CHALLENGES FOR DEVELOPMENT OF CONSTRUCTION INDUSTRY IN CONDITIONS OF CORONAVIRUS (COVID-19) PANDEMIC IN LATVIA

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Abstract. The construction industry, like other industries, is being forced to change the working conditions during the COVID-19 pandemic, within the limits set by the EU and the government. Construction is an industry in which a large part of the construction process cannot be carried out remotely, regardless of the level of technological development. Manufacturing, construction, assembly, and other works require a great deal of human labour. During the COVID-19 pandemic, when it is necessary to distance, these construction processes may be adversely affected. However, the use of technologies such as Construction Information Modelling (BIM) and the new Construction Information System (BIS) allows the design industry not to stop using the latest construction technology tools. Digital technologies increase production efficiency, complement other factors of production and stimulate innovation, significantly reduce costs and overcome information barriers. The interpretation of statistics and the interviews conducted confirmed the hypothesis that the virus has had negative and positive effects within the constructor sector of the economy. The research aims to investigate the problems and challenges faced by the construction industry in the conditions of the COVID-19 pandemic, identifying the main obstacles to the introduction of digital technologies in the Latvian construction sector, as well as other problems faced by the industry in the coronary virus COVID-19 pandemic in Latvia, analyze the construction sector and identify the COVID-19 pandemic effect on Latvia's construction sector. As part of the study, an electronic questionnaire was established and a survey was carried out to identify the changes caused by the COVID-19 pandemic in Latvia's construction sector, the results were compiled and the conclusions were reached.

Keywords: construction industry, COVID-19 effect, digitization of construction.

Introduction

According to CSB data [1], the spread of the Covid-19 virus and the epidemiological security measures still affect people, companies, industries, and the economy. The restrictions in October and November 2021 strongly influenced retail and service industries, particularly shops, hospitality, and restaurant businesses as well as arts, entertainment, and leisure companies. In addition, the sudden increase in energy prices in October and November last year slowed down the growth of the manufacturing industry.

The Covid-19 pandemic has been affecting everyday life for almost two years. At first, it seemed that the virus would not be lasting and the most effective solution to stop it would be strict restrictions. But now it is clear that the virus will stay, and people must be able to survive daily, and economic activities must continue. The countries face other problems: the crisis in energy prices, the necessary support programs, and instruments in the areas of human capital, innovation, digitalization, energy efficiency, and others important for the growth of the economy. The situation has been worsened by the hostilities in Ukraine since 24 February 2022.

A major study on today's very actual topic – COVID-19 pandemic effects on the development of the construction industry in Latvia, is carried out at the University of Life Sciences and Technologies, Department of Architecture and Building. The study's main aim was to determine the impact of the COVID-19 pandemic on the construction industry in Latvia.

Annual Comparison by Construction Sector and by EU Member States

In the euro area in March 2022, compared with March 2021, building construction increased by 3.4% and civil engineering by 3.3%. In the EU civil engineering increased by 4.9% and building construction increased by 4.0%

Among the member states for which data are available, the highest annual increases in production in construction were observed in Poland (+27.7%), Slovenia (+12%), and Hungary (+10.5). Decreases were recorded in Spain (-7.7%), Belgium (-2.2%), Germany (-0.4%), and Austria (-0.2%).

March 2022 compared with February 2022 production in construction is stable in the euro area and up by 0,2% in the EU. Construction - quarterly data in the EU, Estonia, Latvia, Lithuania, and Poland from 2020 QI till 2022 Q2 are shown in Figure 1.

