Industrial Zone Development by Warehouse and Production Hall Constructions

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Abstract. The article focuses on the analysis of the development and use of industrial zones, which represent areas for the concentrated location of manufacturing sites specialised in a particular industry, strategic services, or technology centres. Both services and industry have an impact as the top engines of Gross Domestic Product and the labour force employment both in the Czech Republic and European Union. The area and the predominant category of economic activities are important parameters of each industrial zone. They place demands on the employees, transport, technical equipment, landscape, and settlement within the impact on the territory. The main goal of the research was the analysis of the industrial zone as a territory where warehouse and production hall projects are implemented. The analysis of warehouse and production hall construction investment was performed in Žďár nad Sázavou. The study of this project presents the project impact on the industrial area and the deviation between the project plan and the audited reality. The research sample consisted of 12 selected warehouse and production hall projects located in Central and Eastern Europe in various phases of their life cycle - the planning, implementation or operational phases. One of the partial outputs of the article is a SWOT analysis which deals with variables that affect project effectiveness both from the perspective of the investor and the public in the area where they are located. Implementation and operation of such projects significantly affect public life, so their potential socio-economic impact on the economic cash flow creation was examined.

1. Introduction
Industrial zones are areas representing the concentrated location of the production facilities specialised in a particular industrial field, strategic services, or technological centres. Both services and industry are the main engines of the economy of both the Czech Republic and the European Union with services accounting for 60.8% (2017 est.) [1] of Gross Domestic Product (GDP) and industry for 36.9% (2017 est.), and 59.2% of the Czech labour force working in the sector of services, while 38% work in the industrial sector (2016 est.) [1]. GDP in the European Union by sector is composed of 70.7% representing services and 24.5% industry, the share of the labour force in the service sector accounts for 73.1% and in the industry for 21.9% (2014 est.) [1].

An industrial area (also known as an industrial estate/park) is an area zoned and planned for the purpose of industrial development. An industrial park can be considered to be a "heavier" version of a business park or office park, featuring offices and light industry rather than heavy industry.

Construction of industrial complexes in terms of economic improvement has a positive impact due to new jobs that are created which is beneficial especially for the areas with a high unemployment rate.
They are usually situated in abandoned overgrown areas that are not used in any way. Declaration of territory as an industrial zone requires cooperation with the Ministry of Industry and Trade, the CzechInvest agency and the local government representatives on the Czech Republic side.

Industrial zones have developed a lot in recent years representing a part of the innovation strategy of the Czech Republic 2019-2030 [2].

The government in its strategical plans for future development has the ambition to become one of the innovation leaders in Europe and a country with the technological future: Czech Republic: The Country for the Future. Implementing this strategy means that the country develops industrial zones, areas where industry and services or technology centres are concentrated and implements the following sub-strategies for the Czech Republic to be:

- The Country for R&D: Funding and Evaluation of R&D.
- The Country for Technology: Polytechnic Education.
- The Country for Startups: National Start-up and Spin-off Environment.
- The Country for Digitalization: Digital State, Manufacturing and Services.
- The Country for Excellence: Centres for Innovation and Research.
- The Country for Investment: Smart Investment.
- The Country for Patents: Centres for Innovation and Research.
- The Country for Smart Infrastructure: Mobility and Construction Environment.
- The Country for Smart People: Smart Marketing.

This is beneficial both for private investors and local people since it creates investment opportunities and increases employment in the area. However, the investor must analyse the project well in the initial phase of the project life cycle before implementing it. Investment projects related to the implementation of industrial zones are accompanied by several uncertainties and risks during their life cycle.

There is a large number of risks and their definition depends on the problem that is being solved. This paper analyses business risk which is generally defined as the deviation between the planned and actual economic result (outcome) of the investment project. Risks that may occur during each stage of the investment project life cycle according to Departmental methodology [3] are as follows:

- Demand-related risks (different development of demand than expected).
- Risks related to the project design.
- Administration and public procurement risks (building permit).
- Risks related to the purchase of the land (land price).
- Risks related to the construction process (exceeding investment costs).
- Operational risks.
- Regulatory risks (change in environmental regulations).
- Other risks (public opposition).

