ECONOMICS AND BUILDING MANAGEMENT II

Martin Hanko and Eva Jankovichová

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INTRODUCTION

The university textbook broadens understanding in the fields of building management and construction economics. This information is designed for students enrolled in various study programs at both undergraduate and graduate levels at the Faculty of Civil Engineering across different universities. Additionally, this knowledge is applicable to students participating in a variety of courses, training sessions, and seminars. The textbook deals with the issue of business in the construction industry from a global perspective, the construction company, its establishment, planning of the necessary finances and the current situation in the management of buildings in Slovakia.

Building management is a complex set of activities that ensure the smooth **operation, maintenance and long-term functionality** of a building.
Building management systems are computer-based systems installed in buildings to control and monitor the building's mechanical and electrical equipment, such as HVAC, lighting, energy, fire systems, and security systems. BMSs are also used in corporate real estate management, real estate development, and real estate leasing. These systems are based on a BMS platform, which is able to collect and analyze data for energy savings, preventive maintenance, and other performance improvements. The BMS provides a unified management platform that enables facility managers to integrate various systems and provide valuable insights into the performance and utilization of a building, aiding in effective asset management and decision-making regarding maintenance and capital investments. Building economics seeks to explore **cost-effective construction techniques** and expertise that enable corporates to make economically **sound decisions** to address building problems. In the startup world, companies are emerging to make the lives of Architecture, Engineering, and Construction professionals easier by improving job site safety, **streamlining project communication,** opening job access, and more. As the industry continues to evolve, keeping an eye on the innovative companies and emerging technologies will be crucial for anyone serious about the **future of construction**. Business plans are an important part of creating new businesses, whether as a startup or an offshoot of an existing business. Business plan is a document that conveys the first and most important picture of the company.

The construction industry is a decentralized sector with many different stakeholders involved in the construction process. The construction sector is characterized by a wide range of **challenges and opportunities**, from **innovative technologies** to **revolutionary construction techniques**. Digitalization is central to the required transformation of the construction industry. The advent of digital technologies has brought about a swift transformation at construction sites. Technological development drives **change in the industry** as research and development leads to innovation and new technologies.

Building materials are becoming increasingly important in the construction industry. In order to meet the growing demand for eco-friendly building materials, it is important to plan and optimize supply chains in good time. In this textbook, we discuss the characteristics of different types of building materials that can be used to support buildings, such as concrete, steel, and other materials. In addition, we also discuss some of the key trends that can significantly affect the development of the market, from the global economic situation to the growing environmental requirements and the demand for sustainable solutions.

The aim of the textbook is to present the current situation and challenges for building management in Slovakia and point out the importance of **facility management** in making decisions about the facility in the current global situation and the ongoing risk of the pandemic. Building management is an important part of the strategic management of organizations. It is aimed at ensuring functional, trouble-free and above all efficient operation of buildings and all services associated with it.

Building management faces **technological, legislative, and economic challenges**, including the shift towards renewable energy, improved energy efficiency, and **digital transformation**. There's a growing need for skilled professionals and lifelong learning in the sector. Rising operational costs necessitate innovative cost-reduction strategies to maintain buildings efficiently.

1 BUILDING MANAGEMENT

Building management involves maintaining and supervising the physical infrastructure of a building. This includes facilities, equipment, and overall systems within a building. From HVAC systems to lighting, plumbing, elevators, and security systems; building management encompasses the maintenance and supervision of everything within a building.

Building management can involve the maintenance and management of commercial buildings like office buildings or shopping malls (building maintenance), and residential buildings like apartments, houses, villas, and condominiums (residential buildings).
Careful planning, execution, and ongoing maintenance are required for effective building management. As a result, this ensures the comfort, safety, and efficiency of the occupants.
Anything within the domain of managing and maintaining buildings is a part of building management.
When buildings and facilities are well maintained and supervised, the occupants can experience a comfortable and functional environment around them.

Efficiently managing a commercial building can significantly impact the bottom line, and that’s where the intelligent application of a Building Management System (BMS) comes into play.

Building Management Systems (BMS), also known as Building Automation Systems (BAS), are computer-based systems installed in buildings to control and monitor the building's mechanical and electrical equipment, such as HVAC, lighting, energy, fire systems, and security systems.
In simple terms, the BMS serves as a central control point for all facilities within a building.
Here are some examples of what the BMS controls:
► HVAC Management: The BMS oversees duct conditions, including temperature, pressure, humidity, and exhaust heat levels, triggering alerts if they stray from preset thresholds and ensuring maximal HVAC energy efficiency.

► Hot Water and Heating Control: Temperature regulation and pump operations for hot water and central heating are managed by the BMS, assuring proper distribution and functionality.

► Chilled Water Oversight: Chiller functions, including temperature control and pump operations, are supervised by the BMS to guarantee proper coolant distribution.

► Lighting Control: The system automates lighting operations, adjusting for optimal use and energy savings while maintaining comfort and safety standards.

► Electrical Consumption Tracking: The BMS monitors electrical usage and the status of main power switches, offering insights into energy consumption and potential savings.

► Fire Safety Sprinkler Oversight: Monitoring of the sprinkler system is incorporated to ensure adherence to fire safety protocols.

► Security Systems Management: Surveillance and access control are integrated into the BMS, bolstering building security and response to incidents

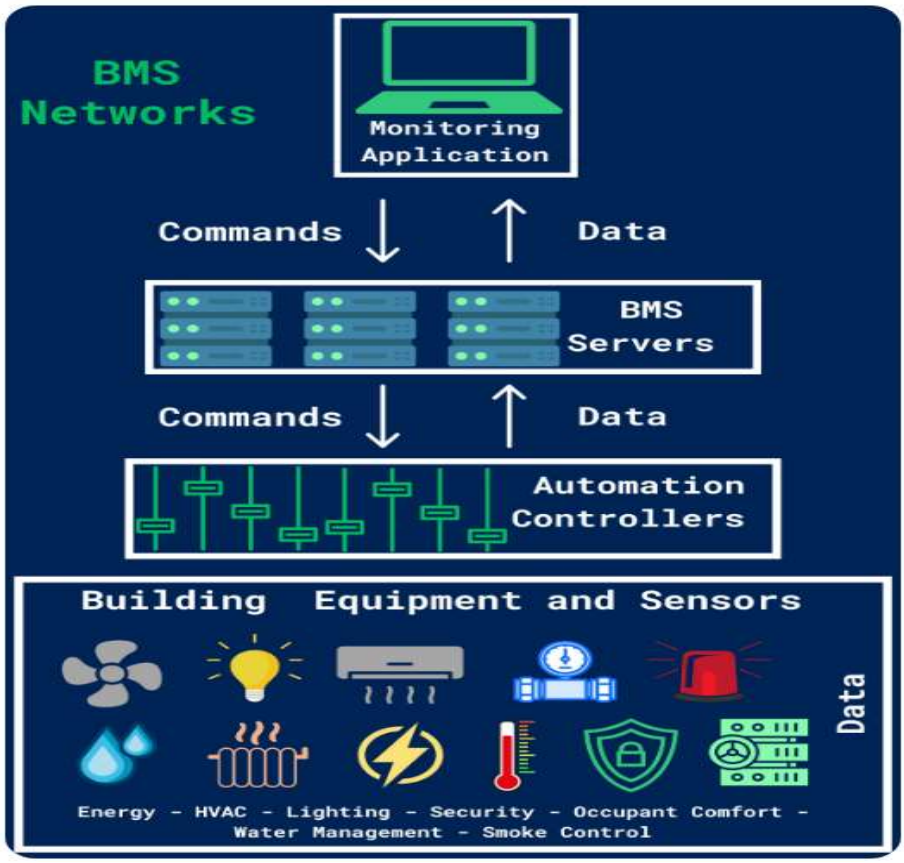

Figure 1 Diagram BMS[1]

[1] HOLBERT, C. 2024: *What is a Bulding Management System?* [online] published , April 26, 202a [cited March 2024]. Available at: https://www.cim.io/blog/what-is-a-building-management-system

1.1 TYPES OF BUILGING MANAGEMENT SYSTEM

There are several types of building management. Let's discuss them below:

Commercial building management

It involves managing and supervising shopping malls, office buildings, and other commercial buildings and properties.

Residential building management

It includes overseeing properties and buildings like condominiums, villas, townhouses, and apartments.

Facility management

It includes managing and overseeing specific facilities within a building like laboratories, manufacturing plants, and data centers.

Corporate real estate management

It involves managing an organization's real estate assets like leasing, acquiring, and disposing of properties.[2]

1.2 ADVANTAGES OF IMPLEMENTING BMS

Implementing a modern Building Management System (BMS) provides significant advantages that contribute to operational efficiencies, safety, and occupant comfort. Here's a closer look at how a BMS enhances building management:

1. *Energy Efficiency:*

A modern BMS optimizes the operation of mechanical and electrical systems including HVAC, lighting, and power systems. By automating processes such as turning off lights when not needed and adjusting temperature based on occupancy, a BMS can significantly reduce energy consumption and lower energy bills.

For example, smart scheduling and demand-controlled ventilation ensure that energy is used only when necessary, optimizing consumption patterns and significantly reducing waste.

2. *Comfort:*

By maintaining controlled indoor environmental conditions—regulating temperature, humidity, and air quality—a BMS ensures a comfortable atmosphere for occupants. Appropriate lighting levels and smooth operation of systems contribute to an environment conducive to productivity and well-being.

[2] NAVEED, S., 2024. *What is Building Management? Types and Best Practices.* [online] published , April 29, 2024 [cited September, 2024]. Available at: https://ezo.io/ezo-cmms/blog/building-management/

The system's ability to adapt to varying occupancy and environmental conditions without manual intervention allows for consistent comfort without excessive energy use.

3. *Safety and Emergency Response:*

A BMS enhances building safety by integrating fire alarms, smoke detectors, and other emergency response systems into a unified management platform. It can detect and respond to emergencies swiftly, for instance, by controlling emergency exits and directing occupants safely.

Regular monitoring and automatic adjustments reduce risks associated with equipment malfunction, which can lead to accidents or failures.

4. *Reduced Operating Costs:*

Through efficient management of building systems, a BMS reduces the costs associated with maintenance and operation. It extends the lifespan of equipment by preventing overuse and facilitating timely maintenance, thereby decreasing the likelihood of costly repairs or replacements. Proactive data analysis and fault detection allow facility managers to address issues before they escalate, ensuring systems operate within their optimal parameters.

With a properly configured BMS, ASHRAE energy audits are easier to perform because all of the data is in one, central location.

5. *Enhanced Regulatory Compliance:*

Modern BMS systems help buildings comply with increasingly stringent energy consumption and emissions regulations. Automated data logging and reporting simplify compliance with environmental standards and building codes.

This compliance is not only beneficial for avoiding penalties but also positions the property as a leader in sustainability, enhancing its market value and appeal.

6. *Improved Asset Management and Security:*

The data collected by a BMS provides valuable insights into the performance and utilization of a building’s infrastructure, aiding in effective asset management and decision-making regarding maintenance and capital investments. Organizations attempting to secure ISO 55000 certification, can benefit greatly from implementing a modern BMS.

Enhanced security features of a BMS include controlled access to different building zones and monitoring of security cameras, which help prevent unauthorized access and ensure the safety of the premises.

1.3 COST OF A BUILDING MANAGEMENT SYSTEM

The cost of a Building Management System (BMS) and the selection of the system provider are crucial considerations for any facility manager planning to install or upgrade a BMS. These factors significantly influence both the initial investment and the long-term operational costs of managing a building effectively.

Factors Influencing BMS Costs

• *Building Size and Type*

The cost of a BMS typically varies based on the total square footage and the type of building. Larger buildings and those with complex needs, such as data centers requiring extensive cooling, generally incur higher costs.

• *Integration with Existing Systems*

The ability to integrate with existing systems like lighting, HVAC, fire safety, security, and access control can affect the initial setup cost. Buildings with comprehensive integrations often see a higher return on investment due to improved operational efficiencies and energy savings.

• *System Openness*

Choosing an open, non-proprietary BMS platform can lead to higher ROI as it allows facility managers to integrate various systems and analyze data for energy savings, preventive maintenance, and other performance improvements. Open platforms provide flexibility and can adapt to future technological advancements.

• *Installation Environment*

The cost can also differ depending on whether the BMS is being installed in a new building, retrofitted into an older building, or upgraded from a legacy system. New installations in new constructions are usually less expensive compared to retrofitting an old system due to the absence of legacy system complications.

1.4 BASIC TERMS

Building is a structure that provides shelter for its occupants or is one of its main purposes and is usually enclosed and designed to stand permanently in one place.[3]

Building is a structure that is a spatially concentrated roofed building structure connected to the ground by a solid foundation, or firmly connected to another

[3] STN ISO 15686-1 – Buildings and their parts. Part 1: General principles and framework.

structure that is designed and structurally suitable for the protection of people, animals, or things.

Building is a construction work made by construction works, with a defined purpose function, which is located on a plot of land, a permanent structure or another building, which is capable of independent use, regardless of the method of installation or fastening and the type of material used. A building can consist of several construction objects. A free-standing building includes related underground spaces, above-ground structures, connections, and technical, technological, and operating equipment, without which the building would not be complete and capable of operation.

Building economics seeks to explore cost-effective construction techniques and expertise that enables corporates to make economically sound decisions to address building problems.

Building management is a part of facility management that involves facility maintenance, operations, and repairs. The main goal of building management is to keep the building in optimal condition so that it continues to function smoothly.[4]

Business model is part of your overall business strategy. Some business models extend beyond economic context and include value exchange in social or cultural terms — such as the intangible impact the company will have on a community or industry. The process of constructing and changing a business model is often referred to as "business model innovation." A business model will include a brief overview of what you offer and to whom.[5]

Building object is a spatially separated or technically independent part of the building (e.g., a building with all accessories and equipment, external sewerage, etc.), ensuring a function within the object composition of the building.[6]

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[4] NAVEED, S., 2024. *What is Building Management? Types and Best Practices.* [online] published , April 29, 2024 [cited September, 2024]. Available at: https://ezo.io/ezo-cmms/blog/building-management/

[5] HAAFF, B., 2022. *Business Model vs. Business Plan.* [online] published , November 2022 [cited March 2023]. Available at: https://www.aha.io/roadmapping/guide/product-strategy/what-are-some-examples-of-a-business-model

[6] NAGY, J., 2016. *Technical Economic Indicators*. Bratislava: Institute of Construction Economics, Ltd., 2016, p. 4, ISBN 978-80-970019-4-0.

Business plan is a document demonstrating the feasibility of a prospective new business and providing a roadmap for its first several years of operation.

Business plans are an important part of creating new businesses, whether as a startup or an offshoot of an existing business. Business plans for startups are often shared with funding agencies, potential investors and venture capitalists to obtain the necessary funding.[7]

Business register is a public list of legally established data, which includes a collection of legally established documents.
The following are entered in the commercial register:
● trading companies, cooperatives, other legal entities for which a special law provides, legal entities established under the law of the European Union, enterprises, and organizational units of enterprises of foreign persons,
● spin-off plants and other organizational components of enterprises, if provided for by a special law,
● natural persons with permanent residence in the territory of the Slovak Republic who are entrepreneurs according to this law and who are registered in the commercial register at their own request or if a special law provides.[8]

Construction is everything that is built or is the result of construction activity (the term includes buildings and engineering structures. It refers to the complete construction, including load bearing, non-load-bearing and geotechnical elements).[9]

Construction enterprise
A type of social enterprise or organization created to construct a variety of buildings, infrastructure, properties, facilities, housing, path, pavement, roads, motorway, and other types of construction projects.

Construction manager is the key manager of the construction company. Organizes, manages and coordinates construction work and other activities on the

[7] WIGMORE, I., 2018. *Business Plan.* [online] published , August, 2018 [cited March, 2023]. Available at: https://www.techtarget.com/whatis/definition/business-plan
[8] Law No. 513/1991 Coll. Commercial Code, as amended, § 27.
[9] STN 73 0001 Terminology of Eurocodes.

construction site and on the construction site and keeps records of them in the construction diary.[10]

Construction work is a general term denoting any result of construction and assembly activities, including built-in materials, products, semi-finished products, machines, and equipment.[11]

Economics is a science about how society uses rare, natural, and artificial resources to produce useful goods and how it divides them between different groups of people or individuals,

- examines the activities involved in the production (supply) and the exchange of goods and services,
- analyzes the overall movement in the economy - the development of prices, production, and unemployment,
- is the science of trade between countries,
- is the science of money, banks, capital, and wealth,
- is the science of choice - the use of resources and their distribution.[12]

Enterprise is a large-scale organization with a composite structure. Enterprise companies often have multiple divisions, each with its specialized function. For instance, a multinational corporation may have a marketing department, manufacturing infrastructure, legal team, and resources for launching new projects.[13]

Entrepreneur according to the Commercial Code is (§ 2):

a) a person registered in the commercial register,

b) a person who does business based on a trade license,

c) a person who does business based on a license other than a trade license according to special regulations,

[10] KOZLOVSKÁ, M., HYBEN, I., 2015. *Construction Manager. New Challenges and Realities.* Bratislava: EUROSTAV, Ltd. 2015. 288 pp. ISBN 978-80-89228-43-0.
[11] Law No. 201/2022 Coll. Construction Law, § 10. Available at: https://www.zakonypreludi.sk/zz/2022-201
[12] SAMUELSON, A.P. – NORDHAUS, D.W. 2013. *Economics*. Praha: NS Svoboda, 19th Edition. 2013, p. 23, ISBN 978-80-205-0629-0.
[13] HITCHCOCK, J., 2023. *What is an Enterprise.* [online] published , 2021 [cited March 2023]. Available at: https://www.shopify.com/blog/what-is-an-enterprise

d) a natural person who carries out agricultural production and is registered in accordance with a special regulation.[14]

Entrepreneurship is a process in which an individual or group, based on organized effort and resources, seeks and exploits opportunities for value creation and growth, through the fulfillment of innovation and exclusivity, regardless of the resources managed so far.

Three aspects are important when defining a business. The first of them is the use of opportunities. The second important aspect of business is innovation. Business is change, revolution, transformation, and new approaches. The third aspect of business is growth.[15]

Entrepreneurship is defined as continuous activity carried out independently by an entrepreneur in his own name and on his own responsibility for the purpose of making a profit.[16]

Investment process is the process of procuring a new or reconstruction, restoration of an existing construction work.

Legal entities that have the capacity to have rights and obligations.

The legal entities are:

- associations of natural or legal people,
- special purpose property associations,
- territorial self-government units,
- other entities that are stipulated by law.[17]

A written contract or memorandum of association is required for the establishment of a legal entity unless a special law provides otherwise.

Legal entities are created on the day they are registered in the commercial or other register determined by law unless a special law provides for their creation otherwise (§ 19 of the Civil Code).

[14] Law No. 513/1991 Coll. Commercial Code, as amended, § 2.
[15] ROBBINS, P. S., COULTER, M., 2004. *Management.* Prague: Grada Publishing, 2004, p. 57, ISBN 80-247-0495-1.
[16] Law No. 513/1991 Coll. Commercial Code, as amended, § 2.
[17] Law No. 40/1964 Coll. Civil Code, as amended, § 18

Legal acts of a legal entity in all matters are performed by those who are authorized to do so by the contract establishing the legal entity, the charter, or the law (statutory bodies), (Section 20 of the Civil Code).

Linear building is a building that forms a continuous structurally and operationally uninterrupted line. Separate building connections are not line buildings.[18]

Management is defined as the practice of enabling groups of people with different knowledge, skills, and backgrounds to work together toward a common goal. This goal is often the company's mission that either you or a higher-up is responsible for creating.[19]

Manager is a professional management person who coordinates human, financial, physical and information resources, performs functions (planning, organizing, leading, controlling), makes decisions and supervises at least one or more people. The mission of managers is to achieve profit and profit through effective management.[20]

Management and administration of the company - the relationship between shareholders, statutory bodies, top management, and other financial groups (creditors, banks, holders of bonds, bonds, etc.).[21]

Natural persons whose rights and obligations arise at birth and cease at death. They are capable of legal actions.[22]

Non-residential building is a building that is not a residential building. If a part of a non-residential building is used for housing, the requirements for a residential building apply to this part of the building.

Reserved structure is a building or engineering structure that is technologically demanding or structurally unusual, which, from the point of view of the scope of construction work and the technology of construction work and the construction

[18] Law No. 201/2022 Coll. Construction Law, § 2. Available at: https://www.zakonypreludi.sk/zz/2022-201
[19] DOLL, K., 2023. *Peter Drucker's Definition of Management.* [online] published , Oct 23, 2023 [cited March 8, 2024]. Available at: https://www.shortform.com/blog/peter-drucker-management/
[20] MARCELKA, M., 2019. *Personal Responsibility of the Manager.* [online] published February 2019, [cited September, 2024]. Available at: Osobná zodpovednosť manažéra - EuroEkonóm.sk
[21] VEBER, J. et al., 2014. *Management. Basics, Modern Managerial Approaches, Performance and Prosperity.* Prague: Management Press, 2014, p. 119, ISBN 978-80-7261-274-1 (978-80-7261-200-0).
[22] Law No. 40/1964 Coll. Civil Code, as amended, § 7,8

products used, places increased demands on the organization of construction, on the coordination of construction activities and on the necessary technical equipment of the construction contractor. The list of reserved buildings is given in Annex No. 4.

Residential building is a building in which more than half of the floor area of all floors is designated and suitable for permanent residence. A residential building is also a family house intended for permanent residence, which has a maximum of three apartments, two above-ground floors and one lower floor. A residential building is also an apartment building intended for permanent residence consisting of four or more apartments.

Simple building is a building or building structure that, even as main buildings, does not have a significant impact on its surroundings. The list of simple constructions is given in Annex No. 3.

Small building is a construction, construction and related minor construction work, or its alteration, which as a rule fulfill a supplementary function to the main building and cannot significantly affect its surroundings. The list of minor constructions and minor construction works is given in Annex No. 2.

Subject of business is important because without being registered in the commercial, trade or other register, it is not possible to do business in it. Therefore, it is necessary to carefully consider its choice. The most important thing when choosing a business subject is to think about what the entrepreneur wants to do.

Temporary structure is a structure whose duration is limited by its purpose or duration.