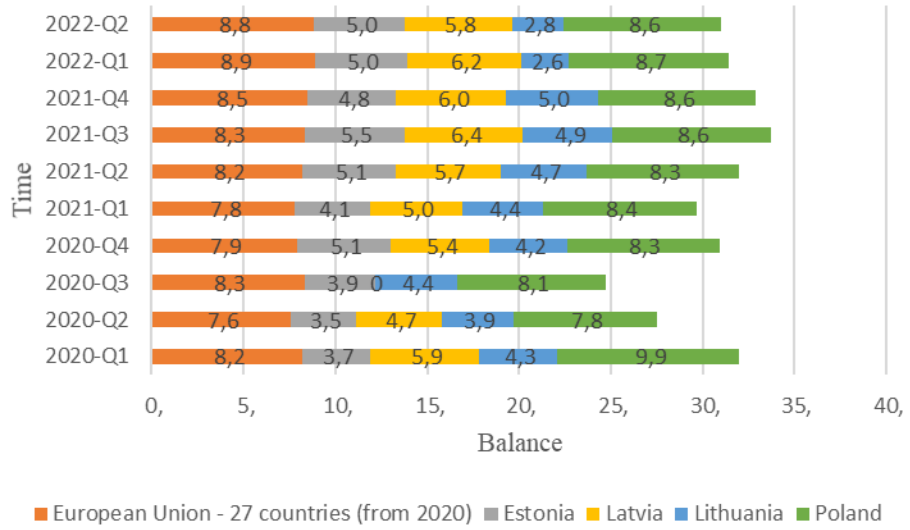

Fig.1. **Construction – quarterly data in EU, Estonia, Latvia, Lithuania, and Poland from 2020 QI till 2022 Q2 [2]**

Materials and methods

Within the framework of the research work, the literature analysis on the emergence and spread of the COVID19 pandemic in the world, the assessment of the Latvian economy and construction sector in 2020-2021 are done, as well as the current events in the construction sector were summarized.

The methods used include desk research, global trend analysis, regression analyses, case studies of proven champions, and expert interviews. Problems related to construction problems have been discussed and studied in scientific articles in previous years as well [3-5]. Problems related to the impact of the COVID-19 pandemic on economic sector problems have also been discussed and studied in scientific articles [6-22].

Results and discussion

The situation in the construction industry

The construction industry has an important role in the Latvian economy. In times of climate change and globalization, the research on saving the recourses, as well as preservation of the identity of places is being implemented. Long-term building comprises complex solutions and practices that increase the efficiency of houses and reduce the consumption of energy, water, and other natural resources. The building and management processes consider material input per unit, power intensity, and negative impact on people's health and environment.

Under the 2015 Paris Agreement on Climate Change and the UN 2030 Agenda for Sustainable Development, all UN member states have committed to pursuing the Sustainable Development Goals (SDGs) – stronger health systems, expanded social protection, the resilience that comes from more equal societies, and a healthier natural environment. A specific agenda has been set for sustainable building, framed by the EU Green Deal outcomes and funding. From 2021-to 2027, it will be around 3 billion EUR accessible for green and sustainable investments in Latvia.

NZEB is the energy performance standard developed according to the European Union Energy Performance in Buildings Directive (EPBD). This Directive requires that all new public buildings must meet the NZEB standard from the end of 2018 onwards, and ALL new buildings from the end of 2020 onwards. The Directive also entitles that the deep renovation of existing buildings to the NZEB standard beyond 2020 is performed. It means that to meet the NZEB standard, it will be necessary to change a culture at all levels in the building industry, from procurement, to design, construction, use, and maintenance of the building over its life cycle [10, 17].

Sustainable building projects for long-term use are becoming more popular in Latvia. Three factors: economic (saving resources and energy), social (consumers demand better quality and a wider range of

accommodations), and environmental issues (green thinking in the context of climate change and pollution). In this paper sustainable building and management, their basic principles are investigated. The article provides an analysis of the situation in the construction sector in Latvia from the point of sustainability and discusses the challenges, opportunities, and threats to the sustainable development of construction in the current situation. The index of Production in Construction is shown in Figure 2.

