threats	**2019**	**2020**	**2021**	**2022**	**2023**
High inflation	15%	16%	48%	84%	90%
Growth in labour costs	87%	77%	48%	85%	85%
Volatility of energy prices			37%	67%	85%
Availability of qualified employees	88%	81%	71%	94%	85%
Geopolitical risks	46%	63%	41%	46%	77%
Raw material price volatility			46%	69%	77%
Uncertain or unstable economic growth	46%	60%	68%	60%	74%
Cyber threat		39%	49%	54%	71%
Increasing tax and levy burden	43%	65%	71%	55%	69%
Low-quality legislation or its hard-to-predict changes	51%	64%	81%	60%	65%
Too much regulation	59%	68%	77%	56%	65%
A permanent shift in consumer behaviour and their willingness to spend	31%	40%	45%	40%	64%
Uncertain political developments			64%	34%	63%
Supply chain security	29%	26%	37%	59%	61%
Disinformation			61%	48%	60%
Fluctuations in exchange rates	44%	45%	59%	51%	59%
Lack of energy	38%	35%	21%		55%
Unstable capital markets	49%	39%	42%	41%	54%
Rising interest rates and worsening availability of financing				34%	51%

While last year the Chief Executive Officers of Czech companies were most troubled by the lack of qualified employees, this year they consider high inflation to be the biggest threat to their business. Also, other business risks following closely behind the rising inflation that is associated with the impact of the war in Ukraine - the imaginary second row for this year was equally occupied by the

fear of fluctuating energy prices and rising labour costs. However, 81% of CEOs still deal intensively with the unavailability of labour [15].

Question: Which of the following measures is your company considering using to mitigate potential economic problems in the next 12 months?

The figure below shows the mitigation measures that companies consider mitigating the risks.

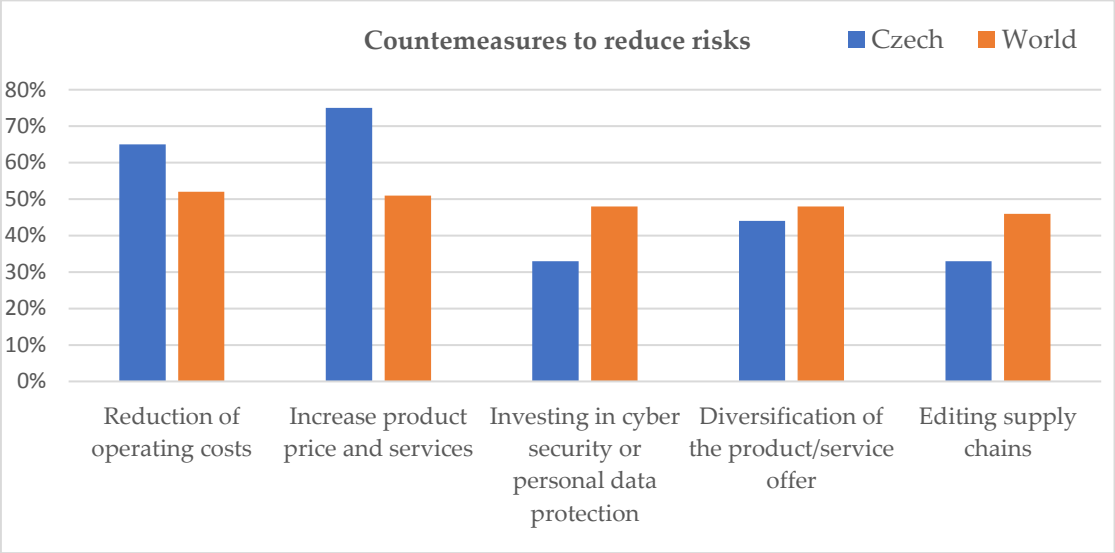

Figure 4. Mitigation measures that companies consider mitigating the risks [15]

It can be seen from the survey that most companies are flexible and are used to help themselves in difficult times and the Czech CEOs prefer quick fix, while global CEOs prefer more complex solutions such as diversification of the portfolio of products and services or expansion into other markets.

3. Results

Risk registers are sorted into the risks categories, and each categories contains both the risks and the mitigation countermeasures. The risks categories that were determined when investing in construction of manufacturing and warehouse facilities are listed as financials risks, legal risks, technological risks, political risks, supply chain and operation risks, social risks, project management risks, environmental risks. The table below shows the risk register for most frequent risks.

Table 2. The risk register for most frequent risks in investing in such projects [authors own work].

Risks description	Investors risk perception	Risk Category	Risk owner	Controls / Mitigation
High inflation	90%	Financial	Investor	Reduce the operational cost Increase the product and service price
Growth in labour costs	85%	Financial	Investor/ Constructor	Increase the price of product and service price and automate the routine jobs.

Volatility of energy prices	85%	Financial / technological	Investor	Increase the price product and service price, generate renewable energy onsite.
Availability of qualified employees	85%	Social	Investor/ Constructor	Invest in the training and support public education
Geopolitical risks	77%	Political	Investor	Change the supply chain, relocate the workforce and tangible property
Raw material price volatility	77%	Financial	Investor	Reduce the operational cost Increase the product and service price
Uncertain growth	74%	Financial	Investor	Evaluate the economic efficiency of project with increased risk analysis.
Cyber threat	71%	Technological	Investor/ Constructor	Investing in cyber security or personal data protection
Increasing tax	69%	Finance	Investor	Increase the tax cost in the sensitivity analysis
Overregulation	65%	Legal	Investor	Add the flexibility in the project
Consumer behaviour	64%	Financial	Investor	Analyse the market and adapt to it
Uncertain political development	63%	Political	Investor	Diversification of the product/service offer and review the location to relocate if necessary.
Supply chain security	61%	Supply Chain	Investor/ Constructor	Change the supply chain look for alternative suppliers and solutions
Disinformation	60%	Social	Investor/ Constructor	Support the public education
Currency fluctuations	59%	Financial	Investor	Pre agree with bank the fix rate
Lack of energy	55%	Technological	Investor/ Constructor	Look for alternative solutions on how to be self-sustainable
Unstable capital markets	54%	Financial	Investor	Pre agree with bank the long-term financing.

Other risks that have been identified with lower frequency are rising interest rates and worsening availability of financing, inability to finance further growth, social unrest, pandemics, and other crises related to the health of the population, project delay, over budget and suppliers or sub-contractor poor performance.

4. Discussion

Multiple authors wrote that the risks management is a very important part for investment decision making and for manufacturing and warehouse construction project, there are specific risk

for them as found in the 12 European project article that, focuses on manufacturing and warehouses in industrial zone.

The aim of risk management is to eliminate of minimize the risks, the risk mitigation could be seen in the article of 12 global projects initiatives to reduce the environment risks in manufacturing and warehouse facilities. Lastly the global CEO survey that was elaborated in this article shows what investors are seeing as risks and actions they taking to mitigate the risks. Theses inputs allow to create a risk register for such projects which is output of this article.

Further research can investigate how the technology like Artificial Intelligence can help to mitigate the global risks.

5. Conclusions

The article describes the creation of a specific risk register for manufacturing and warehouse construction investment projects. The risks were divided into 7 categories (Financial risks, Legal risks, Technological risks, Political risks, Supply chain and operation risks, social risks, Project management risks, Environmental risks) and for each category the most important risks were identified and recommendations on how to deal with them were described pre-investment phase to work. It is obvious that if an investor can identify, quantify, and relevantly include the impact of risks in the process of assessing investment plans, he is able to manage his investments as efficiently as possible even in an uncertain economic environment.

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