1.5 CONSTRUCTION ENTERPRISE

The basic characteristics of a company are ***economic and legal independence***, with the help of which the company appears on the market independently, creates mutual relations with other business entities and at the same time becomes the bearer of rights and obligations regarding contractual relations.

1.5.1 Basic Functions of Construction Company

All businesses perform several functions during their existence:

- business function (making a profit),
- production, implementation, function (main activity – construction, production),
- economic function (effective management of company resources),
- technical function (investments and innovations in the company),
- social function (social level of the company),
- environmental function (creation and protection of the environment),
- organizational function (organizing all resources, activities).

1.5.2 Characteristics of Construction Enterprise

Economic independence represents the independent performance of a company in the market environment, without state intervention.

Legal personality allows the company to be the bearer of rights and obligations in the field of contractual relations.

A business in a market economy is based on the following principles:

- on the principle of private ownership – the owner reserves the right to participate in the management of the company directly or indirectly,
- based on the principle of autonomy – freedom and independence of the enterprise. activities managed by market relations without directive interventions of the state,
- on the principle of profitability – the necessity of achieving profit because of business activity.

Specific features of construction production

In the procurement phase:

√ construction procurement is financially, organizationally, and time-consuming,

√ before the start of construction and after its completion, the building is subject to approval procedures.

In the construction preparation phase:

√ both the design and implementation of the building are done on an individual order,

√ offers for the design and implementation of the construction are submitted by several designers, contractors,

√ each proposal must go through a special approval process before construction (production) begins,

√ the design can be changed even during construction.

In the construction phase:

√ every building is unique, unrepeatable, and unique work,

√ construction is carried out for a customer known in advance,

√ bids for construction are submitted by several contractors,

√ the building has a stationary character, it is tied to a specific space,

√ many workers from various professions participate in the implementation of the construction,

√ the implementation of the main construction works is exposed to climatic influences,

√ the production capacities of enterprises are often needed on several construction sites (contracts) at the same time,

√ relatively long period of production - implementation of construction,

√ prior to use of the building, a permit procedure must take place.[23]

1.5.3 Construction Company of its Surroundings

The enterprise always exists in a certain time and space reality. Spatial reality, these are the elements of the environment that surround it and with which the company has mutual ties, it is made up of the *micro-environment* and the *macro-environment*.

The microenvironment consists of all participants in the investment process, including customers, competitors, and the public.

The macro environment represents:

► demographic environment – important demographic trends, changes in the age structure of the population, changes in the educational structure, in the working status,

► economic environment – mainly created by the purchasing power of the company and the structure of its expenses based on the economic potential of the country,

► natural environment – mainly represent natural resources,

[23] Adapted from MESÁROŠ, P., MANDIČÁK, T., 2015. *Construction Economics.* Košice: University of Technology, Košice, p. 63 - 64, ITMS 26110230093.

► technological environment – significantly affects the position of the company. It is mainly created by new technologies, new market opportunities, new products,
► political environment – enforced through law. It is created by laws, legislation that regulates business activities, the competitive environment of businesses, consumer protection, ecological behavior of businesses,
► cultural environment – it is created by the basic values of society, hobbies and attitudes, educational and cultural level of the population.

1.5.4 Legal Forms of Enterprises

The basic legal forms of businesses in the Slovak Republic include:
► Individual business and trade
► Limited liability company
► Joint-stock company
► Cooperative
► State enterprise, association, joint venture

1.5.5 Classification of Enterprises

The most common criteria we use when classifying businesses are:
■ the nature of the resulting business activity,
■ economic sector,
■ technical and organizational characteristics of the company,
■ company size (micro, small, medium, and large companies),
■ business ownership (private, state, mixed),
■ legal form of the company.[24]

1.5.6 Life Cycle of a Construction Enterprise

The life cycle of an enterprise is the period from its creation to its demise. It consists of several defined phases. The company goes through them, but it doesn't have to go through all of them.
The existence of a company as a business entity is limited in time by the start and end of its business activity.

[24] Available at: http://www.euroekonom.sk/ekonomia/podnik-a-podnikanie/#_ftn1

The stages of the business life cycle are:

1. Establishment and creation - business plan
2. Growth – growth phase
3. Stabilization phase
4. Crisis – critical phase
5. Extinction – phase of extinction

❶ ***A business plan*** is a simplified company strategy. Its aim is to:

● Analyze the initial state in the field of business.

● Clarify the further development process.

● Prove that the assumed business goals can be realized.

● Convince potential future investors that their capital investments are effective evaluate.

● It is prepared before a bank institution for the purpose of obtaining a subsidy or acquisition of capital participation.

● Create an image for customers.

The business plan should be supported by the founding budget.

The phase of establishing a business is the phase of the decision-making process, when it is decided about the amount of capital, the distribution of business risk, the tax burden, whether the owner will participate in the management of the company.

❷ ***Phase of business growth***

Business growth can have a twofold nature:

- internal growth - this is the increasingly effective use of production factors that the entrepreneur acquired and invested in the company when the company was founded,
- external growth - is growth caused either using external (foreign) financial resources, or external assets that merge with the company's assets (merger).

❸ ***Phase of stabilizing the company***

A prosperous construction company in the stabilization phase implements several measures to prevent the transition to the crisis phase. Part of these measures is a constant analysis of the company's position compared to the competition. It is an analysis of what has been achieved:

● the market environment and predictions of its development in comparison with the competition.

● economic results, through indicators of economy, labor productivity, profitability and others compared to the competition,
● other factors that are a manifestation of strengths and weaknesses, opportunities and threats compared to the competition (e.g. quality, prices, and others).

❹ ***Critical phase of the enterprise***

Business crisis management is such a management process that crisis management implements not only in the crisis phase, but also in the phase of extinction. It consists of the following sets of activities:
● diagnosis of the state of the enterprise,
● measures in case of an advancing crisis.
● preventive liquidation,
● settlement or bankruptcy.

Consolidation of the company is the rescue of the company based on a developed program. In principle, the business is preserved in terms of business object, scope, and organizational structure. The management of the company, the style of management work, control methods are often changed, and savings measures are sought to improve efficiency.

Rehabilitation of the company is a more demanding rescue of a company that is mostly in a deep crisis. Only the "healthy core" that does not produce a loss remains from the enterprise.

❺ ***Phase of the company's demise***

A business may be dissolved:
● transformation (change of legal form, settlement),
● fusion,
● liquidation (Law on Bankruptcy and Liquidation).

Bankruptcy - occurs when the debtor is in financial bankruptcy, has creditors and is unable to fulfill his obligations for a long time. The goal of bankruptcy is to achieve proportional satisfaction of creditors from the bankrupt's property. Bankruptcy can only be declared if there is such a bankruptcy substance that is sufficient at least to pay the court proceedings.

Settlement - if the court's scheduling order has not yet been issued, the bankrupt can present to the court a proposal for what settlement he offers to his creditors.

A list of all creditors and their claims, as well as a list of their assets, shall be attached to the settlement proposal.

Bankruptcy trustee – if the company is declared bankrupt, the bankrupt loses the right to freely dispose of the property, the authority to dispose of the property passes to the bankruptcy trustee.

Liquidation

Liquidator – he is appointed by the court or the statutory body of the company in the case when the bankruptcy is carried out by liquidation.[25]

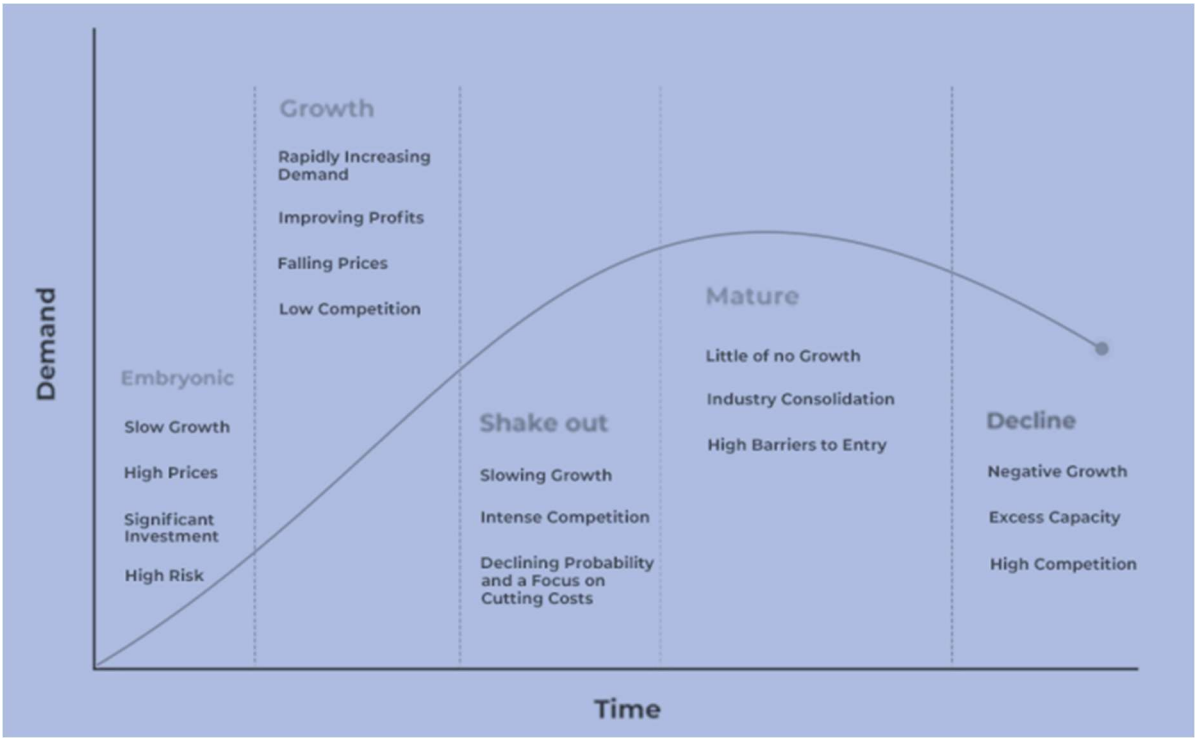

Figure 2 Industry Life - Cycle Model.[26]

1.6 START UP

Startup is a term denoting a newly emerging project or a starting company - often still in the phase of creating a business plan.

There is no universally valid definition of start-up. The European Association of Private Equity and Venture Capital (EVCA) defines a start-up as a company that is

[25] Available at: http://www.euroekonom.sk/ekonomia/podnik-a-podnikanie/zivotny-cyklus-podniku/
[26] Industry Life Cycle Model. [online] published Sep 27, 2019 [cited Nov 10, 2021]. Available at: https://analystprep.com/cfa-level-1-exam/equity/industry-life-cycle-models/

in the process of starting a business or shortly after starting a business but has not yet achieved sales. The main disadvantage of this view is that the above definition lumps together sophisticated innovative firms that have an above-average potential to become one of the key organizations within the domestic economy, together with ordinary start-ups that never exceed the boundaries of a small local business.

Also, for this reason, in professional literature, several authors are inclined to single out start-ups from the group of all start-ups.
To support this specific group of businesses, the Ministry of Finance of the Slovak Republic came up with its own definition, which should distinguish start-ups from ordinary start-ups. According to it, a start-up is a capital trading company with its registered office in the territory of the Slovak Republic, since its establishment no more than 36 months have passed and at the same time:
• was created for the purpose of creating an innovative product or service,
• is a micro, small or medium-sized enterprise,
• it is characterized by the fact that most voting rights belong to natural persons who are its founders.
A start-up project can appear in any sector, but most often it is still technological or IT companies.
Examples of the most successful start-ups: Apple Inc., Google, Inc., Microsoft Corporation, Amazon.com, Inc., Facebook.

1.6.1 Characteristic Features of a Startup

Based on the above, we can summarize the typical characteristics of a start-up:
• it is no longer just about a business idea – the founders are preparing real steps related to entering the market,
• the start-up offers a new (innovative or innovative) product or service, while this product has not yet been tested on the market (and thus the risk of failure is very high),
• rapid growth is expected after entering the market,
• the start-up applies to a scalable business model,
• has international/global ambitions.

In the startup world, companies are emerging to make the lives of AEC (Architecture, Engineering, and Construction) professionals easier by improving job site safety, streamlining project communication, opening job access, and more. From BIM management platforms like bimspot and Plannerly to job marketplaces like Faber Connect and Trade Hounds to other construction management platforms, these companies aim to rework manual processes and eliminate sources of inefficiency.

Business owners need to understand what stage their startup is at, as well as what tasks at that stage they need to accomplish to stay motivated and focused. No startup is the same as any other, just as plants are not the same. A startup may be a spike of wheat, or it may be a huge oak tree. It all depends on you. The main thing is to grow it strong and stable. In any case, at each startup stage of product life cycle, you should pay special attention to your customers because they are the most valuable thing you have.

The fusion of construction and technology is redefining the industry landscape, opening doors to unprecedented efficiency, safety, and cost-effectiveness.
With innovators and startups leading the way, embracing technological solutions is no longer optional - it's essential for survival in this fast-paced and competitive environment. As the industry continues to evolve, keeping an eye on the innovative companies and emerging technologies will be crucial for anyone serious about the future of construction.[27]

1.7 BUSINESS PLAN

Business plan is a document that conveys the first and most important picture of the company. It maps and analyzes the entire period from the intention to start a business to the period when the invested funds start to be returned to the entrepreneur.
The business plan describes all key external and internal factors related to the establishment and operation of the business.[28]

[27] Most Innovative Construction Tech Companies and Startups. [online] published Sep 5, 2023 [cited November 10, 2024]. Available at: https://www.linkedin.com/pulse/20-most-innovative-construction-tech-companies-startups-echo-global
[28] Available at: https://sk.wikipedia.org/wiki/Podnikate%C4%BEsk%C3%BD_pl%C3%A1n

1.7.1 Importance of Business Plan

● provides all essential information about the company, product, marketing activities, production, personnel, costs, revenues, economic results,
● enables better decisions to be made in the future,
● ensure control of the achievement of set goals,
● has to convince:
  a) investors (return on investment, profitability of the company, survival, success of the company),
  b) banking, financial institutions, people who lend money (cash flow),
  c) company management (methods used in developing the plan, location operations, set goals, pricing, expected economic results, ...).

1.7.2 Use of Business Plan

An entrepreneur develops a business plan for himself, to successfully establish himself on the market, or for investors and to obtain a loan. A business plan is a document that captures a long period of time, so when creating it, we must take into account risks that may be sectoral or economic. Among the most significant industry risks are competition, seasonality, or others depending on the industry. Among the most significant economic risks, we include political factors, the economic stability of the country, the development of inflation, interest rates, foreign currency exchange rates, business legislation, tax policy, export and import policy. The riskiest is a start-up business, less risky are new activities in an existing, well-functioning business.
● for the presentation of the company, in the event of the need to obtain funds, either in the form of a loan or in the form of obtaining capital from potential investors,
● the entrepreneur prepares it for himself, for successful establishment on the market (for example, before starting a business),
● serves as a control tool after the start of operation.

1.7.3 Functions of Business Plan

1. It must prove to the future entrepreneur the reality or unreality of the realization of his intention, if the set conditions are met.

2. The entrepreneur obtains information about the required amount of working capital, the amount of costs (expenses), revenues (income), business efficiency, etc.
3. It is the basis for obtaining a loan or support from various support programs, or from the so-called a silent companion.
4. It is a tool for control and management of business activity, whether the intentions in the business plan are being fulfilled and it allows to analyze the reasons for possible deviations.

1.7.4 Recommended Structure

Even though there is no ideal model for processing a business plan, it should primarily contain an introduction to the company (legal form, purpose of establishment, origin of capital, organizational and management structure, etc.), an introduction to the subject of the company's activity, defining the market on which the company wants to operate, financial plans. When developing a business plan, it is recommended to use the following structure:

1. Content
2. Summary
3. Company characteristics (general description of the organization)
4. Product characteristics (products and services)
5. Industry and greening
6. Marketing (market analysis and turnover forecast)
7. Production
8. Business management, human resources (key personalities)
9. Financial plan (financial data)
10. Annexes - increase the credibility of the plan, contain graphs, tables, auxiliary calculations, descriptions, diagrams, maps, etc.

The business plan must demonstrate:

► an adequate market for the given business,
► management's ability to manage the future business,
► the quality and excellence of products and services,
► justified financing considering the requirements.

1.7.5 Development of Business Plan

Certain requirements are placed on the business plan, compliance with which is a sign of its quality and professional processing. It is mainly:

● scope of the plan, most often 40-50 pages, appendices in the range of 50-100 pages (the appendices should contain detailed calculations, graphs, tables, pictures, contracts, and other supplementary materials. The appendices are very important, because whoever does not know the company, unsubstantiated information may discourage them),

● simplicity,

● present the advantages and uniqueness of the provided goods, products, services,

● credibility and reality of the plan,

● do not hide weaknesses, but also draw attention to the strengths of the plan, product, and company,

● demonstrate the ability to pay interest and loan repayments,

● the business plan is a document that represents the company, so it is necessary to pay attention to the high-quality processing of the formal aspects of the plan.[29]

A business plan is not a document that you quickly write in a few minutes and then put away. You should treat it as a "living" document that evolves with the business environment. A successful business must always adapt to changing market conditions and customer behavior.

Once you have a plan, be sure to come back to it regularly and revise it if necessary. If you have a high-quality team of people around you, brainstorming together (for example, every 3 months) can not only bring you great ideas on how to best realize the vision, but can also help you figure out what doesn't work at all and what doesn't make sense to spend your time, energy, or money on.

1.7.6 Example of Business Plans

An example of a business plan that follows this sample template:

1. Executive summary

[29] Adapted from: KORÁB, V. -- REŽŇÁKOVÁ, M. -- PETERKA, J., 2008. *Business Plan.* Brno: Computer Press, s. c., 216 pp., ISBN 978-80-251-1605-0.

An introductory overview of your business.

An executive summary is a pared down version of a longer document, the tl;dr of the business world. Executive summaries often accompany reporting documents, though there are other contexts where you might need one (e.g., press releases). Although all executive summaries provide highlights of a succeeding idea, presentation, or thought, it takes tact and a bit of strategy to write a persuasive executive summary—one that wins interest and support from the very first line.

2. Company description

A more in-depth and detailed description of your business and why it exists.

You might repurpose your company description elsewhere, like on your about page, social media profile pages, or other properties that require a boilerplate description of your business.

3. Market analysis

Research-based information about industry and your target market.

The market analysis consists of research into supply and demand, your target market, industry trends, and the competitive landscape. You might run a SWOT analysis and include that in your business plan.

You'll also want to do a competitive analysis as part of the market research component of your business plan. This will tell you who you're up against and give you ideas on how to differentiate your brand.

4. Products and services

What do you plan to offer in exchange for money.

This section of your business plan describes your offerings—which products and services do you sell to your customers.

5. Marketing plan

The promotional strategy to introduce your business to the world and drive sales.

It's always a good idea to develop a marketing plan before you launch your business. Your marketing plan shows how you'll get the word out about your business, and it's an essential component of your business plan as well.

6. Logistics and operations plan

Everything that happens in the background to make your business function properly.

7. Financial plan

A breakdown of your numbers to show what you need to get started as well as to prove viability of profitability.
The financial plan provides a breakdown of sales, revenue, profit, expenses, and other relevant financial metrics related to funding and profiting from your business.[30]

1.8 SUCCESSFUL CONSTRUCTION BUSINESS MODELS

A business model answers the question: What business are you in? It provides the goal and structure for your business. It's one of the first decisions you need to make when starting a business, as it informs the market, audience, and messages of your marketing efforts. It also determines how you conduct your business, where it's located, your staffing needs, and the amount of financing you'll need. This is essentially the business model for construction company.

1. General construction services
2. Niche construction services
3. Production and manufacturing
4. Suppliers
5.

One company can have multiple business plans that they are pursuing at the same time. Generally, larger companies have the resources, both financial and workforce, to provide multiple business models and work towards business model innovation. A small construction company should start out focusing on just one until they have developed a market share and have seen success.
General contractors are an example of companies that provide general construction industry services. They may focus on appealing to specific sectors of the market, like only residential construction, or may focus on a specific area within the construction sector, like renovation.

Contractors provide specific construction services that require licensing or special knowledge or training.

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[30] SHEEHAN, A., 2021. *The Top 7 Business Plan Examples To Inspire Your Own (2022).* [online] published Aug. 13, 2021 [cited November 10, 2021]. Available at: https://www.shopify.com/blog/business-plan-examples

Production and manufacturing companies produce or fabricate materials used in construction projects. They can provide a wide range of standardized and custom products and materials. These types of companies are always in high demand.
Before starting one of these companies, research the products and materials that are in need in the local market. You may find a niche that you can fill with your knowledge and skills. These companies often need a lot of funding to get started.

Production and manufacturing companies produce or fabricate materials used in construction projects. They can provide a wide range of standardized and custom products and materials. These types of companies are always in high demand.

Suppliers don't produce or manufacture construction material but are responsible for selling and distributing products manufactured by others. These businesses can be brick and mortar establishments that serve the local market, or an e-commerce site that serves a larger market. Their customers include general contractors and trade contractors that use their materials.
Selecting a business model is one of the first steps to starting a new business. It determines who the business's customers are, which in turn affects the workers they hire and directs their marketing efforts. Contractors looking for work need to be clear about their marketing audience and where they can find them. This is the essence of a successful construction business.[31]

[31] Four Successful Construction Business Models. [online] published February 3, 2022 [cited April 10, 2023]. Available at: https://planhub.com/resources/four-successful-construction-business-models/

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WIGMORE, I., 2018. *Business Plan.* [online] published , Aug, 2018 [cited March 2023].
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2 GLOBAL CONSTRUCTION SECTOR

The global Engineering & Construction (E&C) industry should take a leading role in proposing that the global project management community combines their wisdom, intelligence, and resources to advance the role of project management in improving the state of the world, implementing positive global changes and in solving challenging global problems.

While most other industries have undergone tremendous changes over the last few decades and have reaped the benefits of process and product innovations, the Engineering & Construction sector has been hesitant about fully embracing the latest technological opportunities, and its labour productivity has stagnated accordingly. This unimpressive track record can be attributed to various internal and external challenges: the persistent fragmentation of the industry, inadequate collaboration with suppliers and contractors, the difficulties in recruiting a talented workforce, and insufficient knowledge transfer from project to project.