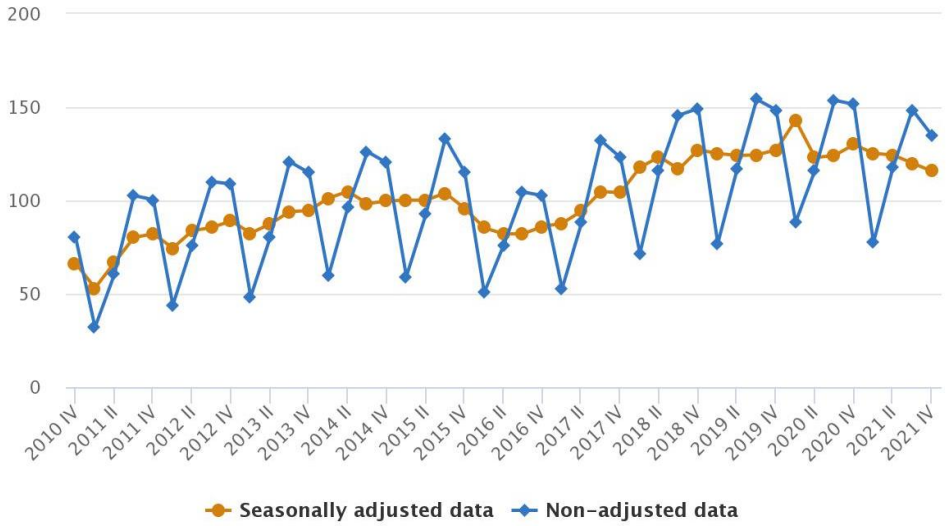

Fig.2. **Index of Production in Construction in Latvia from 2010 IV till 2021 IV (2015 = 100) [1]**

The data show that construction activities decreased by 6.2%. Construction output declined in the construction of buildings – by 10.5%, civil engineering – by 5%, and specialized construction activities – by 2.7% in 2021, compared to 2020. Construction of buildings output at current prices by building type, thousand euros by Indicator, Buildings groups, and the time are shown in Figure 3.

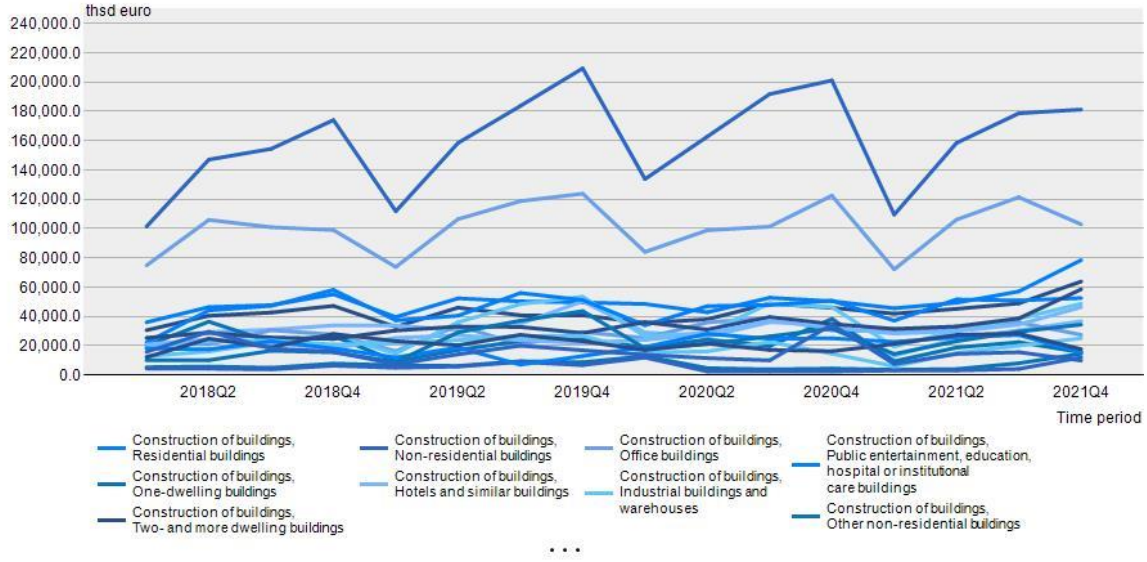

Fig. 3. **Construction of Buildings output in Latvia from 2018 Q2 till 2021 Q4 at current prices by building type, thousand euros by Indicator, Buildings groups, and Time period (developed by the author, based on CSB data)**