According to Kennedy et al. (2018) [4], uncertainty in cost estimation evolves over the project life cycle and arises from the difficulties in estimating construction, maintenance, operation, and financing costs. The above-stated risks affect both the final amount of investment and operating costs, the length of the construction period and the expected amount of revenue during the project operational phase. Pilger et al. (2020) [5] emphasizes that errors in the project are usually transformed into price adjustments and extended duration of the construction phase. The authors of this article focused on the study of risks associated with projects of warehouses and production halls located in industrial zones.

The paper is structured as follows. The following section explains the materials and methods used in the research. Then, the results are presented, discussed, compared with other similar projects in the
research sample and verified by a case study of one location where the project of a new warehouse and production hall was planned and implemented. The main findings and an outlook of the future research directions are proposed at the end of the paper.

2. Materials and methods
The risks of investment projects of warehouses and production halls located in industrial zones were examined from two perspectives. Firstly, a separate SWOT analysis was performed for each research sample project and a summary SWOT analysis was carried out showing the expected project strengths, weaknesses, opportunities, and threats in the current societal situation.

Furthermore, a detailed risk analysis was performed on one sample project in a form of a case study. Quantitative analysis was used as the risk analysis method.

Quantitative risk analysis is generally performed for the risks that were prioritized using the qualitative risk analysis. However, it is possible to skip the qualitative risk analysis depending on the team experience and familiarity with the risk and after the risk identification, to move directly to the quantitative risk analysis. The quantitative risk analysis has three major goals [6]:

- Assess the probabilities of achieving specific project objectives
- Quantify the impact of the risks on the overall project objectives
- Prioritize risks according to their contributions to the overall project risk.

The research sample consisted of 12 projects of warehouses and production halls placed in industrial zones, located in different countries of Central and Eastern Europe – the Czech Republic, Slovakia, Poland, Hungary, and Romania. The basic description of the selected zones – industrial areas can be seen in Table 1.

| Industrial area          | Advantages of the location                                                                 |
|--------------------------|------------------------------------------------------------------------------------------|
| Žďár nad Sázavou,        | Land attached to the production facility that will use it.                                |
| Czech Republic           |                                                                                          |
| Jičín,                   | Land in the industrial area where it is needed.                                           |
| Czech Republic           |                                                                                          |
| Jindřichův Hradec,       | Land attached to the production facility that will use it.                                |
| Czech Republic           |                                                                                          |
| Bucharest West,          | 5 km from the city centre. Strategic location.                                            |
| Romania                  | Proximity to the Budapest M0 highway.                                                     |
|                          | Strategically located in Western Bohemia, 50 km from Plzeň city centre, with              |
|                          | excellent highway connectivity and only 15 km from the Czech/German border. The          |
|                          | routes and important trade paths lead through Germany further to Italy.                   |
| Bor,                     | 5 km south of Brno/D1 junction.                                                           |
| Czech Republic           | 13 universities in the city/region.                                                       |
|                          | Skilled labour force available.                                                           |
|                          | Lower operational costs.                                                                  |
|                          | Proximity to the Brno international airport.                                             |
|                          | Onsite public transport.                                                                 |
|                          | 1-hour drive to Vienna.                                                                   |
| Brno Modřice,            |                                                                                          |
| Czech Republic           |                                                                                          |
Industrial area | Advantages of the location
--- | ---
Budapest East, Hungary | 8 km to the south-east of Budapest at the intersection of M0 ring road and motorway M4. Budapest International Airport is very close. Located on the busiest transit route to and from Budapest.
Sibiu, Romania | Located in the vicinity of two European routes E68 and E81, and just off the A1 motorway which runs from Sibiu city all the way to the Romanian/Hungarian border. Located in the area which has the longest industrial tradition in Romania. Sibiu is home to 148,000 inhabitants, 40% of whom are employed in industrial activities.
Opole, Poland | Strategically located between two strong agglomerations: Katowice and Wroclaw. 56 km from the Polish/Czech border, 250 km to the German border. 6 universities in close vicinity.
Bratislava, Slovakia | Direct highway connection. Well-developed infrastructure, highway, railway, naval and cargo port and international airport. Directly adjacent to VW automotive plant.
Belgrade, Serbia | Ideal for e-commerce, first-mile logistic, distribution, manufacturing. Prime location between two biggest cities in Serbia Belgrade and Novi Sad 20 minutes away from the city centre with excellent transport access to Zagreb, Budapest and Timisoara.