The construction sector is characterized by many small enterprises and high labor intensity; it is also highly dependent on public regulations and public investments. Thus, policymakers frequently use the sector as a trend indicator – a cyclical stabilizer of macro – economic trends, which are restricted in periods with economic expansion and stimulated in periods of recession.

The market situation for the construction sector is also changing. The ageing European population represents a challenge regarding recruitment. However, construction and renovation of houses and buildings in growing urban areas pose new demands and thus require the markets to develop. Growing awareness of sustainability leads to demands from private and public customers, and from public regulations at both national and EU levels. A greater awareness of health and safety.

Several factors will play a significant role in improving the sector's competitiveness in the future, such as the use of ICT in materials and buildings (intelligent buildings), for presentation internally and externally (visualisation), for communication with customers and among the partners within a construction

project, and for process control (monitoring and tagging activities, materials and equipment). In procurement as well as during the construction process the use of e-business improves information sharing and virtual collaboration.[32]

We expect global construction spend will reach $15.7 trillion in 2025, a 4.3% and 8.1% increase from a year before, boosted by nonresidential spend and a sustained recovery for residential construction.

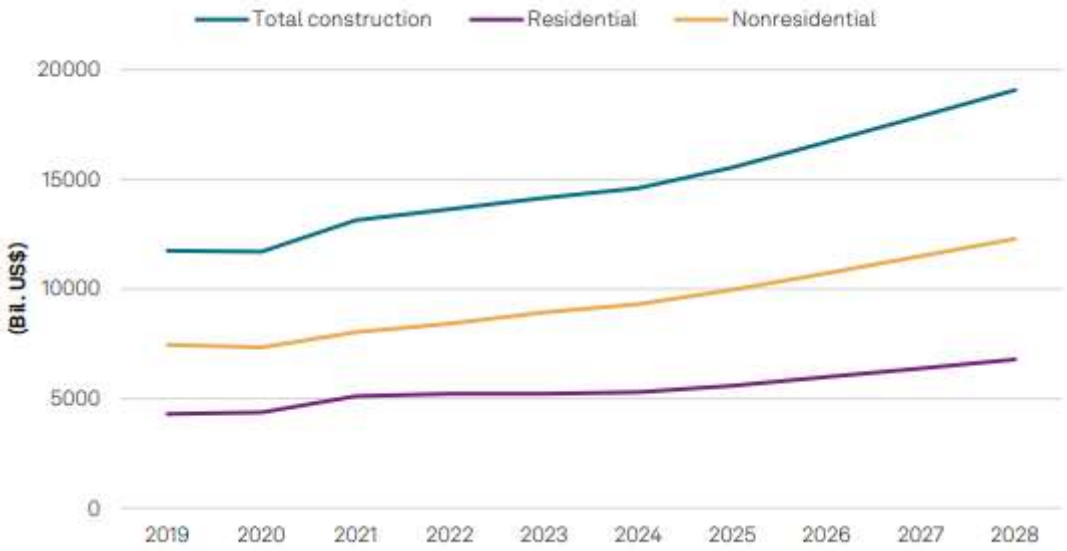

Figure 3 Nominal Global Construction Spend (bil.US$)[33]

Construction spend in North America is set to outpace the rest of the world in 2024 due to accelerating infrastructure spend, which we expect will maintain a positive trend. • In most other regions, we anticipate a modest but progressive growth, largely fueled by the civil and infrastructure segments.

The European construction outlook remains gloomy in 2024, especially in the Nordics, the U.K., and Germany, largely due to the contraction of residential building construction ahead of increased interest rates and households' reduced purchasing power. The drop in Italy in 2024 mainly reflects the reduction of

[32] European Foundation for the Improvement of Living and Working Conditions, 2005. *Trends and Drivers of Change in the European Construction Sector.* Mapping report, p.11. Available at: http://www.eurofound.eu.int
[33] HERNANDEZ, F., PANICHI, R., CHAN S., 2024. *Global Engineering and Construction. S&P Global.* [online] published July 24, 2024 [cited Oct 10, 2024]. Available at: https://www.spglobal.com/_assets/documents/ratings/research/101601659.pdf

generous tax grants that had fueled growth in the residential building renovation 2021-2023 (Fig. 4).

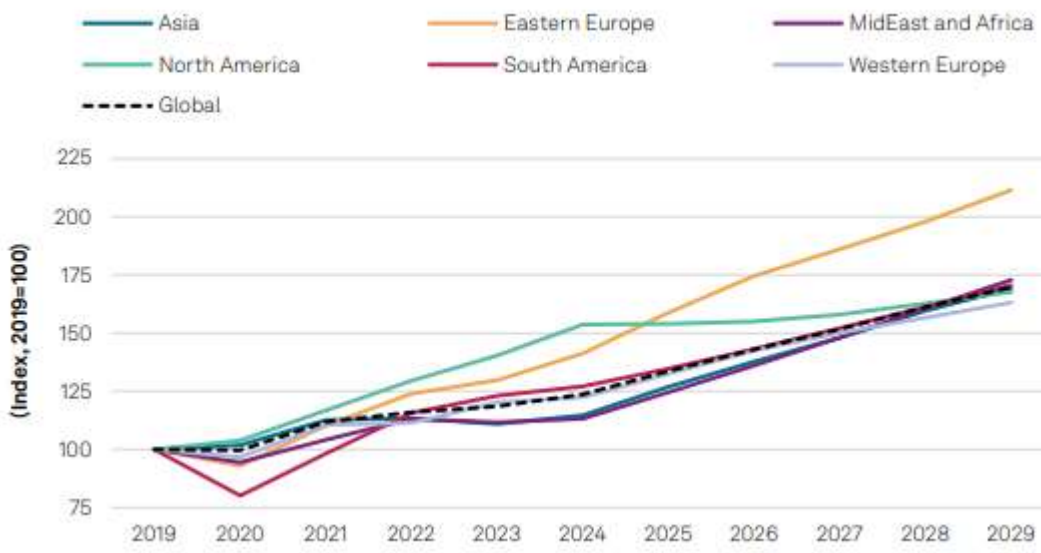

Figure 4 Construction Spend by Region[34]

2.1 SWOT ANALYSIS OF THE CONSTRUCTION SECTOR IN EU

The construction sector can be characterized also in the form of a SWOT analysis:

► ***Strengths***

• Increased focus on R&D among the large construction companies,

• growing specialization in many firms has created highly knowledgeable and competent companies within specific construction fields.

► ***Opportunities***

• Growth markets in new Member States, China, India and others;

• demographic changes leading to new markets developing;

• environmentally sustainable development, including waste management;

• off-site construction (pre-assembly);

• embedding ICT in construction products and processes to improve effi ciency and effectiveness;

• virtual prototyping for design, manufacture and operation ;

• new market segments in BOOT activities (Build-own-operate-transfer).

[34] HERNANDEZ, F., PANICHI, R., CHAN S., 2024. *Global Engineering and Construction. S&P Global.* [online] published July 24, 2024 [cited Oct 10, 2024]. Available at: https://www.spglobal.com/_assets/documents/ratings/research/101601659.pdf

► ***Weaknesses***

• Low productivity;

• weak industry image among customers and potential new workers;

• problems with health and safety in terms of accidents and physical strain on employees;

• problems with undeclared work;

• little interest in further education and training among small construction companies;

• low level of R&D investment among SME construction companies;

• SMEs lack marketing, ICT and management skills.

► ***Threats***

• Many European markets with stagnating growth, if any growth at all;

• increasingly globalised engineering sector where Japanese and US construction companies will enter certain European constructi on sectors;

• recruitment and retention of ageing workforce in some low-skilled professions;

• inter-European price-based competition represents a threat to employment in some EU countries.[35]

2.2 PRODUCTIVITY GROWTH

In the EU, productivity of the construction sector has been considerably lower than in the manufacturing sector in general over the last 10 years. This is related to the fact that the sector is very home-market oriented and less exposed to international competition. This, in turn, should increase the demand for higher productivity and thereby increase competitiveness. As most sector products are solid and difficult to move over long distances, exports consist primarily of knowledge or entire production processes (labour, materials, etc). Apart from civil engineering, there is very little international competition within most construction activities. This does, however, not exclude competition in domestic markets.

A more competitive domestic market driven by higher productivity levels is thus essential for the sector. Various factors impact on the sector's productivity level, such as the development and use of technology, increases in R&D investment as

[35] JANKOVICHOVÁ, E. et al., 2016. *Construction Economics I.* Brno: Tribun EU, 2016, ISBN 978-80-263-1129-4, p. 14.

well as public initiatives regarding procurement incentives and sector improvement programmes.

2.3 DEMOGRAPHIC DEVELOPMENT

In future, demographic development will play a key role driving development in the construction sector as well as in most other economic sectors in the EU. The ageing of the population represents a challenge for the sector regarding recruitment of labour. In addition, the construction sector suffers of a relatively poor image in large parts of Europe since the work is hard and physically demanding, but not well paid. This is also documented by a poor occupational safety and health (OSH) record (European Agency for Safety and Health at Work, 2004), and research indicating a great deal of monotonous tasks and a perception of health or safety being at risk because of the work situation.

Recruitment of qualified labour will become critical for the construction sector, with a declining number of young people and higher job specialisation. Various strategies exist to recruit qualified labour, such as improving career development opportunities and job security and health and safety in the workplace.

The social partners at EU and national levels also consider initiatives to improve working conditions, to enhance the sector's image and attract potential workers to the sector. Health and safety is a central topic in this context, as the construction sector has a high rate of accidents and health problems compared to other sectors. According to the third European survey on working conditions, a total of 43 % of construction workers think their health and safety is at risk because of their work; this is the highest level of all sectors.

2.3.1 Demographic Changes and New Market Opportunities

The ageing of the population involves changing needs in the housing sector, which cannot be met solely by new construction activities, but also require the renewal of existing buildings. Structural requirements of the population must be considered (doors that open in a different direction, location of light switches, differences in heights, etc) as well as services targeted at senior citizens living in their homes (cleaning services, nursing, etc). These requirements concern the residents as well as their surroundings. In addition, the busy lives that people lead today, and an

increasing awareness of energy costs are driving forces to build more intelligently in the future. For example, buildings that can be pre-programmed or reprogrammed remotely, and are able to detect and turn off excess use of energy, are likely to be developed in the future. This development will require additional skills among workers in all phases of the construction process in relation to building management systems, networks, and electronics.

2.3.2 Transfer of Company Ownership to Younger Generation

Part of the challenge of the ageing population is the transfer of company ownership to the younger generation. This is a general problem for business and industry and challenges particularly the construction sector, consisting of large
number of small, family-owned companies, as is the case especially in the completion/building sub-sector. Companies must tackle this issue as well as national governments since the fiscal legislation is in their domain. If ownership transfer is not handled properly, a few small, family-owned companies could close when the owner retires.
This could change the sector's company structure, leading to a higher rate of one-man companies or medium and large companies with ownership structures other than family/private ownership.

2.4 NEW MARKETS IN THE EUROPIEN UNION

EU enlargement opens new markets and new competition from the construction sector in the new Member States.
Considering the expected high growth rates and subsequent need for new infrastructure and urban development in the new Member States, a new market appears to be opening for the highly specialised and large civil engineering companies.

To some extent, the competition of construction companies or labour from the new Member States put a downward pressure on employment and wages for local labour. This could lead to a higher unemployment rate among the local workforce due to social dumping, involving the export of labour from a country with weak or poorly enforced labour standards. To what extent this will happen depends on the work of local actors in organising employers and employees under the general

national conditions (or enforcing the workers directive posted). The higher level of competition in national markets may lower the prices for construction work and benefit large companies, which could use low-cost companies from the new Member States as sub-contractors.

2.4.1 Movement of Labour

There is already a certain amount of labour from the new Member States working in the EU15 construction sector. The number of incoming workers varies from country to country with a tendency of influx being high between border countries. The number of workers is still limited because of the transitional schemes in various EU15 countries that regulate (and restrict) the possibilities for east European labour to enter EU15 labour markets.

The movement of labour should also be considered in the light of possible recruitment difficulties for the sector in the future, not least because of the ageing population in most parts of Europe. The consequences for the movement of labour depend on how the sector acts in the process. Social dumping can be diminished if the social partners (often the trade unions) ensure that workers are covered by national collective agreements and that foreign companies accept these agreements.
In countries where union penetration in the construction sector is weak, as is the case in many of the new member countries, this will be a difficult process. Apart from Slovakia, where a national agreement for the sector covers working conditions for about 70% of the workforce, most other new member countries only cover a low percentage of the workforce that is regulated by collective agreements.

2.4.2 Enlargement of Market

In terms of the EU construction sector in general, enlargement opens new markets as the accession countries will need major investment in infrastructure, energy, manufacturing, and processing. According to the European Construction Industry Federation (FIEC), the sector sees this as an important consequence of enlargement. This may also encourage an influx of labour and contractors from the old to the new Member States. It is emphasised that due to the nature of construction enterprises in the old Member States, they are likely to bring in

management facilitation and, to some extent, high-value materials, and highly specialised workers/sub-contractors while local main and sub-contractors will undertake most of the building and completion activities. In addition, most of the building materials will be sourced locally.

The European Construction Institute (ECI), which has some of the largest contractors based in Europe as members, emphasises, however, that the low productivity of the construction sector can have a negative impact on growth and subsequently on investments in building and construction in the new Member States.

2.5 NEW CONSTRUCTION TECHNOLOGIES

Technological development drives change in the construction sector as research and development leads to innovation and new technologies. However, the pace at which these developments are integrated and implemented in the sector, particularly among the smaller companies, is very slow. The main barriers to unfolding the potential of these technological developments are awareness, knowledge, competencies among construction companies and incentives.

2.5.1 European Technological Platform for Construction

As part of the general policy on research, the European Research Advisory Board recommends the establishment of European technological platforms. These platforms cover the following aspects: development of a shared long-term vision by representatives of public and private stakeholders; creation of a coherent, dynamic strategy to achieve this vision; a leading role for industry, as part of a partnership to include research and financial communities, public authorities, users, and representatives of civil society.

The platform for construction embraces the following themes:

1. *"smart construction"* which is based on applying innovative and cutting-edge technologies in construction projects, as well as research results in new construction products and processes, etc.
2. *"building the future"* which sets out the visions for a future European construction sector as a key element in achieving the Lisbon objectives – a

knowledge-based economy, sustainable development and environment, a high quality of life for all, employment, international competitiveness, safety.
3. *"strategies for innovation"* which represents the e-Core strategy for European construction research together with other strategies for related sectors and sub-sectors.
4. *"strategic alliances"* which addresses new mechanisms and groupings to create a European research area in the built environment, brought about by new procurement processes, ICT systems that link all partners in a project, alliances to create sustainable construction, etc.

2.5.2 Use of ICT in Construction

Information and communication technologies (ICT) influence the construction process in various ways, for instance by embedding ICT in 'smart' materials/construction products and by offering new ways of interaction and coordination in trade, construction process and monitoring of materials.

R&D and innovation in intelligent materials, constructions and buildings will be a major source for future competitive advantage for construction enterprises. Buildings that will automatically adjust to various external changes and allow occupants to customise them to individual preferences (change of wall colour, art, etc.) and materials, components and systems that communicate with each other to optimise their use, are likely to become an everyday need in the future as ICT becomes embedded in everything.

E-solutions will lead to a more open procurement process expected to result in increased competition. E-procurement can further assist the process of more elaborate procurements and thus a higher level of precision in the procurement process.

In the construction process, e-technologies enable openness and involvement of various actors, such as customers, the main contractors, sub-contractors and others. The openness of the processes includes online access to documents, specifications, etc, as well as online communication and interaction between the actors, such as designers, customers, and contractors in the design process, in

planning and management of the building process, etc. Several tools are available, but use of ICT is spread differently among the actors.
Virtual reality (VR) and simulation technologies used for visualisation support digital communication during the construction process, and of the expected results to customers and occupants. Visualisation of construction projects allows customers and users to get a look and feel for the construction before it is built. During the construction process, designs can be improved, and clashes and inconsistencies can be examined and eliminated. Furthermore, these technologies improve cooperation as non-technical staff and end-users can understand the project in a better way than simply looking at drawings and designs.

To monitor activities, materials, or equipment, or to optimise their use, mobile devices and tagging technology is used in various ways. For construction companies with various construction sites, it is a challenge to monitor the actual localisation of materials and equipment. Building workers are known to spend much time searching building sites for equipment and materials. Technology also helps to monitor the actual workplace and employees within building maintenance.

2.5.3 Building Information Modelling

FIEC (EUROPEAN CONSTRUCTION INDUSTRY FEDERATION) saw a growing interest among EU members in this topic, which hitherto has been associated with national construction markets in the Nordic countries and the UK. The European construction sector looks to be braced for a revolution, but BIM is not without controversy, and it has its share of sceptics. Nevertheless, CEN took the first steps towards standardisation in 2013, establishing a Working Group on BIM. FIEC will participate in this group.[36]

2.5.4 Energy and Climate Change

Another emerging topic dominating discussions in the EU institutions in 2013, in the policy areas of sustainability, energy and resource efficiency and climate change, was that of Smart and Sustainable Cities and Communities.

[36] FIEC Available at: http://www.fiec.eu/, p. 45

The major policy development in this area in 2013 related to the climate and energy framework 2030. FIEC responded to the Commission's consultation amid concerns that the EU's 20-20-20 targets will be missed. (20% reduction in greenhouse gas emissions from 1990 levels, 20% increase in energy consumption from renewable sources and 20% improvement in the EU's energy efficiency.)[37]

2.5.5 E-Business

There is an ongoing process to develop and elaborate norms and standards at EU and international level within the construction material sector, driven by the international community and political institutions.
This process is an important driver to further open the European and international markets for construction materials. It also encourages the use of e-business in terms of B2B (business-to-business).

Doing business electronically helps to streamline processes and acquire new clients, as already experienced by large construction companies.

Goods, in particular tools, and services are increasingly being procured online, through e-auctions, electronic catalogues, and e-tendering. E-business brings new challenges and opportunities to the businesses operating in the construction sector. They need to be aware of various issues, such as legal ones, that arise from communicating electronically. However, benefits are extensive, and it helps to avoid common difficulties in tendering for, ordering, planning, and organising construction projects. In this respect, companies save costs when using e-business successfully.
There is a need to improve the information quality and structure, which must be done collaboratively to gain wider acceptance. Some initiatives are under way, but the process should be accelerated, so that large and small as well as geographically disadvantaged participants in the construction industry can quickly harness current ICT developments. This will enable companies to 'work apart together' in a more integrated manner and to deliver the type of benefits enjoyed by the financial, insurance, retail, and certain manufacturing sectors. However, the construction

[37] FIEC Available at: http://www.fiec.eu/, p. 47

sector may experience similar difficulties as these sectors, including restructuring, human and social turmoil, if it is not prepared to face such developments.

2.5.6 Industrialisation and Prefabrication of the Construction Process

Use of industrial robots and automation technology in off-site manufacturing as well as material manufacturing is likely to be a driver of change in the construction process. This will introduce more prefabricated materials and preassembled parts in construction. Increased use of off-site manufacturing furthers the industrialisation of the construction process.

By preassembling parts of buildings or constructions (or even whole constructions), the construction process becomes more standardised and less dependent on weather conditions. This could speed up construction, improve quality, reduce waste (and waste control) and make constructions cheaper (Ong, 2004). However, this development also demands extensive coordination between the actors collaborating from different pre-assembling sites.

2.5.7 Environmentally Sustainable Developments

The importance of environmental sustainability will increase in the future, based on demand from customers, climate changes and legislative measures. Solutions are thus often based on combinations of construction and building design and new materials. This includes, for example, the use of passive heating and implementation of new technologies/materials, such as photovoltaic solar cells to generate electricity for heating and energy requirements in buildings. Operators in the construction sector need to upgrade continuously their knowledge of new designs, building methods and materials. In order to stay ahead of competitors, construction companies are obliged to innovate their own products and processes to support sustainable development.

Sustainability awareness is rising among public and private users of buildings and constructions. The sustainability trend spans the whole life cycle of a building. In the construction process, various aspects should be taken into consideration:

- re-using existing built assets
- designing for minimum waste
- minimising energy use throughout the life cycle

● avoiding pollution
● adding to biodiversity
● conserving water resources
● respecting people and communities.

2.6 BUILDING MATERIALS MARKETS

An important drive for market developments is the internationalisation and globalisation of the sector's activities:

◇ The market for construction materials is becoming increasingly internationalised and globalised. The impact varies from large civil engineering projects to building completion and maintenance sectors, where materials are often bought in very small quantities. Within these sub-sectors, effects will only show through a concentration of warehouses for construction materials.

◇ The internationalisation and globalisation of knowledge-intensive activities is particularly important for the civil engineering sub-sector. In the short term, the very intensive hands-on activities in construction will still rather be based on local labour.

◇ Only in the medium term will internationalisation, primarily in the form of EU enlargement, open for international competition within the most labour-intensive parts of construction – building completion.

2.6.1 Internationalisation of Markets for Building Materials

This driver is partly described in relation to the EU initiatives for certification for all products to be sold or traded on the European market, the CE marking. Internationalisation or globalisation will lead to decreasing material prices, which benefits larger enterprises that can purchase in bulk. Small construction companies will have to cooperate to command in bulk together, or charge customers a higher material price.

Large construction companies are already changing their purchasing behaviour from decentralised site-specific purchasing to centralised-bulk purchasing of

frequently needed building materials. This, however, is a lengthy process and requires substantial organisational changes and development to ultimately reduce material costs and gain in productivity.
Globalisation of the markets will help develop 'smart/intelligent' construction materials as costs can be shared across a broader market. This process might bring about the internationalisation of labour – engineers and, to a certain degree, highly specialised manual workers will be needed to drive these developments.

2.6.2 Knowledge-Intensive Services

The internationalisation of construction activities is primarily based on large companies which export management and planning concepts, and managerial and engineering labour. The manual labour, however, stays mainly local or regional and is therefore not exposed to internationalisation. Highly specialised construction functions and materials will to a certain extent pull manual work teams, for example, tunnel or bridge construction workers specialised in the use of equipment and the specific processes. The expanding EU internal market, strengthened by the proposed service directive, will boost the internationalisation of construction services in general.

2.6.3 Development of Supply Chain

The sectors should be able to innovate and deliver best value and satisfaction to its customers. This requires better coordination across the supply chain where suppliers as specialist contractors and component suppliers must play a more integrated role in the construction process.