As shown in Fig.3, overall the numbers had different trends: for example, in the 4th quarter of 2021, compared to the 4th quarter of 2020, construction output declined by 11%. Construction output dropped in civil engineering by 17.7%, in construction of buildings – by 8.6%, and in specialized construction

activities – by 6.9%. The cause for the drop-in output in civil engineering was a decline of 28.9% in the construction of roads and railways and by 7.9% in utility projects, but in other civil engineering (construction of water projects and other civil engineering projects N.E.C.) the production output rose by 70%.

According to the bank's assessment, this was caused by several factors: 1) the base effect and the unsuitable weather conditions influenced construction in the first quarter of 2021; 2) the effects of the Covid-19 pandemic that led to logistics problems and lower capacity utilization during the first wave of the pandemic, and 3) the considerable rise in market demand globally caused by boosting the economy with investment in construction that was the reason of problems of the availability of some building materials and higher construction costs in the world.

Building permits

The statistical data [1] show that in 2021 the following amount of building permits in Latvia was issued for the construction of residential buildings and non-residential buildings (Table 1).

Table 1

Number of building permits in 2021 [1]

Types of buildings	No building permits
With a total floor space of 924 thousand square meters for the building of residential buildings	3387
Or intended floor space of 462000 square meters for new single-apartment houses	2270
With a total area of 1826 thousand square meters for new non-residential buildings with an intended floor space of 861 thousand square meters	1585
For industrial buildings and warehouses with a total area of 493 thousand square meters	243

GDP dynamics (% change compared to the corresponding period of the previous year) are shown in Figure 4.

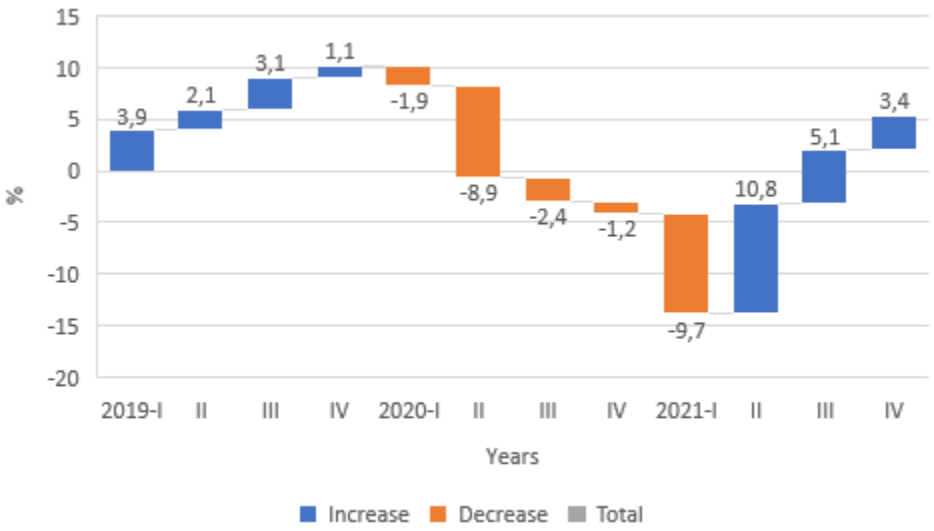

Fig. 4. **Latvian GDP dynamics from 2019 I till 2021 IV (% change compared to the corresponding period of the previous year) (developed by the author, based on CSB data)**

As shown in Fig.3, Latvian GDP growth has recovered from the pandemic quicker than the forecast. It could be explained by gradual reduction of restrictions, government supporting activities, positive financial conditions, and adaptability of consumers and businesses.