The research sample was created by 12 investment projects of warehouses and production halls in the industrial areas which are described in Table 1.

Basic data about these investment projects is shown in Table 2 (project name, size, planned and real costs, time of realization and utilisation).

**Table 2. Data on 12 sample projects of warehouses and production halls**

| Project number | Project name | Size of floor area/overall m² | Planned costs/real costs in million EUR | Planned time of realization/real time of realization in months | % of utilisation |
|---------------|--------------|-------------------------------|----------------------------------------|---------------------------------------------------|----------------|
| 1             | Žďár nad Sázavou Industrial Zone | 3,239 / 5,822 | 3.11 / 3.26 | 12 / 14 | 70 |
| 2             | Jičín Industrial Zone | 1,602 / 1,822 | 1.56 / 1.52 | 8 / 8 | 100 |
| 3             | Jindřichův Hradec Industrial Zone | 593 / 888 | 0.158 / 0.162 | 12 / 12 | 70 |
| 4             | Bucharest West | 127,694 | No deviation from the planned cost | On time | 94 |
| 5             | Bor B7 | 30,606 / 58,718 | No deviation from the planned cost | On time | 94 |
| 6             | Brno Modřice MO13 | 10,413 / 12,322 | No deviation from the planned cost | On time | 94 |
3. Results and discussions

The SWOT analysis was used to identify strengths, weaknesses, opportunities, and threats of the investment projects identified in Table 2. Emphasis was placed on the impact on the public area, such as employment, public transport, and the development of the locations among other things.

Based on the study of individual investment projects located in the analysed industrial zones, the predominant strengths and weaknesses, opportunities and threats identified are shown in Table 3.

**Table 3.** SWOT analysis of 12 warehouse and production hall projects

| Project number | Project name | Size of floor area/overall m² | Planned costs/real costs in million EUR | Planned time of realization/real time of realization in months | % of utilisation |
|----------------|--------------|--------------------------------|----------------------------------------|---------------------------------------------------------------|-----------------|
| 7              | Budapest East ULL2 | 11,200 / 36,531 | No deviation from the planned cost | On time | 94 |
| 8              | Romania Sibiu SU1 | 15,403 / 18,401 | In Pre-investment phase | On time | In Pre-investment phase |
| 9              | Poland Opole | 10,500 / 32,806 | No deviation from the planned cost | On time | 94 |
| 10             | Poland Opole | 5,900 / 11,851 | In Pre-investment phase | On time | In Pre-investment phase |
| 11             | Bratislava | 5,340 / 5,670 | No deviation from the planned cost | On time | 94 |
| 12             | Belgrade | 15,000 / 20,000 | No deviation from the planned cost | On time | 94 |

**STRENGTHS**

- Well-thought-out business plan
- Supporting the company growth
- Well diversified customers
- Customer-focused projects
- Stable management team
- Well-positioned location
- Know-how and infrastructure availability in place

**WEAKNESSES**

- Availability of suppliers
- Limitation of current production hall/area
- The complex requirement from the project
### OPPORTUNITIES

| Expansion of construction investment in the location | Potential economic crises |
| Upskilling the employees | Global pandemic |
| Possibility to innovate the products and processes | Unavailability of employees |
| Income tax exemptions | Non-fulfilment of contractual obligations by suppliers |
| Increase in job opportunities | |

### THREATS

- **Strengths**
  The majority of projects are very well-thought-out, have a mission to grow, the mission can be achieved by focusing on customers, developing the employee potential and placement in a good location, all of that was fulfilled by 12 sample projects.