Complex developments of the sector structure will continue. For larger companies, increasing customer demand – public and private, and public-private project-arrangements – will further consolidation of the sector. Companies require a broad range of qualifications, as well as a solid financial base to be able to interact with the customer to develop building solutions, including the construction and possibly also the management of the construction. To complement the fullservice consolidated companies, small, specialised suppliers will evolve. Their function will be to offer highly specialised and qualified services, which the large companies do not regard as one of their key competencies.

2.6.4 Financing of Construction Projects

In the years to come, new financial arrangements will develop. These include risk sharing between the constructor/operator and the customer, and PPP/BOOT (Private-Public Partnerships/Build-Own-Operate-Transfer).

Private-public partnerships (PPP) are a realtively new way of financing big construction projects. Many European countries use PPP, though in some places they are still at an experimental stage. In these partnerships, the private contractor will construct and run a certain facility, while the public institution rents the service for a few years. Subsequently the construction will be sold to the public sector under certain conditions (BOOT).

To participate in these arrangements the construction entities should be large in volume and financial terms or will have to build consortia with financial operators and arrange the management of the facility for the period of return of investment.

The PPP/BOOT projects concern typically large infrastructural projects; the construction of hospitals, prisons, educational institutions, etc, have also been financed through such partnerships. As these arrangements relate to large projects, this opportunity is mainly open to big companies that are main contractors on these projects. Consequently, the contracting company needs a very strong capital base, or build a permanent partnership with financial institutions, investors, or operational companies.
As the operational dimension is now included in the contract, it can be expected that even large companies will specialise in certain industrial sectors.

2.7 LEGISLATION AND REGULATIONS

The public sector influences the development of the construction sector in various ways through:
• public regulation, the level of investment in construction, public investments in infrastructure, and construction as an instrument of structural regulation. The sector is very labour intensive and has a relatively high level of publicly finan ced or directed activities (either direct public investments or tax conditions on private construction investments). A country’s economic outlook and political response of

either increasing (to boost the economy) or decreasing (to avoid overheating of the economy) construction investments drive the overall development of the construction sector.

• direct regulation and legislation regarding construction. Important areas are environmental regulations with respect to the construction process (environment and labour safety) as well as the construction materials in use. Other regulations and legislative traditions often embedded in the national settings around the construction sector also drive change in the sector.

• the public sector which can enforce the development of new standards in the sector, by coordinating the demand in relation to public construction projects. Various examples are underway in European countries. The public sector acts as a strong demanding customer by combining requirements in relation to procurement with legislation and regulations.

2.7.1 Legislation for Trade, Health, and Safety

In the Member States and at EU level, initiatives are under way to harmonise standards and regulations.

An EU initiative that has importance for the construction sector is the CE marking of building materials. Its intention is to establish an internal market for building materials through technical harmonisation, thereby removing technical barriers to trade. The CE marking is supposed to replace all national standards, approval systems, conformity systems or other systems, which may constitute technical barriers to trade in a single European system. The requirements of the CE marking relate to various aspects, such as mechanical resistance and stability, safety in case of fire, hygiene, health and the environment, safety in use, protection against noise and energy economy and heat retention.

2.7.2 Safety at Work

Safety is a very specific problem in the construction sector, as the risk of accidents in construction is considerably higher than the EU average for all other economic sectors.

Initiatives at EU level (such as directives and European safety weeks) as well as national initiatives from authorities and unions will put pressure on changing construction processes and improve safety. The Bilbao Declaration – an agreement between six leading industry, engineering and architecture groups and the EU presidency – aims at reducing the number of accidents in the construction industry. The declaration suggests five key actions to boost construction safety standards in Europe:

1. integrate health and safety standards into procurement policies,
2. ensure health and safety is considered at the design and planning stages of construction projects,
3. use site inspections and other techniques to encourage more businesses to comply with the legislation,
4. develop guidelines to help businesses comply with this legislation and stimulate higher standards of safety and health,
5. social dialogue and agreements on training, accident reduction targets and other issues.

2.7.3 Public Procurement

Public procurement will play a role in the development of the construction sector in at least two ways:

- higher degree of transparency of the procurement process;
- higher qualitative standard of requirements and specifications in public procurement.

Public procurement procedures have developed across the EU. They constitute an important element of the European internal market to safeguard fair and transparent competition, and to have an efficient judicial review in the case of infringements. The latter is done by simplifying the existing legal framework and adapting electronic tools. Electronic tenders will secure a transparent process and probably provide the basis for improved competition. According to the FIEC representative, national legislation remains an important barrier to international (even inter-EU) competition. Simplification and harmonisation of the legal

framework will therefore be a possible drive for international competition in the construction sector.

At national level, a process of rendering public procurement more professional and standardised is under way on both the demand and supply sides. This will be a driven for implementing several of the regulations and legislative demands in the companies which operate in the public market.

2.7.4 Undeclared Work

Undeclared work is of growing concern in the EU. According to a report to the EC, undeclared work is assessed to be between 1.5 and 20% of the GDP in the EU15 Member States. The construction sector is the most affected sector for undeclared work.

Minimising the financial drivers (such as taxes and VAT) for undeclared work is expected to lead to legalisation regulating this kind of work, and hence boost some construction activities which are currently postponed for financial reasons:

- companies must demand proof of payment of tax and pension contributions from prospective contractors when they call for tenders. If these payments have not been made, it is justifiable to reject a bid;
- information about contracts must be delivered quarterly to the tax administration;
- electronic pass systems must be used for workers and contractors at building sites.

Of the three measures, only the latter has proven to be effective.

A successful reduction in undeclared work would increase demand for construction work within the legal framework. At the same time, reducing undeclared work would ease the pressure for low cost and salaries in legal companies in the subsectors that are under pressure from undeclared work.

2.7.5 Framework Factors

FIEC emphasises that reorganising risk sharing, as well as liability and insurance issues related to construction projects would be an important factor for innovation and productivity growth in the sector in most countries. In some countries, under the current liability regime, there is no incentive for the different parties in a project to work as a team and offer advice and help in the event of a problem. Even peripheral involvement, such as providing advice, can bring about total liability for a failure in the outcome. This works against innovation since cooperation beyond the letter of the contract is actively discouraged. As a result, construction companies act mainly in their own interests to protect themselves instead of looking for the best solution.

2.7.6 EU Internal Market

The European Commission continues in its aim to strengthen the internal market for services to facilitate international competition within the EU, including the construction sector. Various instruments are used to reach that goal, like specifying the right of recipients to use services from other Member States, harmonisation of legislation, development of administrative cooperation, particularly in the case of posting workers, and development of measures (voluntary certification of activities, etc) to promote the quality of services.

2.8 NEW TYPES OF QUALIFICATIONS

New types of qualifications are required so that construction workers can handle new machinery, technologies, processes, and materials. Furthermore, strong company specialisation in certain parts of the construction process tends to define new specialised crafts or further specialisation within existing crafts. Following the drivers and trends presented above, most sub-sectors will face the challenge of new qualification needs within different areas. The companies' answers to this challenge will undoubtedly affect their chance of survival and growth in regional, national, or even international competition.

2.8.1 Need to Change Qualification

The changes in the sector result in a broad range of qualification needs. These needs will have to be addressed in the curricula of general vocational training, as well as in company-specific retraining and supplementary vocational education and training courses. Retraining and other courses address the concrete new challenges within developments in technology, the building process, and the market, etc.

● knowledge about and training in the use of new technologies – new generic technologies such as ICT, new materials, chemicals, etc;

● health and safety issues should be emphasised, particularly in general vocational training and education, and training in relation to specific technologies, machinery, and materials. This aspect should reduce accidents in the sector and further reduce the number of workers leaving the sector after a few years. The social partners are aware of this problem and address it in a joint work program.

● communication, teamwork skills, etc. This aspect is still more important with new construction methods such as lean construction, where productivity is reached by tight time schedules, just in time, etc.

2.8.2 Importance of Qualification Levels

At the organisational level among the social partners, there is a clear understanding about the importance of higher qualification levels and further investment in education and training in the sector. It is considered partly as a sectoral issue to achieve general growth, respond to international competition, and satisfy public demand for higher productivity and improved quality. It is also a company issue in a drive to stay competitive and an issue for the individual employee to remain competent and employable.

Large companies are usually ready to act on qualification needs, since employee development is – and will be – high on the priority list as a central success factor in the future. Employee development is essential not only in terms of new qualifications (via education and training) but also to improve work motivation and organisation of work (teamwork, etc) within construction companies.

2.8.3 Training Courses in SMEs

In most of the small and medium-sized construction companies (SMEs), focus on education and training tends to be low. Day-to-day tasks and problem solving take all the attention. This is often related to a lack of strategic direction or plans for the development of the company in general. Consequently, there is no framework provided within which training courses could drive company development. The social partners at national and EU level, as well as awareness campaigns at government level try to address this issue. Furthermore, improving managers' skills sets and providing tools to handle this challenge would also support more and broader training in small and medium-sized construction companies.

2.8.4 Short-Term Labour Contracts

Construction projects often use short-term labour contracts (with national differences). This seems to be a growing trend. The use of short-term contracts makes the sector more dynamic: hiring labour only for the period when it is needed may have a positive impact on the profitability of the project and the company. It also enables the use of non-local labour on short-term contracts. However, from a skills perspective this can be counter productive. Short-term contracts offer less job security for the employee and may diminish the recruitment of highly qualified labour to the sector. Also, short-term contracts are not compatible with the individual/company and sector interests in furthering education and training.

2.8.5 Financing of Education and Training

Financing training costs represents a further challenge to achieving a higher level of qualification in the sector. Whereas large companies are in a better situation to accomodate training costs, which constitutes a competitive advantage, smaller companies are finding it difficult to finance education and training for their staff other than what is laid down by law.

These financial challenges must be met to improve qualification levels across the sector in general. How these costs should be shared between individual workers, companies, the sector, and governments will depend on the national framework,

the existing national educational organisation and approach to lifelong learning, as well as the actual strength of the social partners.[38]

2.9 CONSTRUCTION 4.0 TECHNOLOGY

Construction 4.0 Technologies is described by as a revolutionary paradigm in which three transitions occur: industrial production and construction, cyber-physical system, and digital technologies. BIM (building information system), CDE (common data environment), cloud-based systems engineering, AR/VR (augmented reality/virtual reality), big data and analytics, blockchain, and laser scanners are all instances of emerging innovations. Robotics and automation, sensors, the internet of things, industrial manufacturing, off-site and on-site construction, employees using wearable sensors, and devices fitted with sensors all fall into the category of cyber-physical systems. As a result, it's crucial to comprehend the developments that make this transition possible.[39]

2.9.1 Drones

Drones are mostly used in the construction industry for observation and tracking purposes during survey work, construction, and facilities operations. In the past, they were primarily used for military purposes. Using drones in building and other industries have risen steadily over the years.

2.9.2 Virtual Reality (VR)

VR is a step further than AR (Augmented Reality) on the spectrum of virtuality. VR creates a virtual and an immersive experience for the user through headsets with 360-degree visions, allowing the user to experience a completely different environment. Since 1990, it has experienced remarkable growth, undergone development, and been applied in areas such as education and training. When using VR in training related to the construction industry, it reduces the risks people may be exposed to, optimizes procedures, and makes it possible to identify danger zones.

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[38] Processed by: European Foundation for the Improvement of Living and Working Conditions, 2005. *Trends and Drivers of Change in the European Construction Sector.* Mapping report, available at: http://www.eurofound.eu.int

[39] IRIZARRY, J. and COSTA, D. B., 2020. Exploratory Study of Potential Applications of Unmanned Aerial Systems for Construction Management Tasks. *Journal of Management in Engineering*, 32 (3)

2.9.3 3D Printing

The method of making a dynamic, physical 3D structure from a CAD model is known as 3D printing or additive manufacturing. 3D printing has been the focus of 25 years of research and development, and it is now used in several fields, including aerospace, vehicles, and medicine. The construction industry is still looking at 3D printing, but mostly for small to medium-sized projects right now. These technologies have recently ignited attention in the Construction 4.0 sector, particularly with cement, lending to its potential to substitute human workers with automated manufacturing, enabling substantial saving of time as well as personalized and scalable construction manufacturing. The result is heavily influenced by the printing quality, material behavior, speed, and printing duration between layers.[40]

2.9.4 Building Information Modeling (BIM)

BIM is a computer program that allows all stakeholders in the construction process to generate, transfer, exchange, and communicate data. BIM has been critical in the building industry's digitalization. Overall, BIM – specifically 5D planning and budget integration – is supposed to result in substantial cost savings (direct costs, efficiency, delays, protection, and image) across the entire construction value chain (design, construction, operations, and destruction). In other words, BIM (Building Knowledge Modeling) can enhance operating processes over the lifespan of a construction project.[41] Today, Building Information Modeling (BIM) is the central technology for the digitization of the construction manufacturing environment.

2.9.5 Robotics

This technology is widely used in the construction industry, particularly in the assembling of high-rise buildings. For example, the SMART machine built by SHIMIZU in Japan was also used to create a 30-story office tower. Furthermore,

[40] PAUL, S. C., TAY, Y. W. D. PANDA, B. and TAN, M. J., 2018. Fresh and Hardened Properties of 3D Printable Cementitious Materials for Building and Construction. *Archive of Civil and Mechanical Engineering*, 18, 311–319 pp.
[41] WYMAN, O., 2018. *Digitalization of the Construction Industry: The Revolution Is Underway.*

robots can execute various building operations like painting, brick overlaying, and earthwork.

2.9.6 Artificial Intelligence (AI)

AI is a concept that refers to a computer that mimics human cognition. Throughout the construction industry, 4.0 AI can be used in adaptive vision systems to distinguish different aspects on a construction site, as well as voice and recognize patter to track the progress of construction workers in full detail. It's still being analyzed to see how it can forecast several anomalies involved in building architecture, construction, and service. Furthermore, intelligent manufacturing is a viable technique.

Robotics, AI, and the Internet of Things can reduce building costs by up to 20 percent. Engineers can don virtual reality goggles and send mini-robots into buildings under construction. These robots use cameras to track the work as it progresses. AI is being used to plan the routing of electrical and plumbing systems in modern buildings. Companies are using AI to develop safety systems for worksites. AI is being used to track the real-time interactions of workers, machinery, and objects on the site and alert supervisors of potential safety issues, construction errors, and productivity issues.

Despite the predictions of massive job losses, AI is unlikely to replace the human workforce. Instead, it will alter business models in the construction industry, reduce expensive errors, reduce worksite injuries, and make building operations more efficient.
Leaders at construction companies should prioritize investment based on areas where AI can have the most impact on their company's unique needs. Early movers will set the direction of the industry and benefit in the short and long term.[42]

2.9.7 Internet of Things (IoT)

Using built-in sensors and wireless technology, the Internet of Things allows for the fast storage, processing, and sharing of data. It's generally acknowledged as

[42] RAO, S., 2022. *The Benefits of AI in Construction*. [online] published April, 2022 [cited September, 2022]. Available at: https://constructible.trimble.com/construction-industry/the-benefits-of-ai-in-construction

one of the most critical fields of future technology, and it's gaining a lot of interest from sectors. In the context of construction 4.0, the Internet of Things (IoT) is being used to incorporate goods (Wireless sensor networks, middleware, cloud computing and IoT application software).

Many of these advancements in technology today present new opportunities for businesses who wish to enhance their competition, operations quality, project delivery punctuality, as well as new services delivered to customers Also, several of these technologies, such as BIM, sensors, and the Internet of things, have proved to be useful in accomplishing the objectives for a prosperous future (Along with the enormous potential and promise of sustainable decision-making in the field of construction technology. In other words, investing in new technology contributes to improved efficiency, and that's what companies like construction are looking for (Figure 3).[43]

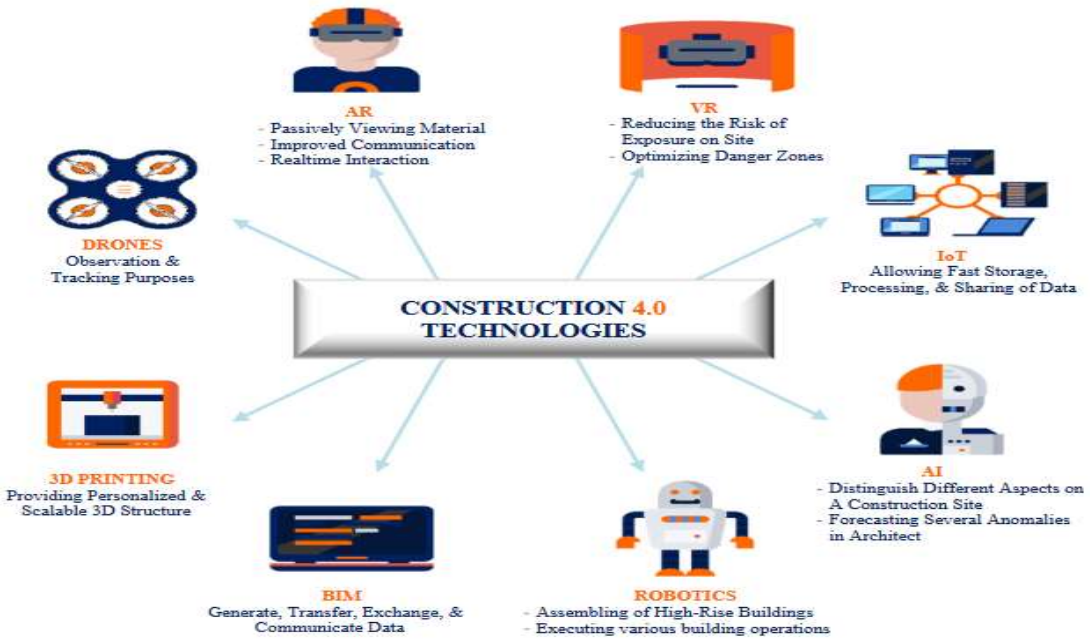

Figure 5 Construction 4.0 Technologies[44]

Many times, the construction industry resist for implementing Industry 4.0 technologies and undergo digital transition, the result is the shortage of theory

[43] ALALOUL, W. S., LIEW, M. S., ZAWAWI, N. A. B. and KENNEDY, I. B., 2020. *Industrial Revolution 4.0 in the Construction Industry: Challenges and Opportunities for Stakeholders.* Science Direct Journal, 11, 225-230 pp.
[44] RAO, S., 2022. *The Benefits of AI in Construction*. [online] published April, 2022 [cited September 2022]. Available at: https://constructible.trimble.com/construction-industry/the-benefits-of-ai-in-construction

knowledge. Therefore, Extra efforts among academicians and industry players are required to implement the innovative concept of Industry 4.0 in the complicated environment of the construction industry and push its traditional borders.

2.10 TRANSFORMATION OF CONSTRUCTION INDUSTRY

The industry has vast potential, however, for improving productivity and efficiency, thanks to digitalization, innovative technologies and new construction techniques. Consider the rapid emergence of augmented reality, drones, 3D scanning and printing, Building Information Modelling (BIM), autonomous equipment and advanced building materials – all of them have now reached market maturity. By adopting and exploiting these innovations, companies will boost productivity, streamline their project management and procedures, and enhance quality and safety. To capture all this potential will require a committed and concerted effort by the industry across many aspects, from technology, operations and strategy to personnel and regulation.

It then introduces a conceptual industry-transformation framework, listing several measures, grouped in eight topical areas, that would profoundly change the industry system. The measures are classified into three groups: measures taken by private companies on their own; measures taken by companies in collaboration with their peers – or by the industry as a whole; and measures taken by the government, acting both as the regulator and as a major project owner. The eight topical areas are:

► Technology, materials and tools
► Processes and operations
► Strategy and business model innovation
► People, organization and culture
► Industry collaboration
► Joint industry marketing
► Regulation and policies
► Public procurement

The "Future of Construction Project" requires the commitment and encouragement of many active participants in our industry – people who believe in a modern E&C (Engineering and Construction) industry that will benefit all.

The Engineering & Construction (E&C) industry strongly affects the economy, the environment and society as a whole. It touches the daily lives of everyone, as

quality of life is heavily influenced by the built environment surrounding people. The construction industry serves almost all other industries, as all economic value creation occurs within or by means of buildings or other "constructed assets". As an industry, moreover, it accounts for 6% of global GDP. It is also the largest global consumer of raw materials, and constructed objects account for 25-40% of the world's total carbon emissions.

Companies themselves should spearhead the industry transformation. Tremendous opportunities are available through the application of new technologies, materials and tools. New technologies in the digital space, for example, will not only improve productivity and reduce project delays, but can also enhance the quality of buildings and improve safety, working conditions and environmental compatibility.

2.11 INDUSTRY IS CRUCIAL TO SOCIETY, ECONOMY AND ENVIRONMENT

2.11.1 Societal Relevance

Construction is one of the first businesses that humankind developed, and it continues to shape our daily life in unique ways. Virtually all other businesses rely on the construction industry to provide and maintain their accommodation, plants and infrastructure, and construction is a determinant of where and how almost everyone lives, works and plays. For nearly the entire population of the world, the built environment heavily influences quality of life.
So the building and the materials used in its construction and finishing have a major impact on the health and well-being of its occupants.

2.11.2 Economic Relevance

With total annual revenues of almost $10 trillion and added value of $3.6 trillion, the construction industry accounts for about 6% of global GDP. More specifically, it accounts for about 5% of total GDP in developed countries, while in developing countries it tends to account for more than 8% of GDP. The industry is expected to grow greatly in the coming years, to estimated revenues of $15 trillion by 2025.

More than 100 million people are already employed today in construction worldwide.[45]

For countries to enjoy inclusive and sustainable growth, modern and efficient infrastructure is essential. According to a 2014 estimate by the International Monetary Fund, if advanced economies invested an extra 1% of GDP into infrastructure construction, they would achieve a 1.5% increase in GDP after four years.

2.11.3 Environmental Relevance

The construction industry is the single largest global consumer of resources and raw materials. It consumes about 50% of global steel production and, each year, 3 billion tonnes of raw materials are used to manufacture building products worldwide.

About 40% of solid waste in the United States derives from construction and demolition. Throughout the world, such waste involves a significant loss of valuable minerals, metals and organic materials – so there is great opportunity to create closed material loops in a circular economy. As for energy use, buildings are responsible for 25-40% of the global total, thereby contributing hugely to the release of carbon dioxide.