Construction of buildings output at current prices by building type, thousand euros by indicator, buildings groups, and the time are shown in Figure 5.

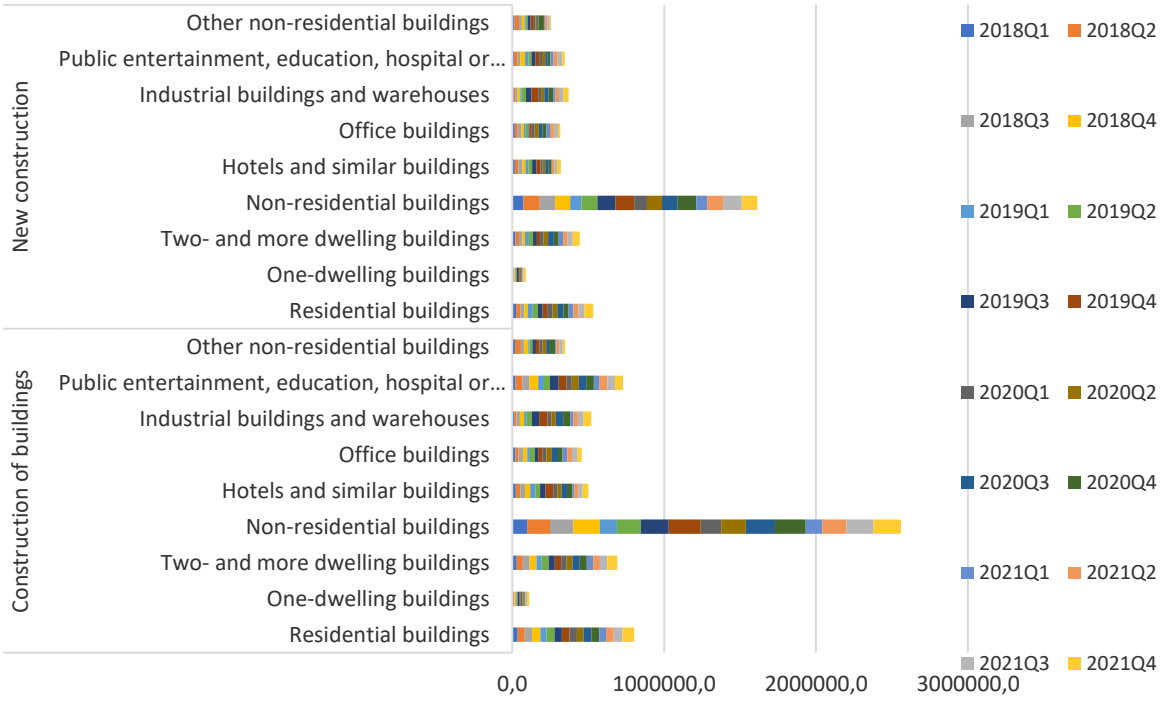

Fig. 5. **Construction of buildings output in Latvia from 2019 till 2021 at current prices by building type, thousand euros by Indicator, Buildings groups, and Period (developed by the author, based on CSB data)**

In January, average construction costs were affected by a rise in prices for asphalt concrete, hollow core slabs, sand, dolomite crushed stone, and commodity concrete. In February, compared to January, the level of construction costs increased by 2.7%. Maintenance and operational costs of machinery and equipment grew by 3.4%, prices of building materials – by 3.2%, but the salary of workers increased by 1.1%. Changes in construction costs are shown in Fig.6.