- **Weakness**
  It is known that construction activity is a complex project, limitation comes from the current production area and limited capacity of suppliers which remained a weakness for the sample projects.

- **Opportunity**
  All 12 projects have the potential to create jobs for local people and new business for local suppliers. Investors make use of the income tax exemptions opportunity in some countries.

- **Threats**
  Global pandemics as the world has seen at the beginning of 2020 and economic crises as the one of 2008 remained threats to any businesses. On the other hand, if the economic growth is large, there is a threat of the lack of labour availability and suppliers as the Czech Republic experienced the in 2016-2018 period.

### 3.1 Risk assessment

Risks and opportunities for 12 warehouse and production hall constructions situated in Central and Eastern Europe were identified. The risks that were identified for these projects are listed below.

#### 3.1.1 Risks related to construction

Risks found in the sample projects were related to the change in the planned construction project cost price compared to the realised cost price.

Two projects exceeded investment costs and did not meet the expected investment costs. Project 1 had planned costs of EUR 3.11 million however, the real costs were EUR 3.26 million which was by 5% more than the planned costs, project 3 had planned costs of EUR 0.158 million and the realised costs were EUR 0.162 million which was by 4% more than the planned costs.

Project 2 was completed with a cost saving of EUR 0.06 million, its planned costs were EUR 1.62 million and the realised costs EUR 1.56 million, which was by 4% less than the planned costs thanks to the cost saving agreed between the investor and the constructor.

Projects 4 to 12 met both the expected investment costs and the time of realization.

#### 3.1.2 Utilisation

Projects 2 and 3 achieved a utilisation rate of 70%, projects 4, 5, 6, 7, 8 and 10 achieved 94% of utilisation rate and project 2 achieved 100% of the utilization rate. The planned utilization rate of all the projects was around 90 - 95%. It means that the objective has been achieved.

More detailed information will be addressed by further research.

The following chapter presents a case study of the project in Žďár nad Sázavou.
4. A new warehouse and production hall construction – a case study

The case study project deals with the construction of a new warehouse and production hall in Žďár nad Sázavou in the Czech Republic. The warehouse and production hall construction are well located in the Žďár industrial zone adjacent to another manufacturer, ZDAS, a.s., near the railway station and the main road.

This location was chosen since there was technology know-how such as development and production of die casting, furniture assembly and fitting, so the necessary infrastructure was built there. The town of Žďár nad Sázavou continues to attract investments by the industrial zone extension.

This project had a significant impact on the local life as 100 jobs were created and external suppliers in the area gained new business possibilities as well.

The investment costs of this project were EUR 3.11 million. The project also created annual savings of EUR 0.332 million compared to the project designed by the investor. It meant a payback period of 9.4 years.

The following 3 variants were analysed during the pre-investment project phase:

- **Variant 1** “Without building with support outsourcing”. It meant investment costs of approx. EUR 0.569 million, annual savings of about EUR 0.166 million with the variant payback of approx. 3.4 years. The disadvantage of this variant is a risk of know-how loss and it does not allow continuous growth.

- **Variant 2** “New warehouse and production hall” which offered annual savings of approx. EUR 0.332 million, investment costs of EUR 3,110,000 with the variant payback of approx. 9.4 years. In addition to the gained savings, the factory output could be doubled.

- **Variant 3** “New assembly hall” offered annual savings of approx. EUR 0.332 million, investment costs of EUR 3,965 million with the variant payback of approx. 11.9 years.