Value therefore lies in improving the quality of construction and the quality of materials used, in contributing to a healthier indoor environment, increasing its sustainability and reducing its cost. Any endeavour towards this goal will generate welcome benefits – whether for families investing in their first private home or governments embarking on a giant infrastructure project.

2.12 NUMBER OF MEGATRENDS IN INDUSTRY'S FUTURE

The construction industry is affected by megatrends in four domains: markets and customers, sustainability and resilience, society and workforce, and politics and regulation. The industry needs to identify and implement optimal responses to these megatrends – both with respect to the opportunities they offer and with respect to the challenges they pose.

[45] *Shaping the Future of Construction: A Breakthrough in Mindset and Technology*.Word Economic Forum, The Boston Consulting Group, May 2016, p. 11.

2.12.1 Market and Customer Trends

As demand in emerging countries rises, the industry must identify how emerging and developing markets can benefit best from the technological advances and increased safety standards already being applied in developed countries, while still taking into account local market conditions. The expected increase in global competition will produce winners and losers as strengths and strategies differ between companies and countries.

One particularly challenging area is that of infrastructure. Ageing infrastructure assets in developed countries demand proper maintenance, upgrading, replacing or newly built assets, and there is, of course, a fast-growing societal need for infrastructure assets in emerging markets. So overall, there is immense opportunity, and responsibility, for the construction industry. The vast "infrastructure gap" cannot be bridged by public-sector money alone. Private capital is needed, so the trend in infrastructure construction projects is for PPPs. One other notable development is the increasing number of infrastructure megaprojects; these projects, however, have a poor record historically in terms of on-time and on-budget delivery, environmental footprint and public support.

2.12.2 Sustainability and Resilience Trends

Increasingly, sustainability is becoming a requirement rather than just a desirable characteristic, and its pursuit is bound to affect both the construction process and the built asset itself. The construction sector produces an enormous amount of waste, so the more efficient use and recycling of raw materials, even a small improvement, offer huge potential benefits. Other new priorities are emerging accordingly, including optimizing space, for example, and ensuring more efficient methods of heating, cooling and lighting. The industry is increasingly making use of off-grid or distributed power sources, such as wind power, geothermal energy and solar panels on roofs.

The industry also has to address the growing concerns over natural hazards (notably, flooding, hurricanes and earthquakes), and to enhance resilience. So new emphasis is being placed on devising risk-mitigating solutions, especially in urban areas with high population density.

Finally, the industry must engage against the growing threats to cybersecurity. No doubt many important benefits will emerge from the convergence of Web, cloud

and mobile platforms, as well as the Internet of Things (IoT), but vulnerability will increase, too – particularly in an industry as decentralized as the construction industry, with so many different stakeholders involved. So the imperative to protect the industry from threats without disrupting business innovation and growth has never been greater.

2.12.3 Societal and Workforce Trends

The world's urban population is expected to exceed 6 billion by 2045, with about a quarter of that population living in slums if the current proportion remains unchanged.21 Hence the need for a boost in affordable housing in urban areas – where the construction process is very complex, owing to the space constraints – and for increased infrastructure spending on water supply, sanitation, and so on.
Another demographic trend, especially in developed countries, is the shifting age profile. The increasing proportion of elderly people in the population affects the construction industry in two main ways: first, it creates a need to construct or adapt buildings to accommodate ageing and convalescent citizens; second, it threatens to reduce the available supply of construction workers.
The construction industry is concerned with the health and safety not only of workers but also of the people who actually live or work in the buildings. Employee health and productivity are linked to the quality of the indoor environment, and that quality is largely determined by decisions made during project development and construction. The safer the materials, the better for health and the environment. For instance, asbestos has been outlawed in many countries as a construction material, and construction companies are increasingly motivated to ensure that the living and work environments that they create are ergonomic and allergy-free. In addition, at the end of the building's life, safer materials can be more easily integrated in the circular economy.
A further challenge facing the construction industry concerns the rights or needs of local communities. Neighbourhood lobby groups, for instance, often influence permit decisions and might even be able to force the withdrawal of permits already granted. Communities are also becoming more organized and professional, partly thanks to new forms of communication and social media.

2.12.4 Political and Regulatory Trends

The various political challenges relate to regulation, bureaucracy, instability and corruption. Regulation impacts on many aspects of the E&C industry. In a recent global survey, regulation was identified as the most important driver of increasing complexity.

The industry is especially affected by changes in health and safety requirements, financial and labour legislation, and environmental standards. New regulations in any of these areas can affect business operations adversely. If designed thoughtfully, however, regulation can actually prove advantageous to companies.

Another constant issue is that of political instability. The international community has arguably managed to reduce overall levels of violence in recent decades, but regional hotspots obviously persist and new ones flare up, at enormous human and economic cost. Contractors are wary of getting involved in such locations, even in post-crisis conditions – especially in long-term infrastructure programmes, where predictability is key – and need to find ways of mitigating the risks.

Finally, the challenge of corruption must be addressed. In many countries, corruption remains one of the greatest barriers to economic and social development. Although bribery and other forms of corruption afflict almost every industry sector, they are a particular concern for companies in the E&C and Real Estate sectors, given the nature of their business.

2.13 INDUSTRY IS CAPABLE OF TRANSFORMATION

New opportunities are emerging as transformative developments reshape the E&C industry – from innovative technologies to revolutionary construction techniques. Productivity and efficiency will surge. It is up to the industry to embrace these new opportunities more vigorously and change the way it has traditionally operated.

Given all the megatrends and internal challenges, the construction industry should take action in several areas. A comprehensive approach is outlined in the industry transformation framework shown in Figure 6.

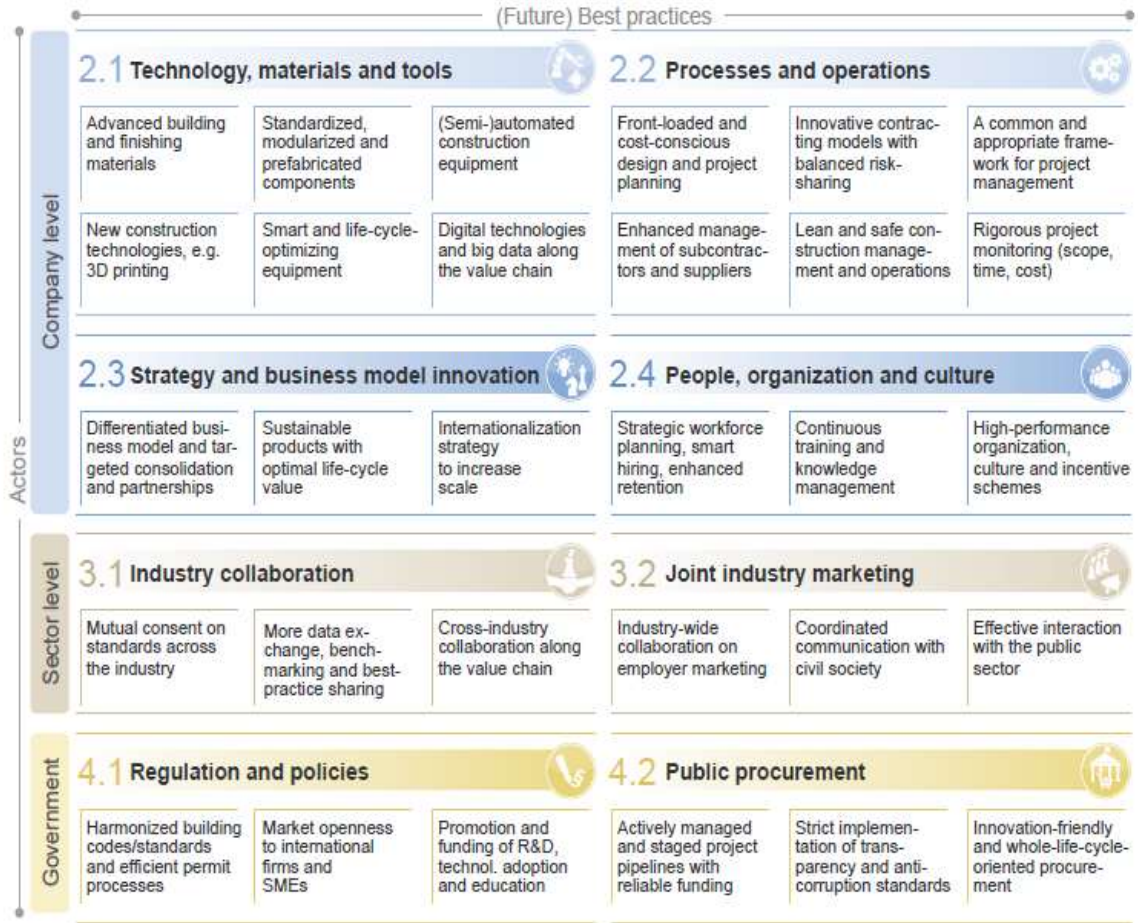

Figure 6 Industry Transformation Framework[46]

The framework structures the various areas of action according to responsibility. Initially, the transformation relies on the initiatives of individual companies – the adoption of new technologies and processes, business-model innovation, refinements to the corporate culture and organization, and so on. Individual action is not enough, however, in such a highly fragmented and horizontal industry: many of the challenges need to be tackled collectively – the industry as a whole has a responsibility. It needs to establish new forms of collaboration, or to improve

[46] *Shaping the Future of Construction: A Breakthrough in Mindset and Technology.*Word Economic Forum, The Boston Consulting Group, May 2016, p. 17.

existing forms. Finally, governments, too, have a large part to play, in their dual role as regulators and clients.

2.13.1 Technology, Materials and Tools

Materials constitute an extremely powerful lever for innovation. The European Commission estimates that 70% of product innovation across all industries is derived from new or improved materials. With approximately one-third of construction cost attributed to building materials, the scope for applying advanced building materials (ABMs) is considerable.
The solutions emerging from the building material industry are numerous and wide-ranging – from the incremental innovation of traditional materials and existing characteristics, to the generation of new material combinations with additional multifunctional characteristics, to radically innovative materials with entirely new functionalities.

A large variety of innovative ABMs are market-ready or close-to-market. Yet despite their great potential, they very often fail to penetrate the market, let alone achieve widespread acceptance. That is particularly true for emerging countries. One reason is that ABMs often require a higher initial investment, with the benefits generally realized over the entire life cycle. Other reasons are that the new materials still lack a track record of success, and that project owners and E&C company decision-makers may not be up-to-date on the latest developments, or may lack the information needed for making difficult trade-offs (on such issues as price vs quality, durability and ecological merit). All of that points to another serious impediment to the introduction of new materials: the liability risks that engineers, contractors and suppliers would face if they recommend a new material.
To remedy this unsatisfactory state of affairs, it is crucial for stakeholders along the value chain to take action.
E&C companies should build up relevant competencies in-house, and create a database of evidence on the applicability and benefits of ABMs, to be able to provide clients with a convincing quantitative case for using ABMs. Afterwards, contractors should institutionalize the knowledge transfer to local project teams, so the decision-makers at a project level have all the relevant up-to-date information and can thereby optimize their decisions on materials.

• **Standardized, modularized or prefabricated components**

Productivity in construction could receive a substantial boost from **standardization, modularization and prefabrication**. The standardization of components brings many benefits, including a reduction in construction costs, fewer interface and tolerance problems, greater certainty over outcomes, reduced maintenance costs for end-users, and more scope for recycling. Modularization adds to the advantages of standardization, by increasing the possibilities for customization and flexibility, and helping to realize the potential of prefabrication in a factory-like environment. Prefabrication would increase construction efficiency, enable better sequencing in the construction process and reduce weather-related holdups; by such means, it becomes possible to reduce a project's delivery times and construction costs relative to traditional construction methods, and also to create safer working environments.

• **New construction technologies**

The development of 3D printing is expected to have a disruptive impact on the construction industry. The technology enables the production of purpose-built shapes that cannot be produced by any other method; it promises productivity gains of up to 80% for some applications, together with an important reduction in waste. Construction time for some buildings could shrink from weeks to hours, and customized components could be provided at much lower cost.

At present, 3D printing is still mostly applicable to low-volume, high-value parts. It remains to be seen how quickly companies will overcome the main technological challenges, and whether they will be able to bring down costs and achieve economies of scale.

• **Smart and life-cycle-optimizing equipment**

The concept of smart building is gaining in popularity. This is in part due to technological advances, which are driving down the cost of sensors, data storage and computing services. At the same time, potential customers are showing increased interest, attracted by the widening adoption of connected devices, and are demanding greater energy efficiency in buildings and improved safety and convenience. As for the owners or end-users of buildings, they stand to gain several benefits: reduced operating costs, through a likely 20-40% reduction in energy usage; greater comfort, thanks to improved lighting and temperature controls, for instance; and increased operational efficiency, partly by means of remote servicing.

• Digital technologies and big data along the value chain

Digitalization – the development and deployment of digital technologies and processes – is central to the required transformation of the construction industry. Innovations of this kind enable new functionalities along the entire value chain, from the early design phase to the very end of an asset's life cycle at the demolition phase.

These digital technologies also facilitate the adoption or enhanced application of many of the other innovations, such as prefabrication, automation and 3D printing, and should help to improve various processes in the industry, such as front-loaded design and planning or project management in general.

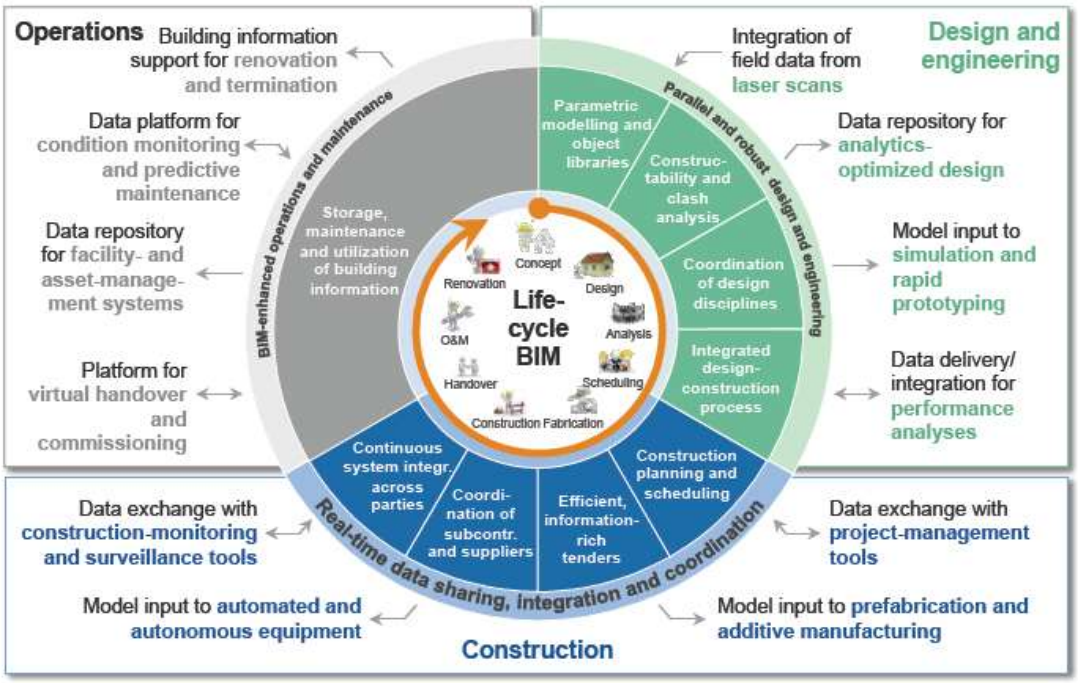

Figure 7 Applications of BIM along the E&C Value Chain[47]

2.13.2 Processes and Operations

• Cost-conscious design and project planning

From a TCO perspective, construction's share of the total cost over the lifetime of the asset can be as high as 10- 50%, while the O&M costs may account for 40-80%.56 These two major cost components are largely determined early on, during the design and engineering phase. At this early stage, it is still relatively easy and

[47] *Shaping the Future of Construction: A Breakthrough in Mindset and Technology.* Word Economic Forum, The Boston Consulting Group, May 2016, p. 24.

inexpensive to make changes: hence the case for smart front-loaded design and engineering, as highlighted in Figure 12. By making whole-life-cycle-conscious decisions and finding the right innovative solutions, project planners can create significant value.

To achieve substantial improvements in construction productivity and to reduce O&M costs, companies need to ensure that, during the design and engineering phase, they keep the actual construction process in mind, as well as the final operations phase. This early phase should ideally incorporate the knowledge of all companies along the value chain – the main contractor, subcontractors, suppliers, and later on the asset's operator, owner and maintenance firms.

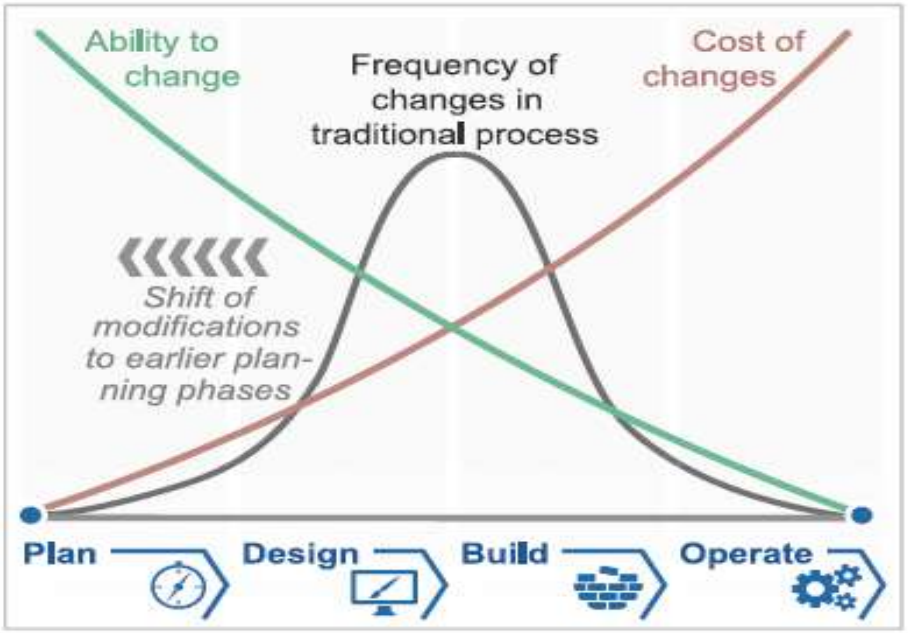

Figure 8 Cost of Changes in the Construction Life Cycle[48]

Companies across the value chain can enhance front-loaded design and project planning by adopting the following procedures:

Highlight and plan adequately the construction and O&M phases (do so during the design and engineering phase) and continuously analyse the impact of all design and planning decisions.

[48] *Shaping the Future of Construction: A Breakthrough in Mindset and Technology.* Word Economic Forum, The Boston Consulting Group, May 2016, p. 26.

• Innovative contracting models with balanced risk sharing

To realize the full potential of front-loaded and cost-conscious design and project planning, it is crucial to get all relevant parties engaged and well coordinated early on.58 All those parties involved in the construction process – owners, contractors, subcontractors and suppliers – obviously have a vested interest in on-time performance and on-time payment, and would benefit by shifting away from the classic sequential design-bid-build approach to a more integrative approach.

Construction companies could take on new roles by applying innovative contracting models. In a design-build (DB) approach, for example, a single company could – through a single contract with the project owner – undertake to provide all design and construction services and therefore contribute to better trade-offs between design and construction decisions. PPPs can accelerate infrastructure programmes by tapping into the private sector's financial resources, as well as its skills in designing, building and operating infrastructure on a whole-life-cycle cost basis. An early contractor involvement (ECI) model integrates design development and construction planning by including a contractor in the early planning stages. In the first phase, the contractor advises on project engineering and planning, and a target price is agreed upon; if that target price is met, the contractor will be retained for the construction phase as well.

Companies should increasingly use models based on these principles. One such model is an "alliance" between a project owner and private-sector parties for delivering one or more construction projects, where the parties generally have to work together as an integrated, collaborative team. Another such model is integrated project delivery (IPD), with core elements such as target cost pricing, shared risks and rewards, common collaboration platforms like BIM, and cross-functional groups.

• A common and appropriate framework for project management

The execution of construction projects all too often relies heavily on the expertise or even intuition of the individual project manager. Even though no two construction projects are identical, the "lessons learned" from any one project can prove very helpful when applied to another. Ideally, companies should institutionalize these lessons, so that project management can undergo continuous improvement across projects.

To establish a common framework for project management in this way, construction companies should consider taking the following steps:

► *Collect and consolidate project-management data. Among the requirements here are an improved project-monitoring system and a strong reporting tool, enabling the continuous collection of project data.*

► *Standardize the identification of best practices. This includes evaluating the performance of individual projects and developing a portfolio of best-practice processes to accommodate a variety of different projects.*

► *Make sure that the best-practice standards actually get applied at the project level. If necessary, educate project managers and other important decision-makers in the appropriate processes, or make the best practices mandatory.*

A key facilitator in implementing these steps is a set of company-wide software tools. These tools will help in connecting islands of information, making information easily available and simplifying actual project management (by providing support for scoping, scheduling or costing).

Modern project management, however, concerns itself with the planning and strategic components as well; it engages with the "front end", for instance, as the source of particular benefits and value, and assigns great importance to the interdisciplinary, interpersonal and integrative aspects of the project manager's role.

• Enhanced management of subcontractors and suppliers

It is crucial to integrate suppliers and subcontractors more effectively, and that task falls mainly to the main contractor. Various measures are available, not just in the planning phase but throughout the entire project. The goal should be to establish an agile supply chain able to respond flexibly and promptly to changes in the external environment (weather-related hold-ups, changes in scope and schedule, regulatory changes) and integrate well with other parts of the business in addition to procurement. The supply chain as a whole should be regarded as a business partner.

The first step for a contractor might be to consolidate some of its internal functions – such as procurement, quality and logistics – into a central team, to work more closely with the supply chain.66 The contractor would then abandon the old system

– multiple, ever-changing transactional supply contracts, with great complexity and little reliability for both sides – and switch to a new system involving fewer contracts but more strategic long-term cooperation. Such a switch not only will reduce the contractor's administrative burden and initial set-up costs, but will enable suppliers to conduct long-term planning, and will often bring innovations to the market. Nevertheless, the long-term commitment should be accompanied by a transparent, fair and regularly revised evaluation of the suppliers.