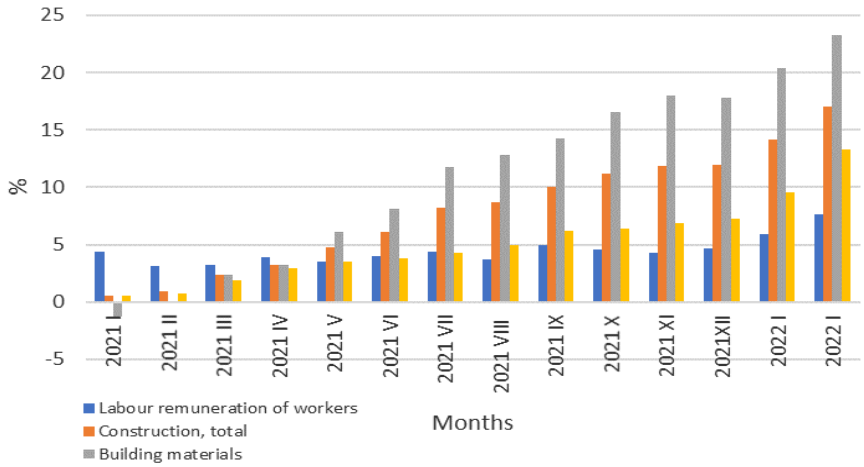

Fig. 6. **Changes in Construction costs in Latvia from 2021 till 2022 (as percent, compared to the corresponding month of the previous year) (developed by the author, based on CSB data)**

The latest data from 2022 show upward trends – in February, the average level of construction costs was mostly affected by the growth of maintenance and operational costs of machinery and equipment of trucks, semi-trailers, and excavators, as well as the price rise of sand and reinforcement, reinforcement mesh, frames, but in March, the level of construction costs, grew by 18.7%, prices of building materials

– by 25.2%, maintenance and operational costs of machinery and equipment – by 15.3%, and salaries of workers – by 8.9%, compared to March 2021 [1].

Correlation analysis shows that there is a strong positive correlation (r = 0.9997) between building materials, the total and building materials, and a strong positive correlation (r = 0.9884) between building materials and the maintenance and operation of machinery and equipment.