The investor chose variant 2, it meant building a new warehouse and production hall. The factory output could be doubled, and new growth opportunities could be realised.

The return on investment was calculated as follows:

\[
P_B = \frac{IC}{S}
\]

Where:
- PB Payback period
- IC Investment Cost
- S Savings

Data Input for calculating the Savings in million EUR

- Saving in annual rental costs: 0.145
- Saving in annual transportation costs: 0.082
- Less internal transportation: 0.077
- Improved material flow: 0.026
- Total 0.332

Planned Investment: EUR 3.110 million.
Return of investment is 9.4 years.

4.1 Project post-audit
In the initial project plan, the project was expected to be completed within 12 months, however, it was completed within 14 months due to complications caused by the Covid-19 pandemic. A comparison of the key items of the plan and the reality is given in the following Table 4.

| Key figures | Planned savings in million EUR | Reality in million EUR | Absolute deviation |
|-------------|--------------------------------|------------------------|--------------------|
| Saving in external warehouse annual rental costs | 0.145 | 0.072 | 100% |
| Saving in annual transportation to external warehouse costs | 0.082 | 0.041 | 100% |
| Less internal transportation due to increase in process efficiency | 0.077 | 0.069 | 11% |
| Improved internal material flow due to a new warehouse | 0.025 | 0.024 | 5% |
| Saving from new projects/opportunities | | 0.230 | 100% |
| Total savings | 0.332 | 0.439 | 24% |
| Rough total investments | 3.110 | 3.260 | 5% |
| Payback period in years | 9.4 | 7.4 | 26% |

4.2 Analysis of the deviation from the plan
The project investment cost was expected at EUR 3.11 million, however, it ended up being EUR 3.26 million. The increase in cost resulted from excavation, as the soil contained rocks that were more expensive to dig through than planned, this increased the cost of the project by 5%.

The total saving was expected at EUR 0.33 million, however, in reality, the company saving was EUR 0.44 million. An additional saving opportunity is the increased warehouse and production hall capacity together with the planned saving of rental cost and transport to the external warehouse which did not happen as planned resulting in a total annual saving of about 24% more than planned.

The planned return on investment was 9.4 years during the project initial phase, however, thanks to the increase in saving, the planned return on investment was improved to 7.4 years which represented a 26% improvement.

The project was delayed by 2 months due to Covid-19 pandemic which was not planned in the project design.
4.3 Creation of jobs
The project planned to create 100 jobs. In fact, 124 jobs were created, so the project overachieved the job creation plan by 24%.

The construction of warehouse and production hall in Žďár nad Sázavou had a positive financial impact on the people close to the industrial area by creating 124 jobs and bringing the investor saving of EUR 0.44 million per year.

Furthermore, the external suppliers in this area gained more business such as catering, cleaning, security, indirect and direct material deliveries as the investors increased the revenue and number of employees, the external suppliers increased their number of employees too.

5. Conclusions
The industrial zone development is important for unifying the local government strategy with the country strategy, to attract more investors and create job opportunities.

Investment in the construction of a warehouse and a production hall requires a well-thought project, good risk management and good cooperation between the project stakeholders, mainly between investors, architect, and constructor. One of the main goals of the stakeholders in the construction of a warehouse and a production hall is to create profit and provide better life quality for people. When all parts cooperate well together, they can better manage risks and optimise the opportunities, which can be seen on one research sample project.

However, both the investors and the project team need to keep in mind the possible uncertainty that the project team or the global world can face, for example the current Covid-19 pandemic.

The research sample project has shown that the industrial area development by constructing a warehouse and a production hall brings good opportunities to local people and business, as can be seen in the case study of a warehouse and production hall construction in Žďár nad Sázavou industrial area, where the project created 124 job opportunities and operation cost saving of EUR 0.440 million every year.

This research was limited to 12 projects, further steps will be to analyse more sample projects to further extend the research topic.

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