A lean approach reduces complexity and uncertainty by reducing waste and non-value-adding activities throughout the entire value chain: it reduces, for instance, schedule deviations, waiting, stocks of building materials, transportation, rework and unused or underutilized resources. In that way, it makes processes more stable, predictable and efficient.

Four core principles underlie the use of lean methods in construction projects:
► *Alignment of resources, material and information flows. Optimize the construction process by, for instance, identifying repeatable elements and sequencing the various work shifts accordingly. For example, the building could be divided into several sections to allow a value-creation flow based on the orchestrated movement of subcontractors and craftspeople through each section.*
► *Coordination and harmonization of takt speed. (Takt speed is, roughly, the work pace or rhythm; typically, work cycles vary from one day to one week.) Synchronize the steps, identify and ease bottlenecks, and smooth the flow of construction work to avoid idle times by, for instance, sizing teams appropriately and moving rework to night shifts or weekends.*
► *Just-in-time pull of resources and materials. Plan work at the "request" of a downstream "customer". Ensure that the availability of materials is in sync with the progress of construction by, for instance, transporting materials "just in time" and to precise locations on the site. This approach also promotes flexibility, by allowing contractors to accommodate their clients' last-minute decisions.*

• Rigorous project monitoring (scope, time, cost)
Currently, project monitoring in the construction industry often consists of little more than post hoc documenting of the cost overruns and construction delays. Project monitoring needs to become more real-time and forward looking than that,

and to provide data that can immediately be translated into action – action that will bring projects back on course. The following steps are recommended for companies:

Establish the right metrics, and monitor continuously. Define appropriate KPIs that create transparency on the project's progress and enable early identification of any deviation. Monitor regularly, ideally every day, the schedule adherence of each process cycle, and report it as being either "on track" or "requiring action". Leverage state-of-the-art digital tools, big data and new construction equipment in order to generate project-monitoring data more efficiently.

2.13.3 Strategy and Business Model Innovation

• Differentiated business model and targeted consolidation and partnerships

Given the varied and sophisticated customer requirements in today's construction markets, many E&C firms struggle to develop the required know-how internally. One response is to improve collaboration on a project level,. Another response is to partner with, merge with, or acquire other companies – especially if the target company has mastered the latest technologies or complements the portfolio – as part of a strategy to integrate along the value chain.

• Sustainable products with optimal life-cycle value

On a typical vertical construction project, over 30 years of a building's life, the present value of O&M and utility costs is nearly as large as the initial project costs.76 Even so, it is still not standard in the industry to make a deliberate life-cycle-cost optimization of the final asset. Multiple possible reasons explain this neglect. One reason might be conflicting interests between developer, constructor and asset owner, owing to trade-offs between initial investments and the subsequent life-cycle costs. Another might be the absence of a neutral and unbiased view of the life-cycle value of built assets.

To remedy this unsatisfactory situation, the industry should invest in designs and systems with improved long-term life-cycle performance – considering not only the "first costs" of a building (design and construction expenses) but also long-term costs, such as utilities, O&M and externalities. Several companies are conducting pilot schemes to test such new systems, collect information and generate convincing evidence of value.

• Internationalization strategy to increase scale

As emerging countries accelerate their urban and industrial development, new construction markets are opening up for developed-country companies. At the same time, emerging-country companies are interested in getting involved in projects in developed countries. It is crucial for all companies in the industry to develop a clear internationalization strategy

.

Many companies are already establishing a foothold in foreign countries and striving to boost their market share there. When entering new countries, companies will usually find that the best strategy is to cooperate with local firms, via strategic equity alliances and joint ventures, or else to pursue mergers and acquisitions. In that way, they can combine their own expertise with the incumbent partner's local knowledge and relationships. In many fast-growing markets, the local authorities actually advise, request or even require such partnerships.

2.13.4 People, Organization and Culture

• Strategic workforce planning, smart hiring, enhanced retentio

The E&C industry will face stiff recruiting and talent challenges in the years ahead. One major challenge is the prospective scarcity of skilled labour, driven by demographic shifts in developed countries.

Another serious challenge relates to the increasing sophistication of technology, which demands new and broader skill sets at all levels of a company. A final challenge is the high volatility of workforce demand and composition: staff demands become evident at short notice following a competitive tendering bid, and the execution of contracts typically requires the short-term integration of a transient workforce from multiple subcontractors.

In response to these challenges, construction managers need to engage in strategic workforce planning, this planning involves a scenario-based approach that will keep a business sustainable from a people perspective. The steps are as follows:

❶ *Take a long-term view of workforce demand*, by simulating the future project pipeline. This forecast should be made on a granular skill-cluster level: it should consider, for example, future skills requirements in the digital space or the need

for local market experts, but also expected productivity gains through technological advances.

❷ *Simulate the workforce supply accordingly* based on existing staff rosters; consider, for example, shifts in age profiles and capacity losses through attrition.

❸ *Identify gaps and risks*, and devise, on that basis, an executable workforce plan, including interventions to address any over- or under-supply of staff and any skills gaps. Initiate measures, such as recruiting, training, transfers, in-/outsourcing or lay-offs, appropriate to the significance for the business and to the time for qualification.

• Continuous training and knowledge management

Continuous training of staff can help to address the various challenges confronting the E&C industry – the demographic changes, the technological and process advances, and the legislative and regulatory requirements. For instance, project managers will eventually manage multi-billion dollar projects – and the required skills need to be developed accordingly, starting in the early stages of a career. In addition, the provision of training can make employees feel more appreciated and can contribute to a more vibrant company culture. Relative to other industries, construction companies conduct few people-development initiatives.

Effectively designed training systems should improve both the performance and the engagement of workers, and also their health and safety. The best practices include the following:

- *Align training efforts to business strategy.*
  Design or adapt training programmes and curricula to prepare employees for the organization's current and future needs. Occupational safety and health (OSH) training should be a key element. Pay adequate attention to soft skills (notably, leadership or cultural interests) and hard content (such as lean construction or project management). One of the top priorities of many E&C companies over the next few years will be the upgrading of digital skills.
- *Offer rich development opportunities*.
  Effective training combines multiple approaches: in-house and external (for example, through partnerships with education providers, corporate universities or key suppliers), as well as formal (classroom courses) and

informal (coaching and mentoring, on-the-job) to ensure that knowledge is efficiently transferred to the younger generation.

- *Include all staff.*
  Customize offerings to different target groups (for instance, construction workers, functional experts, senior management), taking into account the different needs of diverse generations within the workforce.

Knowledge management should be given a key role on any corporate agenda, yet many construction firms make poor use of such a rich resource. Accordingly, they fail to benefit from experience as they move from one project to another, working with different partners along the value chain. E&C companies need to take action in three main areas, as follows:

- *Take a structured, coherent approach to knowledge management*
- *Foster a culture of proactive knowledge sharing*
- *Create transparency on the internal skills available.*
- *Leverage technology.*

• High-performance organization, culture and incentive schemes

Many construction firms are still characterized by a rather conservative company culture and mindset, and are often hampered by organizational inertia. To support their overall business goals, companies need to drive organizational change – an iterative process, which requires careful alignment of company culture and goals, organizational design and incentive schemes. In particular, it involves the following steps:

- *Conduct an organizational " ethical audit"* and refine the company's purpose and culture. Evaluate the degree to which company culture and the working environment are conducive to individual and team performance, innovation and improvement, collaboration and knowledge sharing, ethical principles (for instance, related to safety, the environment or transparency), diversity and inclusion, and openness and trust
- *Establish a supportive organizational design.*
  Construction is a local-project business that requires decentralized operative decision-making, close to the client. In such a context, it is perhaps more difficult, though no less important, to create an effective organizational

design that reinforces a common company culture and supports strategic objectives.

- *Incentivize desired behaviours.*
  Establish incentive schemes and related measures to reinforce engagement and affiliation and to drive behavioural change: motivate value-maximizing behaviour, implement recognition programmes, offer management-development programmes that focus on culture.[49]

The advent of digital technologies has brought about a swift transformation at construction sites. Digital transformation can result in productivity gains of 14 to 15 percent and cost reductions of 4 to 6 percent.

Promoting Environmental Sustainability: Digital technologies support sustainable construction practices, from eco-friendly designs to optimized resource utilization. By embracing digital transformation, construction companies can reduce their environmental footprint and contribute to a greener future.[50]

[49] Processed by: *Shaping the Future of Construction: A Breakthrough in Mindset and Technology.* Word Economic Forum, The Boston Consulting Group, May 2016, p. 39.
[50] HORNER, H., 2024. *7 Benefits of Digital Transformation in the Construction Sector.* [online] [cit. March 18, 2024]. Available at: https://www.eit.edu.au/benefits-of-digital-transformation-in-construction/

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3 Finance planning for a construction company

Every entrepreneur before starting a business will encounter financial planning in order to start their business. An entrepreneur must plan in detail the financial resources that he will need for the first quarter of the business – start-up capital. These funds must cover one-off costs, operating costs for the first quarter and finances for securing the assets of the new company. The entrepreneur plans these finances in detail in the business plan. This plays a major role when applying for a loan from a bank, which is determined as the difference between the start-up capital and own funds that the entrepreneur already owns and invests in the business. Business plan it is a document in which budding entrepreneurs:

- they set their goals,
- define the subject of the activity,
- determine the legal form of the company,
- choose an organizational structure,
- **process an indicative calculation of operating costs**
- **process the property calculation,**
- **process the calculation of depreciation**
- **and process the start-up capital calculation.**

3.1 ONE-TIME COSTS

When setting up a business, there are a number **of one-time costs** that must be factored into the business plan and financial budget. These costs vary depending on the type of business, legal form and scope of activities. In general, we can divide them into several categories.

Fees for setting up a trade/company: These are fees associated with **registration** at the Trade Licensing Office or registration in the Commercial Register. The amount of fees varies depending on the form of business (trade, limited liability company, joint-stock company) and the number of free trades. For example, the establishment of a limited liability company includes fees for the verification of signatures, registration in the commercial register and, where applicable, fees for the drafting of the instruments of incorporation by a notary.

Legal services: Use of **legal services** in the preparation of **founding documents** (memorandum of association, memorandum of association) and advice on the

legal aspects of business. The price depends on the scope of services and the complexity of the case.
Notary fees: Verification of signatures on founding documents, or other **notarial acts**.
Employee **training**: The cost of initial and professional training of employees.
Insurance: The cost of property, liability, and other types of insurance.

3.2 OPERATING COSTS

Every business activity or use of property brings with it not only income, benefits and advantages, but also operating costs.
Operating costs (sometimes referred to as overheads or indirect costs) are those expenses that are not directly related to a specific construction performance or project, but are necessary for the operation and functioning of the entire business. These are costs that are difficult to assign directly to the price of a particular construction work, but they form an important part of the total costs of the company.

Characteristics of operating costs:
Indirect: They are not directly related to the production or execution of a specific construction work.
Regular or recurring: They occur regularly, such as monthly or annually.
Essential to the running of the business: They enable the functioning of administration, management, marketing and other support activities.
Difficult to assign to individual performances: Their division into specific projects is complex and is often implemented using allocation keys.
Components of operating costs in a construction company:

Operating costs consist of several items, which can be divided into the following categories:

Governance costs:
Wages of administrative staff (management, accountants, human resources, administrative staff).
Costs of office space (rent, utilities, cleaning, maintenance).
Costs of information technology (hardware, software, internet, telephones).

Shipping and telecommunications fees.
Legal and advisory services.
Accounting and auditing services.
Employee training and education.
Travel expenses.

Operating and maintenance costs:
Repairs and maintenance of buildings and premises of the company.
Maintenance and repair of machinery and equipment (not directly assigned to the project).
Energy costs consumed in administrative and operational premises.
Waste removal and disposal.
Security services.

Marketing and sales costs:
Advertising and promotion.
Participation in exhibitions and fairs.
Website creation and online marketing.
Commissions for sales representatives.

Other operating costs:
Property and liability insurance.
Taxes and fees (excluding taxes directly linked to the project).
Membership fees in professional organizations.

Impact of operating costs on the price of construction works:
Operating costs are reflected in the price of construction work through the so-called overhead surcharge. This surcharge is added to the direct costs (materials, wages of workers directly on the construction site) and covers the share of operating costs in the given project. The calculation of the overhead surcharge can be based on various methods, such as:
Percentage of direct costs: A percentage of direct costs is determined to cover operating costs.
Rate per hour of work: A rate per hour of work is calculated, which takes into account operating costs.

Costing by cost centers: Costs are allocated to individual cost centers and then allocated to projects.
Operating cost management:

Effective management of operating costs is important for the profitability of a construction company.

Important tools include:
Budgeting: Budgeting for operating costs for a specific period.
Cost analysis: Track and analyze individual operating cost items to identify savings opportunities.
Process optimization: Improving the efficiency of administrative and management processes.
Outsourcing: Considering outsourcing some activities (e.g., accounting, IT).
Energy management: Reducing energy consumption in administrative and operational areas.
Thorough management of operating costs allows the construction business to maintain competitive prices and make a profit. It's important to remember that while operating costs aren't directly visible on the construction site, they make up a significant portion of total costs, and managing them effectively is critical to a business's success.

Suitable and necessary property for the company is proposed according to the type of specific object of activity of the construction company. In order to determine the necessary funds for the operation of the first quarter of the company's operation, the budget costs for the economic activity of BC for the EA for ¼ year will be determined. These budget costs are the sum of the costs of:
- salaries for the first quarter,
- the company's operation in the first quarter
- one-time costs.
The goal of developing a business plan is to determine the amount of start-up capital that the founding company will need for business during the first ¼ year of business using the company's draft of its legal form, organizational structure, business object, budget costs for economic activity and the **structure of the company's property**.

According to the proposal of its amount and the amount of **equity capital**, the company will be able to determine the need for **loan capital**, i.e. what kind of loan it will have to ask the bank for.

3.1 BASIC TERMS

One-time costs are costs that are paid only once when a business is set up, or must be paid once during the first quarter. Similar to both natural and legal persons, various types of expenses can be incurred before it is incurred. In the case of commercial companies, these are most often fees associated with obtaining a business license and registration in the Commercial Register. These acts may also be associated with the **costs of lawyers' services**, the services of specialized companies dealing with the comprehensive handling of the entire process from the establishment to the **establishment of the company**, **fees for certifying signatures, costs of business trips**, and the like.

The anticipated costs of the company related to the establishment and establishment of the company are even a mandatory element of the memorandum of association or the deed of incorporation of the company.

In the case of legal entities, the Income Tax Act does not contain any provision that would allow them to include in tax expenses expenses expenses that were incurred before they were incurred. There are several reasons. A company is established only when it is registered in the Commercial Register and all expenses related to the commencement of its activity were incurred before it even existed, i.e. they were not incurred by it, but by someone else (most often its founders).[51]

Operating costs are costs that relate to regular, recurring and routine activities or activities related to the use of things or business activities. These are mainly financial costs that need to be incurred to ensure the proper operation or use of the property and to ensure the operation of the business.

[51] *Pre-business expenses as tax expenses* IN: Podnikajte.sk [online] Published 12.07.2021, [cited 25.10.2024]. Available at: https://www.podnikajte.sk/dan-z-prijmov/vydavky-pred-zacatim-podnikania

From the point of view of taxes, these are, for example, tax-deductible costs that an entrepreneur must incur in order to ensure his income and its increase or maintenance. The most common are operating costs, i.e. in the company's business, but also, for example, in the context of opening and operating a sheltered workshop or, for entrepreneurs and non-entrepreneurs, also for a car. Operating costs in accounting are divided into several specific types of costs in the chart of accounts.[52]

Property is needed by every construction company to carry out its business activities. The nature and scope of the construction activity determine its structure and height. The property of a construction company is represented by all tangible and intangible things that the construction company needs for its activity, i.e. all the means that the company procures and uses in its activity to achieve its goals. The company's assets can be divided from several points of view, according to their:

- nature,
- operating cycle,
- liquidity.[53]

According to the Income Tax Act, the company's property are understood as the sum of property values. Assets are the sum of things, claims other rights and other valuables that can be valued in money, which are owned by a natural person with income according to the law and which are used to achieve, secure and maintain this income, for which this natural person accounts or has accounted, recorded or recorded under the Act. According to the law, the property of the company is also tangible property procured in the form of a financial lease.[54]

Property according to the accounting law are those assets of the company that are the result of past events, are almost certain to increase the economic benefits of the company in the future and can be reliably valued according to this law; they

[52] *Operating costs* IN: podnikam.sk [online] [cited 22.11.2024]. Available at: https://podnikam.sk/slovnik/prevadzkove-naklady/

[53] *Property of the enterprise - financing, procurement, depreciation.* IN: EuroEkonóm.sk [online] Published 11.10.2019, [cited 20.10.2021]. Available at: https://www.euroekonom.sk/ekonomia/podnik-a-podnikanie/majetok-podniku/

[54] Act No. 595/2003 Coll. on income tax as amended, § 2.

are reported in the financial statements in the balance sheet or in the statement of assets and liabilities.[55]

Non-current property consist of **long-term** assets:
- intangible,
- tangible,
- and financial.

The non-current assets of the company wear out gradually, and its value gradually passes into the value of finished products and binds a large amount of financial resources.[56] It consists of assets that the company uses for a long time.

Long-term tangible assets are separate movable things, or sets of movable things, which have a separate technical and economic purpose, the entry price of which is **higher than 1,700 euros** and operational and technical functions **longer than one year**.[57] Furthermore, they are:
- buildings and structures,
- growing units of permanent vegetation with a fertility period of more than three years,
- various animals,
- production equipment,
- equipment and objects used for the provision of services,
- purpose-built objects and other equipment that do not form a single functional unit with the building or structure. even if it is firmly connected to it,
- part of a production or other unit,
- opening of new quarries, sand pits, clay pits, waste dumps,
- technical reclamation,
- technical evaluation of an immovable cultural monument over 1700 euros,
- technical evaluation of leased property over 1700 euros,
- technical evaluation of fully of depreciated tangible assets of more than 1,700 euros.
- Inventories are not tangible long-term assets.

Long-term tangible assets also include, for example:

[55] Act No. 431/2002 Coll. on accounting as amended, § 2.
[56] *Corporate economy.* In: EuroEkonóm.sk [online] Published 25.10.2018, [Cited 20.10.2021]. Available at: https://www.euroekonom.sk/ekonomia/podnikove-hospodarstvo/
[57] Act No. 595/2003 Coll. on income tax as amended, § 22.

- land,
- protective dams,
- works of art (which are not part of constructions), but are excluded from depreciation.

Long-term intangible assets are according to the law[58] assets whose entry price is **higher than 2,400 euros** and whose usability or operational-technical functions are **longer than one year** and have an intangible nature. These are, for example, capitalized development costs:
- the results of successfully completed development work,
- design,
- production and testing of prototypes and models before the start of production,
- technological procedures,
- recipes,
- software: computer programs (purchased separately, not as part of hardware, or created by one's own activities with the aim trading with them or with the aim of using them in the company),
- valuable rights: the results of creative intellectual activity that have been acquired for payment, namely inventions, licenses, trademarks, copyrights, know-how and the like.[59]

Current property have a **short-term nature** and are the part of the company's assets that will be consumed and converted into money within a period of less than one year. It is typical for current assets that they are usually consumed once and their entire essence is included in the value of new products. In the process of the company's activity, it changes its forms - that is, it turns. Current assets can be tangible or intangible. [60] It consists of:
- **the stocks** (materials, goods),
- receivables (invoiced deliveries of work products and services)

[58] Act No. 595/2003 Coll. on income tax as amended, § 22.
[59] *Property of the enterprise - financing, procurement, depreciation.* IN: EuroEkonóm.sk [online] Published 11.10.2019, [Cited 20.10.2021]. Available at: https://www.euroekonom.sk/ekonomia/podnik-a-podnikanie/majetok-podniku/
[60] *Current (short-term) assets*. IN: EuroEkonóm.sk [online] Published 31.3.2008, [Cited 20.10.2021]. Available at: https://www.euroekonom.sk/ekonomia/podnikove-hospodarstvo/obezny-kratkodoby-majetok/

- and short-term **financial assets** (especially money in cash and current accounts, checks and short-term securities).[61]

Stocks of a construction company can consist of:

- **material,** which includes:

- raw materials,
- auxiliary substances,
- operating substances (fuel, lubricating oils, cleaning supplies),
- spare parts,
- packaging,
- **small tangible assets**,
  - unfinished production (products that have undergone one or several production stages , they are no longer a material, but they are not yet a product),
  - **semi-finished products** of own production,
  - **and products** of own production.

Short-term financial assets consist of:

- money in cash,
- valuables,
- checks,
- meal tickets,
- stamps,
- postage stamps,
- **money** deposited **in bank accounts** without a notice period, or with a notice period of less than one year and also securities,
- joint stock,
- share certificates with a maturity period of less than one year.

Economic life is the expected period of time during which the asset remains useful to the company, it may differ from the actual physical life. Assets may be in optimal

[61] JANKOVICHOVÁ, E. et al., 2016. *Construction economy I.* Brno: Tribun EU, s. 96, ISBN 978-80-263-1129-4.

physical condition, but may not be economically useful, may become obsolete due to the implementation of new technologies.[62]

Tax depreciations are derived from the economic life of long-term tangible and intangible assets, they are a monetary expression of the wear and tear of assets during the relevant period, for which they are charged to costs, they are an important cost item. The main function of depreciation is to ensure the gradual transfer of the value of the property to the costs of production and circulation and to ensure its reproduction. Tax write-offs are calculated and accounted for in accordance with Act No. 595/2003 Income Tax Act, as amended..[63]

Capital of a construction company refers to the monetary expression of the sum of the resources from which the company acquired **the property**, i.e. its **financial coverage**, it is referred to as capital, in accounting the term liability is used.

Registered capital is defined in the law as the monetary expression of the sum of monetary and non-monetary **contributions** of all partners to the company.[64]

3.2 CONSTRUCTION COMPANY PROPERTY

The determination of assets is based on the balance principle (Fig. 9) so that the property of the construction company must always be in balance with its capital. The principle is based on the balance sheet, where assets (property) must equal liabilities (capital). The structure of the property and its value must be carefully considered by the company at the beginning of the business so that the company's capital (own and external resources) is sufficient.