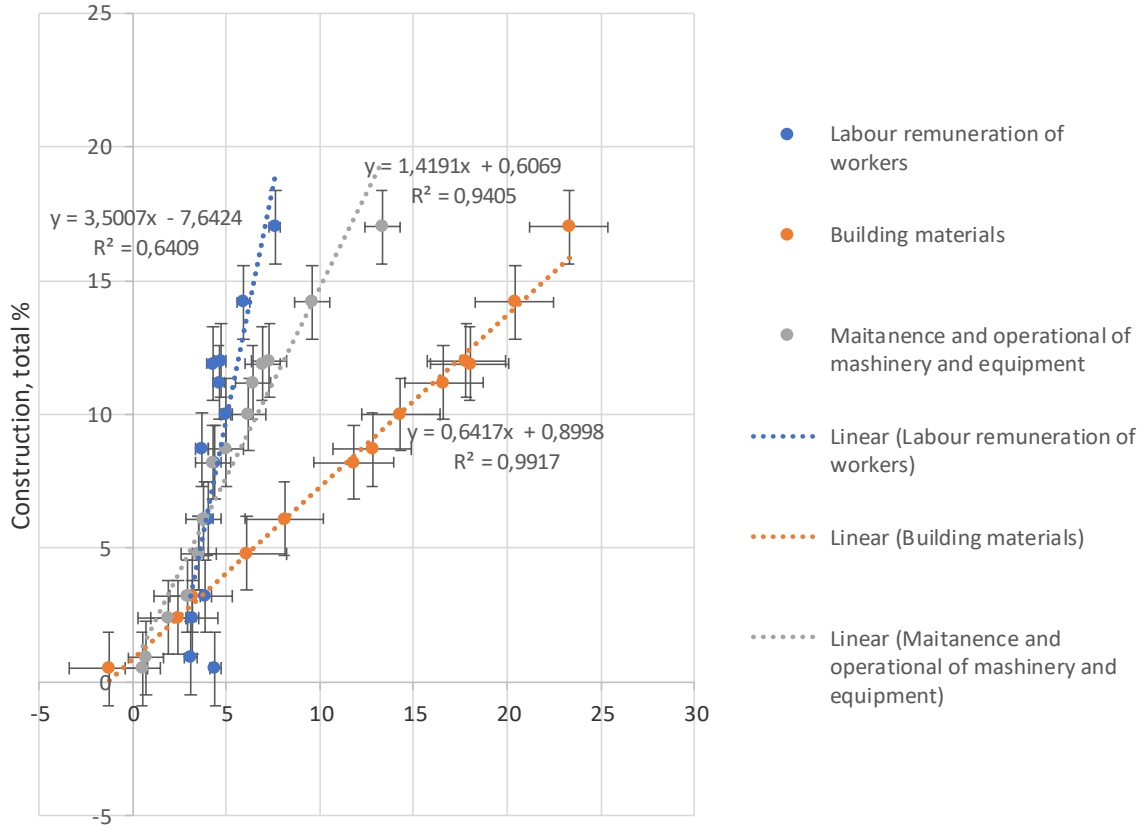

Fig.7. **Correlation analysis between building materials, the total and building materials, and between building materials and the maintenance and operation of machinery and equipment in 2021, Latvia (developed by the author, based on CSB data)**

The Construction Cost Index (CCI) aims to reflect average trends in the prices of construction resources. The CCI is the input price index, it presents price changes for the main types of resources invested in the construction. In 2022, the data were provided by about 200 construction companies and more than 50 trade companies. The sample includes construction companies with the highest value of own account construction works in 2021. The criterion for the sample of trade companies is their turnover and specialization.

Dynamics of construction costs by types of resources are shown in Fig. 8. During the pandemic, many companies have transformed from traditional construction companies into product lifecycle service providers capable of providing customers with full lifecycle services, equipment management, and operational services. There is a greater emphasis in the industry on full life cycle costs as opposed to the traditional one-off payment for a completed object. One of the key features is a complete shift in focus between project construction companies. As companies will increasingly have to take responsibility for the full life cycle of each project they build, they need to focus on project quality, longevity, and ease of maintenance. The project must be designed to be quick and easy to repair and maintain. In the future, there will be a significant increase in the number of construction companies that will switch to a contract covering the entire life cycle of the project, while regulating its outcome and availability.

The impact on companies' business models will be profound, as they will need to significantly expand their planning horizons to ensure long-term profitability. One way for companies to address this

is to implement business software that facilitates the transition from construction to full lifecycle services.