PROPERTY	=	**THE CAPITAL**
It is expressed by its COMPOSITION according to form and species.		It is expressed by SOURCES, by which the property was acquired.
It represents the subject area:		Represents the legal field:

[62] *Economic Life.* IN: Investopedia [online] Published 15. 10. 2020, [Cited 20.10.2021]. Available at: https://investopedia.sk/2020/10/15/hospodarsky-zivot-economic-life/
[63] JANKOVICHOVÁ, E. et al., 2016. *Construction economy I.* Brno: Tribun EU, s. 90, ISBN 978-80-263-1129-4.
[64] Law no. 513/1991 Coll. Commercial Code as amended, § 58.

What does the company own? *Where does the property come from?*

Figure 9 Balance Principle

The property of the construction company is determined in the business plan so that they are suitable according to the type of construction company and according to the Structure (Fig. 10).

Long-term financial assets and receivables are not considered in the plan due to the establishment of a new construction company that has not made a profit in the past and has no receivables. Financial short-term assets are estimated according to the proposed amount of budget costs for the economic activity of BC for the EA for the first quarter, which consist of salary costs, operating costs for the first quarter and one-time costs.

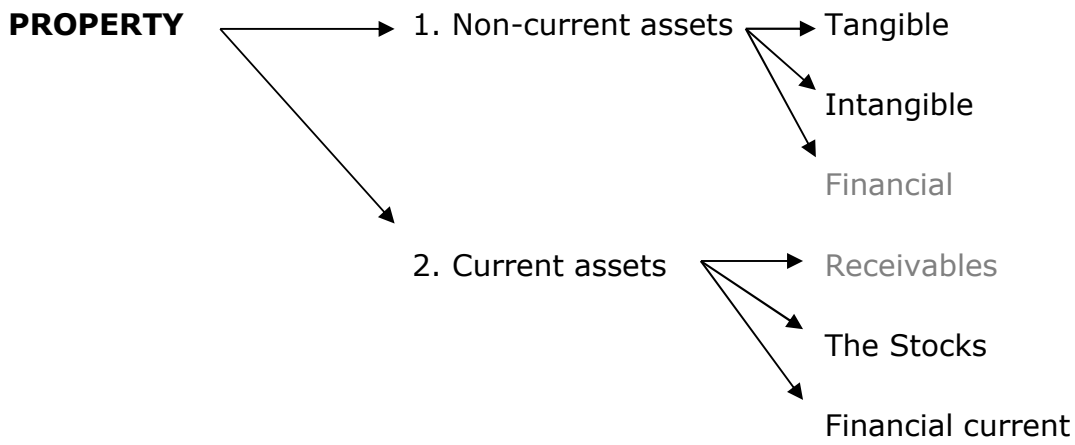

Figure 10 Structure of company property

3.2.1 Materials in Construction

Predictions for 2025 show that the prices of building materials may continue to rise, although the increase should slow down slightly compared to previous years. According to analysts, the most significant changes are expected to be in the following areas:

Timber and lumber: After a sharp increase in prices in 2021 and 2022, timber prices gradually stabilized. A slight increase is expected in 2025, primarily due to the rising costs of sustainable logging and timber production.

Cement and concrete: Cement is a material with a high energy intensity for production, so it is strongly influenced by energy prices. If energy prices remain high, cement and concrete prices are expected to rise further.

Steel: The steel market will be affected by changes in global production and steel demand in countries that are rebuilding infrastructure. Steel is one of the materials whose price can be unstable, which is why a possible price increase is expected in 2025.

Insulation materials: With the development of eco-friendly building, insulation materials, especially sustainable ones, will be increasingly in demand. This may lead to a slight increase in prices.

In order for companies and investors in the construction industry to be able to adapt to fluctuations in the price of building materials, it is important to plan and optimize supply chains in good time. Taking advantage of long-term contracts or buying during periods of lower demand can help mitigate price increases.

In building materials price predictions for 2025, experts agree that several factors will influence prices, including the global economic situation, growing environmental requirements and the demand for sustainable solutions. Construction analysts point to several key trends that can significantly affect the development of the market. **With the growing pressure to reduce the carbon footprint, experts expect an increased demand for environmentally friendly and recycled building materials.** Analysts warn that the advent of stricter environmental regulations may also increase the cost of traditional building materials, which will result in a stronger trend towards sustainable solutions.

Experts assume that new construction technologies and production processes can reduce the cost of some materials. Examples are prefabricated building elements and 3D printing, which can streamline the construction process and reduce the need for some traditional materials**.** Also, the already mentioned economic factors, such as inflation, supply chains and geopolitical instability, may significantly affect the prices of construction materials in 2025.

Building material prices in 2025 will be influenced by a variety of factors, from the global economy to local energy costs. However, with the growing need for eco-friendly solutions, the building materials market can be expected to shift towards

sustainability. This can bring both new challenges and opportunities for those who prepare for them in advance.[65]

Ultra-modern building materials are changing the way we build buildings today. Today's materials are ecological, reliable and durable, while retaining important properties such as breathability and lightness. Find out more in our list of 17 innovative building materials.

Modern materials engineering has advanced significantly in recent years. Today, there are truly new, revolutionary building materials on the market. Innovative synthetic materials are created — building materials that are lighter, stronger and more environmentally friendly than traditional building materials. These advances are stimulating a new architecture that is more environmentally friendly and at the same time completely different from what we are used to.

When a hardened binder breaks, it is a much more serious problem than many people think. It's not just about the aesthetics, although that is certainly important. No, this problem is structural: water gets into the crack and begins to erode the integrity of the concrete. In environments with unstable temperatures, this problem is exacerbated by freeze-thaw cycles. The water in the crack expands during freezing winters and imperceptibly expands each crack. Subsequently, when the ice thaws in the spring, the water penetrates deeper into the hardened binder, deepening the crack and weakening the structural integrity of the building.

But what if concrete could heal on its own? Or asphalt, or even metal? Billions of euros could be saved on repairs and reconstruction work alone, not to mention the reduction of environmental impacts that arise from the replacement of damaged materials.

Some modern building materials may find their place in specific and narrowly defined segments, but a number of innovative building materials have the potential to become widely used. Buildings made of traditional brick and concrete structures will gradually become a thing of the past, because the demands of humanity but

[65] What will be the development of prices of building materials in 2025? IN: PlanRadar.sk [online] Published 22.10.2024, [Cited 14.11.2024]. Available at: https://stavmag.sk/2024/10/22/aky-bude-vyvoj-cien-stavebnych-materialov-v-roku-2025/

new materials are obvious: we need ecological, energy-efficient, durable and lightweight buildings that will look nice and at the same time be highly functional.

The invention of the latest eco-friendly material – **transparent wood** – was announced back in 2016. However, it was not until 2020 that the scientist who, in collaboration with a team from the University of Maryland at College Park, invented a method to make wood transparent, said that the tests had been successfully completed and a stable result had been achieved. Transparent wood is at least 5 times stronger and lighter than glass, and at the same time it is more thermally efficient. It is these properties that make it an interesting potential replacement for plastic or glass windows. Other advantages of transparent wood: the raw material is renewable and environmentally friendly. Balsa wood grows quickly, with the tree growing to maturity in as little as 5 years. Production costs are also much lower than glass production, where a non-negligible carbon footprint is created due to the high temperatures required and the electricity consumed in the production process.

Transparent wood is quite flexible, as it contains natural cellulose. To achieve transparency, balsa wood is soaked in a special solution, and then epoxy resin is added to the structure. Transparent wood or glass made of wood can be used instead of traditional glass blocks or other elements in building structures, which **must be transparent but also durable, environmentally friendly and energy-efficient.**

Carbon fibre is a real material of the future – even if it has long been used in various sports. However, this innovative material is increasingly used in construction, an industry that often requires a combination of strength and lightness. Carbon fiber is 75% lighter than iron and 30% lighter than aluminum. It is used to reinforce traditional building materials to improve their strength – for example, in bricks, reinforced concrete blocks, wooden structures – as well as to reduce the thickness of the panels and thus reduce their weight. Reinforcement of concrete with carbon fiber also provides excellent thermal insulation. The only drawback that limits its widespread use is the high cost of manufacturing this material.

Innovative building materials are not always materials with innovative physical properties such as strength or safety. They can also be materials that integrate

technology providing spectacular decoration as well as the implementation of the most extravagant design ideas. A new type of finishing building material is **sensitive tiles with acrylic fiber**, which responds to your movements, touches or light sources. The optical fiber transmits light and reacts: the tile can shimmer, shine, capture and scatter adjacent colors on its surface. Decorating with this material offers new possibilities in architecture and interior design.

The term "**self-healing concrete**" sounds more than a little fantastic. In 2015, inventor Henk Jonkers from the University of Technology in Delft showed an innovative method for repairing cracks in concrete using bacteria. The principle of this technology is simple: capsules containing specific bacteria and nutrients intended for them were added to the concrete. These bacteria were activated as soon as the water touched them. The cracked concrete was rebuilt using moisture and filled with limestone, which was produced by bacteria.

In addition to this biotechnology, there is another alternative from Korean researchers, in which capsules of a certain polymer are added to concrete. Under the influence of moisture and sunlight, this polymer will also begin to react, increasing its volume and filling the crack.

Traditional concrete is a very reliable and proven building material, which, however, loses its desired properties when cracked. Many materials engineering specialists around the world are working to modernize this basic building material.

Recently, American scientists from the Polytechnic Institute in Worcester (WPI) also presented evidence that they managed to develop bioconcrete. In this case, an enzyme is added that reacts with calcium carbonate crystals releasing CO2 — their properties are similar to concrete. As a result, all cracks are filled, and the strength of the concrete is further improved. This method can restore a crack with a width of 1 mm in just one day.

Further development from the workshop of scientists from the University of Colorado is based on the principle of bacterial photosynthesis. T Bioconcrete is made up of a mixture of cyanobacteria – photosynthetic bacteria – gelatin and sand. These bacteria react to water and enlarge to fill all cavities.

Aerogel is synthetic porous ultralight material is derived from a gel in which the liquid component of the gel is replaced by a gas. The result is a very strong body

with extremely low density and low thermal conductivity. To the touch, it resembles fragile polystyrene foam. Aerogels can be made from several possible chemical compounds. For the first time, this mass was made in 1931 as the idea of Samuel Stephens Kistler. This inventor claimed that he could replace liquid with gas without shrinking the resulting structure. The first aerogels were made from silica gels. Kistler's later work concerned aerogels based on alumina, chromium oxide, and tin oxide. Carbon aerogels were first developed in the late 1980s. The peculiarity of aerogels is that they can have a lower thermal conductivity than the gas contained in them. This material is an excellent thermal insulator, therefore it is widely used for environmentally friendly and effective thermal insulation on an industrial scale. Due to the high and fine porosity of the structure, aerogels can be used as a collection matrix for the smallest dust particles.

Richlite is a durable paper composite material. It is made of waste paper that is pressed into hard smooth panels that can be further processed. Paper from the right sources is much more environmentally friendly than many of the most common materials used in construction, and this is one of the main advantages of Richlite. However, technology turns it into an amazing raw material, which is so much needed for ecological construction.

Research to improve the **quality of concrete** is one of the most popular activities in the field of materials engineering, but this may come as no surprise to anyone.

Currently, almost all buildings are based on concrete. One of the problems of concrete is its fragility if it splits and cracks. In addition, although concrete is extremely strong, its load is limited. In 2014, Singaporeans were able not only to improve strength while reducing the weight of concrete by removing reinforcement in concrete structures, but also added flexibility, which is not a characteristic feature of traditional concrete.

Thanks to a unique additive, the new ConFlexPave concrete has gained flexibility and strength that is up to three times higher than that of traditional concrete. The thinnest polymer microfibers are mixed into the solution, distributing the load over the entire surface of the cast concrete. These microfibers help it become as strong as metal and twice as strong as regular concrete when subjected to bending.

However, it seems that something is still missing from perfection, so other scientists continue to develop **flexible concrete**. For example, specialists from Swinburne University created concrete without the use of cement, but with the same excellent properties in terms of elasticity and load. This new type of concrete is also environmentally friendly, as it contains fly ash and geopolymer composites – typical waste products from coal-fired power plants. It also solidifies at room temperature, which means there is no need for excessively high production costs. Most importantly, this new concrete is up to 400 times more flexible than traditional concrete, while maintaining the same level of strength. Geopolymers not only add to the coefficient of flexibility, but also improve resistance to possible microcracks. Polymer fibers hold the structure under load even in the event of cracks, so the new material can be used in earthquake-prone areas, as the risk of collapse of buildings built of such concrete is minimized.

This revolutionary material is a concrete fabric packed in a roll. Its flexibility offers unlimited design possibilities for architects and offers new challenges for the construction industry.

Berlin-based startup Made of Air has developed a special non-toxic **bioplastic** made from biochar that comes from forest and agricultural waste. It captures carbon and can be used for everything from building facades, furniture, interiors, transportation, and urban infrastructure.

The recycled material consists of 90% carbon and is able to absorb CO2 directly from the atmosphere, while also being a carbon-negative material itself.

The carbon-rich porous material retains carbon very effectively. Unlike decaying biomass, which quickly releases carbon back into the atmosphere, biochar remains stable for hundreds or even thousands of years. The plastic made from Air's biochar is cheaper than conventional bioplastics, but still more expensive than petroleum-based materials.

The hexagonal panels, called HexChar, were first installed as a cladding material at an authorized Audi dealership center in Munich in 2021. This was the first time this product was used in the construction of a building. Life cycle analysis showed that the store envelope can absorb up to 14 tons of carbon.

Researchers at Rensselaer Polytechnic Institute in the US have invented a **hemp** alternative to steel **reinforcement** that they claim prevents corrosion problems and reduces carbon emissions during construction.

Hemp reinforcement can be used to support concrete structures in the same way that steel and other reinforcement is used today, but with less impact on the environment due to the composition of this material and its durability.

At present, rusting of steel reinforcement is the main reason for the premature demolition of structures such as bridges, roads, dams and buildings. The innovative hemp reinforcement will provide buildings with three times the durability and at the same time protection against corrosion. In addition, unlike glass fiber reinforcement in structures that are particularly susceptible to corrosion, hemp reinforcement does not require as much energy consumption in production and installation, making it a more environmentally friendly solution.[66]

3.3 START-UP CAPITAL

In the business plan, the company will determine the amount of loan capital (loan) required to start the business.

First, the company determines the need for start-up capital (SC) for the first quarter of business. Start-up capital expresses the sum of capital needed to cover non-current and current assets.

The need for capital to cover non-current assets is the sum of the need for capital for long-term tangible and intangible assets, which was proposed in chapter 3.3.

The need for capital to cover current assets is the sum of the need for capital for the stocks and financial assets (short-term), which were proposed in chapter 3.3.

The need for foreign capital is equal to the difference between the need for start-up capital and available equity capital.

When the company was founded, it has not yet produced any profit, it has no other equity than private capital, which is invested by the partners as the registered capital when the company is founded. fig. 11.

[66] 17 Innovative Building Materials That Are Changing the Way We Build IN: PlanRadar.sk [online] Published 13.09.2022, [Cited 14.11.2024]. Available at: https://www.planradar.com/sk/inovativnych-stavebnych-materialov/

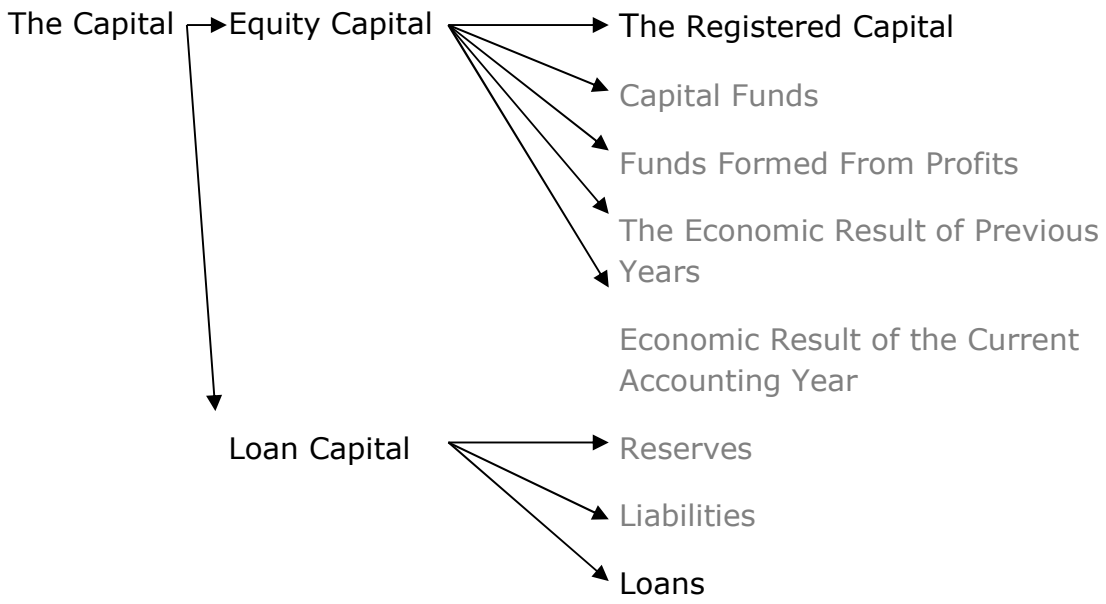

Figure 11 Capital structure

The minimum registered capital for a limited liability company in Slovakia is set at 5,000 euros.

The law[67] does not establish the obligation to create a reserve fund when the company is established, it is created compulsorily from the profit from the first year of business. In the amount of at least 5% of the net profit, but not more than 10% of the share capital. A reserve fund can be created already at the time of the establishment of the company by a provision in the articles of association.

A limited liability company guarantees its obligations to creditors with all of its assets. That is, not with the property of a partner or manager, but only with the company's own property, which is available to him.

3.4 TAX DEPRECIATION POLICY

In the first year of depreciation, the company classifies tangible assets into depreciation categories according to Annex No.1 to the Income Tax Act, selected items of assets are listed in tab. 1. For each depreciation group, the depreciation period is expressed in tab. 2.

[67] Law no. 513/1991 Coll. Commercial Code as amended, § 124.

All calculations under the Income Tax Act shall be made to two decimal places, the second digit after the decimal point being adjusted according to the digits that follow it, so that:

a) the rounded digit followed by a digit less than five remains unchanged,

b) a rounded digit followed by the digit five or a digit greater than five is increased by one.[68]

Table 1 Classification of tangible assets in depreciation categories[69]

Depreciation Category	Item	CPA	Property Name
0	0-1	29.10.2	Only: passenger cars having in the registration certificate Part II in Item "18 P.3 Fuel type/energy source" the designation - "BEV" or - "PHEV" in any combination with another fuel type or energy source.
1	1-1	01.41.10	Dairy cattle, live
	1-2	01.42.11	Other cattle and buffaloes, except calves, live
	1-3	01.43.10	Only: other equines, live
	1-4	01.45.1	Sheep and goats, live
	1-5	01.46.10	Swine, live
	1-6	01.47.13	Geese, live
	1-7	13.92.22	Tarpaulins, awnings and sunblinds; sails for boats, sailboards or landcraft; tents and camping goods
	1-8	22.29	Other plastic products
	1-9	23.19.2	Technical and other glass

[68] Law no. 595/2003 Coll. on income tax as amended, § 47.
[69] Law no. 595/2003 Coll. on income tax as amended, Annex No.1.