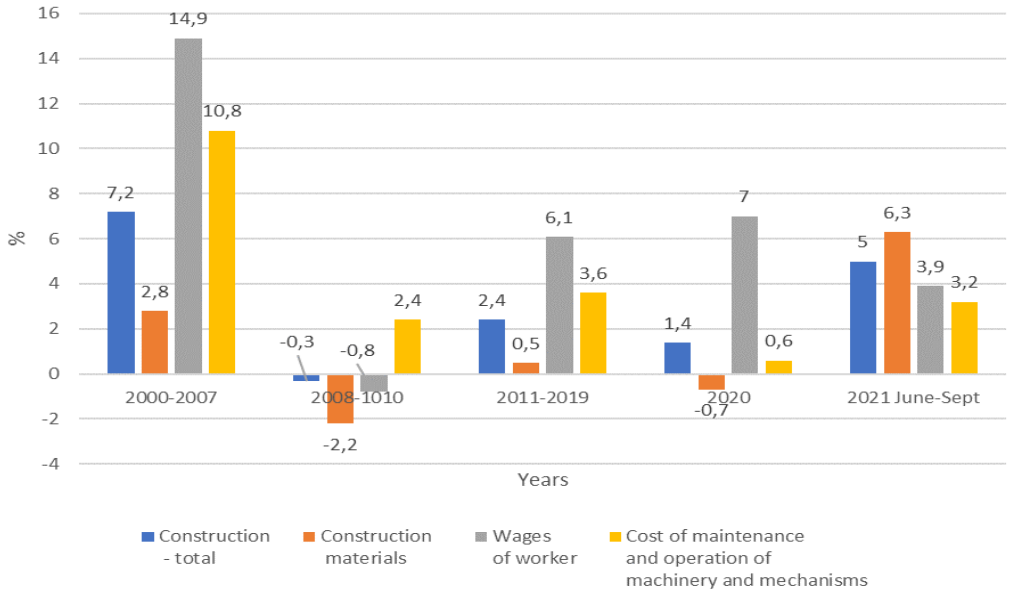

Fig. 8. **Dynamics of Construction Costs in Latvia by Types of Resources from 2000 till 2021 (2000 = 100) annual average, changes as a percent (developed by the author, based on CSB data)**

On-site installation determines the need to standardize materials and processes. In the past, construction companies built houses from materials delivered to the construction site, but now many companies relocate actual construction to factory-like, enclosed spaces where builders and contractors build building elements or modules, which are then delivered to the construction site and assembled.

As construction companies must find increasingly sophisticated logistics solutions for each project, we are expected to see significant growth in companies that focus on implementing the best supply chain management practices.

We expect the construction industry to see an increase in investment in business software development, which is needed to streamline the transition to supply chains that would otherwise quickly go out of control.

Companies are rapidly moving to the manufacturing principle when they become accustomed to the idea of construction, which uses standardized parts with serial numbers that, unlike expensive, customized solutions, can be applied to a variety of projects.

Starting from 2021, the transition to on-site assembly will force construction companies to develop and address the current need for materials and work process standardization.

Conclusions

1. Because of the COVID-19 pandemic, part of the wages or profits of those working in the construction sector has fallen, which is natural because the number of new orders has fallen, and facilities have been suspended indefinitely or suspended altogether.
2. The current problem can be a shortage of skilled labour.
3. Those working in the construction sector are cautious about future developments, which depend to a large extent on the decisions of the Government and the EU, as well as on the war in Ukraine.
4. Prices have risen for all building materials, mainly metal and those that require large energy resources to produce, such as concrete. On the other hand, as the oil prices rise, bitumen and plastic products will also become more expensive. Rising oil and fuel prices will also have an impact on building material prices, as their supply will become more expensive.
5. Delivery of construction materials/products (for example, timber, metal products, energy resources, etc.) from abroad is difficult and expensive, which makes it difficult to plan works on sites and to meet project delivery deadlines.

6. Despite the change in work style, the representatives of the construction industry have mastered modern technologies (BIM, BIS, etc.) and can work remotely. Working remotely saves time and money.
7. The ability is acquired to react quickly, actively seek new markets, and create new cooperation models and new supply chains.
8. Large proportions of the Latvian construction companies follow preventive measures to control COVID-19, have been vaccinated, or are ready to be vaccinated against the virus.
9. Assessment of the pros and cons of the COVID-19 pandemic shows that the impact will be global and lasting. It will affect the workforce, not only in Latvia, but all over the world.
10. The future of the construction industry is irreversibly linked to process automation and digitalization, making the construction process more efficient and faster.
11. Changes are also taking place in the real estate sector, where demand, priorities, and accents are changing. Such housing, from which it is possible to work remotely, is becoming much more in demand.

Proposals

1. Use the COVID-19 pandemic as a valuable experience and develop the weakest links in future business operations.
2. Continue research on the impact of the global pandemic and other factors (for example, the war in Ukraine) on the development of the Latvian construction industry.
3. Continue work within the epidemiological constraint. Expect a safe vaccine and get vaccinated as soon as possible so that construction can return to normal.

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