	1-10	23.44	Other technical ceramic products
	1-11	23.9	Other non-metallic mineral products
	1-12	25.73	Other hand tools except for - 25.73.5 - Moulds; moulding boxes for metal foundry; mould bases; moulding patterns - Other tools
	1-13	26.2	Computers and peripheral equipment
	1-14	26.3	Communication equipment
	1-15	26.4	Consumer electronics
	1-16	26.51	Measuring, testing and navigating equipment
	1-17	26.7	Optical instruments and photographic equipment
	1-18	28.23	Office machinery and equipment (except computers and peripheralequipment)
	1-19	28.24	Power-driven hand tools
	1-20	28.29.3	Industrial, household and other weighing and measuringmachinery
	1-21	28.3	Agricultural and forestry machinery
	1-22	28.93	Machinery for food, beverage and tobacco processing
	1-23	28.94	Machinery for textile, apparel and leather production
	1-24	29.10.2	Passenger cars except for - passenger cars having in the registration certificate Part IIin Item "18 P.3 Fuel type/energy source" the designation - "BEV" or "PHEV" in any combination with another fuel type or energy source
	1-25	29.10.3	Motor vehicles for the transport of 10 or more persons (buses) except trolleybuses and electric buses
	1-26	29.10.4	Motor vehicles for the transport of goods
	1-27	30.92	Bicycles and invalid carriages
	1-28	32.40	Games and toys except for - 32.40.4 - Other games

	1-29	32.9	Manufactured goods not elsewhere classified
2	2-1	01.43.10	Only: horses - live
	2-2	13.9	Other textiles except for - 13.92.22 - Tarpaulins, awnings and sunblinds; sails for boats, sailboards or landcraft; tents and camping goods
	2-3	15	Leather and related products
	2-4	16.23.2	Prefabricated wooden buildings unless they are standalone structures connected to utility infrastructure
	2-5	22.23.2	Prefabricated buildings of plastics unless they are standalone structures connected to utility infrastructure
	2-6	25.21	Central heating radiators and boilers
	2-7	25.7	Cutlery, tools and general hardware except for - 25.71.15 - Swords, cutlasses, bayonets, lances and similar arms and parts thereof - 25.73 - Tools
	2-8	25.9	Other fabricated metal products except for - 25.99.2 - Other articles of base metal
	2-9	26.52	Watches and clocks
	2-10	26.6	Irradiation, electromedical and electrotherapeutic equipment
	2-11	27.11.31	Generating sets with compression-ignition internal combustion piston engines
	2-12	27.2	Batteries and accumulators
	2-13	27.3	Wiring and wiring devices
	2-14	27.4	Electric lighting equipment
	2-15	27.5	Domestic appliances
	2-16	27.9	Other electrical equipment
	2-17	28.11.11	Outboard motors for marine propulsion
	2-18	28.12	Fluid power equipment
	2-19	28.13	Other pumps and compressors
	2-20	28.22	Lifting and handling equipment

	2-21	28.25.13	Refrigeration and freezing equipment and heat pumps, except household type equipment
	2-22	28.29	Other general-purpose machinery not elsewhere classified except for - 28.29.1 - Gas generators, distilling and filtering apparatus - 28.29.3 - Industrial, household and other weighing and measuring machinery
	2-23	28.4	Metal forming machinery and machine tools
	2-24	28.92	Machinery for mining, quarrying and construction
	2-25	28.95	Machinery for paper and paperboard production
	2-26	28.96	Plastics and rubber machinery
	2-27	28.99	Other special-purpose machinery not elsewhere classified
	2-28	29.10.3	Only: trolleybuses and electric buses
	2-29	29.10.5	Special-purpose motor vehicles
	2-30	29.2	Bodies (coachwork) for motor vehicles; trailers and semi-trailers
	2-31	30.20.33	Only mining rail vehicles and local tracks (special-purpose railways)
	2-32	30.91.1	Motorcycles and side-cars
	2-33	30.99	Other transport equipment not elsewhere classified
	2-34	31.0	Furniture
	2-35	32.2	Musical instruments
	2-36	32.3	Sports goods
	2-37	32.40.4	Other games
	2-38	32.5	Medical and dental instruments and supplies
	2-39		Technical improvement of immovable cultural monument
	2-40		Individual separable parts inbuilt in buildings intended for separate depreciation (Article 22 (15)) - computer network distribution systems

	2-41		Summary of technical improvements and repairs carried out on buildings, in which spa care and related services are provided
3	3-1	27.1	Electric motors, generators, transformers and electricity distribution and control apparatus except for - 27.11.31 - Generating sets with compression-ignition internal combustion piston engines
	3-2	28.11.12	Marine propulsion spark-ignition engines; other engines
	3-3	28.11.13	Other compression-ignition internal combustion piston engines
	3-4	28.11.2	Turbines
	3-5	28.21.1	Ovens and furnace burners and parts thereof
	3-6	28.25	Non-domestic cooling and ventilation equipmentexcept for - 28.25.13 - Refrigeration and freezing equipment and heat pumps, except household type equipment
	3-7	28.29.1	Gas generators, distilling and filtering apparatus
	3-8	28.91	Machinery for metallurgy
4	4-1	23.61.20	Prefabricated buildings of concrete unless they are standalone structures connected to utility infrastructure
	4-2	25.11.10	Prefabricated buildings of metal unless they are standalone structures connected to utility infrastructure
	4-3	25.29	Other tanks, reservoirs and containers of metal
	4-4	25.3	Steam generators, except central heating hot water boilers
	4-5	25.4	Weapons and ammunition
	4-6	25.71.15	Swords, cutlasses, bayonets, lances and similar arms and parts thereof

	4-7	25.99.2	Other articles of base metal
	4-8	30.11	Ships and floating structures
	4-9	30.12	Pleasure and sporting boats
	4-10	30.2	Railway locomotives and rolling stock
	4-11	30.3	Air and spacecraft and related machinery
	4-12	30.4	Military fighting vehicles
	4-13		Silvicultural units of permanent growths with a period of productiveness longer than three years
	4-14		2213 KS - Long-distance telecommunication networks and lines
	4-15		2224 KS - local electrical and telecommunication distribution systemsand lines
	4-16		Small buildings specified by a special regulation[107)] except for Article22 (2) (b) Point 2
	4-17		Individual separable parts inbuilt in buildings intended for separate depreciation (Article 22 (15)) - air-conditioning equipment - passenger and freight lifts - escalators and travelators
		KS	
5	5-1	1	Buildings except for codes provided in Depreciation Category 6
	5-2	2	Civil engineering structures except for the codes included in Depreciation Categories 4 and 6 and except for individual separable parts included in Depreciation Categories 2 and 4
6	6-1	11	Apartment buildings
	6-2	121	Hotels and similar buildings
	6-3	1220	Buildings for administration
	6-4	126	Buildings for culture and public entertainment, education and

			healthcare
	6-5	127	Other non-residential buildings except for - 1271 - Non-residential agricultural buildings - 1274 - Other buildings not elsewhere classified only buildings and barracks for firemen
	6-6	24	Other civil engineering structures

Notes:

1) Item - designates the Depreciation Category number (1 to 6) and the serial number of item in the respective Depreciation Category.

2) CPA - code of statistical classification of products by activity (CPA) issued by Regulation (EC) No. 451/2008 of the European Parliament and of the Council of 23 April 2008, which is decisive for the classification of tangible assets under Depreciation Categories. If for the sake of text briefness, the name is specified otherwise, the CPA code shall be decisive.

3) Name - content specification of individual items and codes mostly using the text of CPA or KS text.

4) KS - classification code laid down by Decree of the Statistical Office of the Slovak Republic No. 323/2010 Coll. issuing the Statistical Classification of Buildings.

The tangible assets, which cannot be classified under Depreciation Categories pursuant to the annex and whose useful life does not result from other regulations, shall be, for the purpose of depreciation, classified under Depreciation Category 2.

Table 2 Depreciation Period [70]

Depreciation Category	Depreciation Period [years]
0	2
1	4
2	6
3	8
4	12

[70] Law no. 595/2003 Coll. on income tax, as amended, § 26.

5	20
6	40

In the first year of depreciation, depreciation calculated using the even depreciation method is the same as depreciation according to the accelerated method. With even depreciation, the purchase price of long-term tangible assets is reflected through depreciation into tax expenses evenly during the depreciation period, depending on the depreciation group.

In the case of accelerated depreciation, the purchase price is reflected in tax expenses unevenly, while the depreciation is the highest at the beginning of the set depreciation period, and the amount of depreciation gradually decreases in the following years.

The choice of depreciation method must be considered, because the selected method cannot be changed. Changing from even depreciation to accelerated depreciation or vice versa is not possible.

The accelerated method of depreciation has the effect of reducing the tax base, or increasing the tax loss at the beginning of the period of depreciation of tangible assets. In the last years of depreciation, compared to the even depreciation method, it has a lower amount of tax depreciation.[71]

3.4.1 Even Depreciation of Tangible Assets

With even depreciation, the annual depreciation (AD; tab. 3) (3.1) is determined as a division of the entry price (EP) of tangible assets and the period of depreciation (PD) established for the relevant depreciation categories according to tab. 3.

Table 3 Annual Depreciation [72]

Depreciation Category	Annual Depreciation
0	1/2

[71] *What method to choose for asset depreciation?* IN: HNonline.sk [online] Published 25.04.2012, [Cited 20.10.2021]. Available at: https://hnonline.sk/prakticke-hn/405571-aku-metodu-zvolit-na-odpisovanie-majetku
[72] Zákon č. 595/2003 Z. z. o dani z príjmov v znení neskorších predpisov, § 26.

1	1/4
2	1/6
3	1/8
4	1/12
5	1/20
6	1/40

The depreciation price (DP) (3.2-5) in the following years is expressed by subtracting the annual depreciation from the entry price in the first year and in the following year from the depreciated price in the previous year.

$$AD = EP / PD \quad (3.1)$$

$$DP^1 = EP - AD \quad (3.2)$$

$$DP^2 = DP^1 - AD \quad (3.3)$$

$$DP^3 = DP^2 - AD \quad (3.4)$$

$$DP^4 = DP^3 - AD \quad (3.5)$$

The annual depreciation rate is the substitution of numerical values in the in the formula for annual depreciation.

In the first year of depreciation of the tangible assets, only a proportional part of the annual depreciation shall be applied, calculated according to table 5 depending on the number of months, starting from the month, when they were put into use, to the end of this tax period. If during the period of depreciation of tangible assets:

a) no technical improvement of the tangible assets was carried out, the proportional part of this annual depreciation, which was not applied, shall be applied in the year following the year of expiry of the period of depreciation of tangible assets pursuant to table 1,

b) a technical improvement of the tangible assets was carried out, the proportional part of this annual depreciation, which was not applied, shall be applied pursuant to:

On the execution of the technical improvement or reduction of the depreciation period, the tangible assets depreciation shall be completed up to the amount of the entry price, possibly increased by the technical improvement performed using

the valid annual depreciation rate or up to the amount of the depreciated price or increased depreciated price using the coefficient for the respective Depreciation Category. Technical improvement performance shall extend the period of depreciation by the period resulting from the method of calculation.

3.4.2 Accelerated Depreciation of Tangible Assets

In the case of accelerated depreciation of tangible assets, coefficients for accelerated depreciation are assigned to depreciation categories 2 and 3 according to tab. 4.

Table 4 Koefficients

Depreciation Category	In the first year of depreciation	In the next years of depreciation	For an increased depreciated price
2	6	7	6
3	8	9	8

For the accelerated depreciation of tangible assets, depreciations of tangible assets shall be determined as follows:

a) in the first year of depreciation of tangible assets, only a proportional part of the annual depreciation determined as the quotient of the entry price (EP) and the assigned coefficient (CO) for accelerated depreciation of tangible assets valid in the first year of depreciation (3.6), depending on the number of months, starting from the month, when they were put into use, till the end of this tax period,

b) in the next years of depreciation of tangible assets, as the quotient of twice the depreciated price (DP) and the difference between the assigned coefficient (CO) for accelerated depreciation valid in the next years of depreciation and the number of years (DY), during which they were already depreciated; only for the purpose of calculation of annual depreciations (3.8).
In the second year of depreciation, the depreciated price (DP) of tangible assets shall be determined as the difference between the entry price (EP) and the quotient of their entry price (EP) and the assigned coefficient (CO^1) for accelerated

depreciation valid in the first year of depreciation not reduced by the proportional part of the annual depreciation not applied in the tax expenditures in the first year of depreciation (3.7)

In the next years of depreciation, the depreciated price determined pursuant to previous ones shall be reduced by the annual depreciations of these assets included in tax expenditures, starting from the second year of depreciation (3.9).

$$AD^1 = EP / CO^1 \quad (3.6)$$

$$DP^1 = EP - AD^1 \quad (3.7)$$

$$AD^i = 2*DP^{i-1} / (CO^i - DY) \quad (3.8)$$

$$DP^i = DP^{i-1} - AD^i \quad (3.9)$$

Where:

i = 2-6 at the 2nd depreciation category and 2-8 at the 3rd depreciation category.

For accelerated depreciation of tangible assets after a technical improvement has been carried out, the depreciations shall be determined as follows:

a) in the year of an increase in the depreciated price as the quotient of twice this price of tangible assets and the assigned coefficient of accelerated depreciation valid for the increased depreciated price,

b) in the next years of depreciation as the quotient of twice the depreciated price of tangible assets and the difference between the assigned coefficient of accelerated depreciation valid for the increased depreciated price and the number of years, during which they were depreciated from the increased depreciated price.

3.5 STRUCTURE OF PROPERTY CALCULATION

The draft structure of the table with the breakdown of the company's assets is shown in tab. 5.

Table 5 Structure of the Property Calculation

Property and its structure	Cost [€/no]	Number [no]	Total Price [€]
1. Non-current assets (NA) Total:			
a) *Tangible long-term assets Total:*			
- (machines, car, computer, ...)			
b) *Intangible long-term assets Total:*			
- (software,.....)			
2. Current assets (CA) Total:			
c) *The stocks Total:*			
- (material, goods, ...)			
d) *Financial assets Total:*			
- (Bank account, money, ...)			
TOTAL Property (NA+CA)			

3.6 CALCULATION OF NEED FOR START-UP CAPITAL

The proposal of the structure of the table for calculating the starting capital of the company is shown in tab. 6.

Table 6 Structure of the Calculation of the Need for Start-Up Capital

1. The need for capital to cover non-current assets:	**.....**
- Tangible long-term assets	.....
55 - Intangible long-term assets	.....
2. The need for capital to cover current assets:	**.....**
- The Stocks	.....
- Financial assets - its estimation	.....
The need for start-up capital (SC) Total	**.....**
– *Available equity capital*	.....
= **Need for capital - loan:**	.....

3.7 CALCULATING TAX DEPRECIATIONS

Even Depreciation – *Example 1*
Type of property: ***Porsche 911 Carrera S 2025*** *; Entry price (EP) of the property:* ***45000 €***;
Depreciation Category: ***1***

Calculation:
Annual depreciation (AD)=EP/ period of depreciation (PD)= 45000/4=11250€
Depreciation price (DP^1) after the 1st year (EP-PD)= 45000-11250=33750€
Depreciation price (DP^2) after the 2nd year (DP^1-AD)= 33750-11250=22500€
Depreciation price (DP^3) after the 3rd year (DP^2-AD)= 22500 – 11250=11250€
Depreciation price (DP^4) after the 4th year (DP^3-AD)= 11250-11250=0€
The annual depreciation rate (ADR) = 45000/4

Even Depreciation – *Example 2*
Type of property: ***Car, Škoda SUPERB****;*
Entry price (EP) of the property: ***35000€***;
Depreciation Category: ***1***

Calculation:
Annual depreciation (AD)=EP/ period of depreciation (PD)=
35000/4 = 8750 €
Depreciation price (DP^1) after the 1st year (EP-PD)=
35000– 8750= 26250 €
Depreciation price (DP^2) after the 2nd year (DP^1-AD)=
26250 – 8750= 17500 €
Depreciation price (DP^3) after the 3rd year (DP^2-AD)=
17500 – 8750= 8750€
Depreciation price (DP^4) after the 4th year (DP^3-AD)=
8750– 8750= 0 €
The annual depreciation rate (ADR) = 22 800/4

Accelerated Depreciation *– Example 1*

Type of property: **Excavator**;

Entry price (EP) of the property: **30 000€,**

Depreciation Category: ***2;***

Coefficient *(CO): in the 1st year =* ***6****, in the 2nd-6th year =* ***7***

Calculation:

Annual depreciation (AD^1)=EP/CO^1 = 30000/6= 5000€

Depreciated price DP^1 = EP - AD^1 = 30000–5000 = 25000€

Annual depreciation AD^2= $2*DP^{2-1}$ / (CO^2-DY) = (2*25000)/(7-1)= 8333,33€

(DY – number of years of depreciation)

Depreciated price DP^2= DP^{2-1} – AD^2 = 25000-8333,33= 16666,67€

Annual depreciation AD^3= $2*DP^{3-1}$ / (CO^3-DY) = (2*16666,67)/(7-2)= 6666,67€

Depreciated price DP^3 = DP^{3-1} – AD^3 = 16666,67-6666,7= 10000€

Annual depreciation AD^4= $2*DP^{4-1}$ / (CO^4-DY) = (2*10000)/(7-3)= 5000€

Depreciated price DP^4 = DP^{4-1} – AD^4= 10000-5000= 5000€

Annual depreciation AD^5= $2*DP^{5-1}$ / (CO^5-DY) = (2*5000)/(7-4)= 3333,33€

Depreciated price DP^5 = DP^{5-1} – AD^5 = 5000-3333,33= 1666,67€

Annual depreciation AD^6= $2*DP^{6-1}$ / (CO^6-DY) = (2*1666,67)/(7-5)= 1666,67€

Depreciated price DP^6 = DP^{6-1} – AD^6 = 1666,67-1666,67= 0€

Accelerated Depreciation *– Example 2*

Type of property: **Lifting Scaffolding**;

Entry price (EP) of the property: **6660 €,**

Depreciation Category: ***2;***

Coefficient *(CO): in the 1st year =* ***6****, in the 2nd-6th year =* ***7***

Calculation:

Annual depreciation (AD^1)=EP/CO^1 = 6660/6 = 1110 €

Depreciated price DP^1 = EP - AD^1 = 6660 – 1110 = 5550€

Annual depreciation AD^2= 2*DP^{2-1} / (CO^2-DY) 2*5550/(7-1) = 1850 €

(DY – number of years of depreciation)

Depreciated price DP^2= DP^{2-1} – AD^2 = 5550 – 1850 = 3700 €

Annual depreciation AD^3= 2*DP^{3-1} / (CO^3-DY) = 2*3700/(7-2) = 1480€

Depreciated price DP^3 = DP^{3-1} – AD^3 = 3700 – 1480= 2220 €

Annual depreciation AD^4= 2*DP^{4-1} / (CO^4-DY) = 2*2220/(7-3) = 1110 €

Depreciated price DP^4 = DP^{4-1} – AD^4= 2220 – 1110 = 1110 €

Annual depreciation AD^5= 2*DP^{5-1} / (CO^5-DY) = 2*1110/(7-4) = 740 €

Depreciated price DP^5 = DP^{5-1} – AD^5 = 1110 – 740 = 370 €

Annual depreciation AD^6= 2*DP^{6-1} / (CO^6-DY) = 2*370/(7-5) = 370 €

Depreciated price DP^6 = DP^{6-1} – AD^6 = 370 – 370 = 0

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4 BUILDING MANAGEMENT IN SLOVAKIA

The aim of the chapter is to present the current situation and challenges for building management in Slovakia. The article points out the importance of facility management in making decisions about the facility in the current global situation and the ongoing risk of the pandemic. It briefly describes the current situation of service providers and clients in connection with the operation of buildings in selected aspects such as the ongoing increase in prices of materials and works, the implementation of apartment construction, or construction production. Many other indicators are important for evaluating the overall situation in facility management, which cannot all be included in one article due to the scope.

Building management is a complex set of activities that ensure the smooth operation, maintenance and long-term functionality of a building. It includes a wide range of tasks, from technical services to administrative activities, with the aim of maintaining the building in optimal condition and providing users with a comfortable and safe environment.
Facility management (FM) is aimed at optimizing and streamlining the operation of buildings and all services associated with it. It is a modern approach to property management that goes beyond traditional maintenance and includes a wide range of activities from technical services to human resources management. Facility management is a complex and dynamic process that requires professional knowledge and experience. Its goal is to ensure that the building is functional, safe, comfortable and energy efficient. By implementing facility management, organizations can significantly improve their efficiency and reduce operating costs.

4.1 BUILDING MANAGEMENT FROM A FACILITY MANAGEMENT PERSPECTIVE

The current situation in the economy of the Slovak Republic is in a difficult situation. The field of facility management is no exception. Facility management is, according to the international organization of facility management, a way to coordinate workers, work activities and the work environment in organizations, which includes the laws of architecture, business administration, technical and humanities. The goal of FM is strengthening all processes with the help of which

workers work with the highest efficiency in the workplace and thus ensure the overall economic growth and success of the organization.[73]
Standard ISO 41011 defines facility management as integrating processes within the organization, with the help of which agreed services are secured and developed, which help and make the basic activities of the organization more efficient.[74]

The task of FM is to make correct decisions and manage all supporting activities of companies and organizations. At a time of rising energy prices, inflation, operating costs, wages, or increasing all inputs, the involvement of facility management is essential. The general effort is to ensure the functioning of businesses and organizations that facility managers and strategic management of organizations have the opportunity to influence.

Currently, the greatest degree of influence on the functioning of companies and organizations is exerted by:
- the state, together with possible regulations and measures,
- great market volatility, even increasing in all areas,
- security of supply chains,
- the international situation affecting a range of factors.

According to the available financial and statistical data, the current state only for selected indicators that have an impact on the operation of buildings: material prices, construction production and the actual construction of apartments - their quantity.

The general view of the situation of facility management in Slovakia in 2024 is influenced by two important events. The beginning of the year is still marked by the ongoing coronavirus pandemic, and the second event is the international situation in Ukraine.[75]

[73] SOMOROVÁ, V., 2010. Údržba budov. Facility management. Bratislava: Publishing STU. ISBN 978-80-227-3372-4.
[74] STN EN ISO 41011: 2024. Facility management. Vocabulary
[75] Stavmag.sk, 2024. Stavebný materiál v roku 2024 – aké sú prognózy vývoja cien? [accessed at 2024-11-09]. Available at: https://stavmag.sk/2024/06/09/stavebny-material-v-roku-2024-ake-su-prognozy-vyvoja-cien/

During the coronavirus pandemic, providers largely implemented measures, e.g.:
- implementation of new guidelines and measures in health and safety, regular informing of employees,
- cancellation of larger events,
- introduction of home office, stoppage of work/business trips,
- digitization,
- other measures.

During the coronavirus pandemic, clients largely implemented measures, e.g.:
- increased cooperation with facility managers, facility management providers,
- introduction of home office, stoppage of work/business trips,
- implementation of new health and safety guidelines, regular informing of employees,
- cancellation of larger events,
- digitization,
- other measures.

The current situation is significantly influenced by the situation in Ukraine, international sanctions, and the related measures of state authorities. Providers of facility management services as well as clients must solve and propose several measures.

Facility management service providers claim:
- high inflation in all market segments and pressure to increase wages (including the minimum wage),
- high inflation, increasing prices of materials, technical equipment, and the necessity of opening tendered contracts due to increasing operating costs of buildings,
- lack of goods, late delivery times and related penalties,
- reduction of areas in administrative buildings by the introduction of "home office" and the resulting pressure to reduce prices while maintaining the same quality of building management, property management,
- high competition between FM service providers, unfair practices in competition,

- compared to the previous period, there is a general shortage of workers and equally qualified workers. An improvement would be an increased quality of education (education, postgraduate education, professional education),
- the time allocated for the training of workers increases. Applying new control IT systems and the increasing complexity of operating these systems. The unification of IT systems in facility management would help,
- additional.

Clients of facility management services in the context of the current situation are implementing measures:
- reduction of operating costs by introducing a "home office" and reduction of own space needs, increased interest in the use of shared offices,
- reducing investments in buildings (reconstruction, modernization),
- due to inflation and the increase in the prices of goods, the opening of selection procedures, tenders, e.g.: energy, furniture, services,
- additional.

4.2 BUILDING MANAGEMENT FROM THE PERSPECTIVE OF PRICE DEVELOPMENT

The rise in construction prices is a complex issue that affects many factors. Although some stabilization is expected, it is likely that construction and real estate prices will continue to be higher than in the past. The rise in construction prices is a complex issue that affects many factors. Although some stabilization is expected, it is likely that construction and real estate prices will continue to be higher than in the past.

Increased energy prices have affected the production of construction materials. Global supply chain problems have caused shortages of some raw materials, which has led to their increased prices.

The overall price increase has also affected the prices of construction materials. There is a shortage of qualified workers in the construction industry, which leads to higher wage demands. Increased requirements for occupational health and safety increase the costs of operating construction sites. Requirements for energy efficiency and environmentally friendly materials increase construction costs.

Complicated permits and administrative processes extend construction times and increase costs. Growing demand for new apartments, office space and infrastructure is increasing pressure on prices.

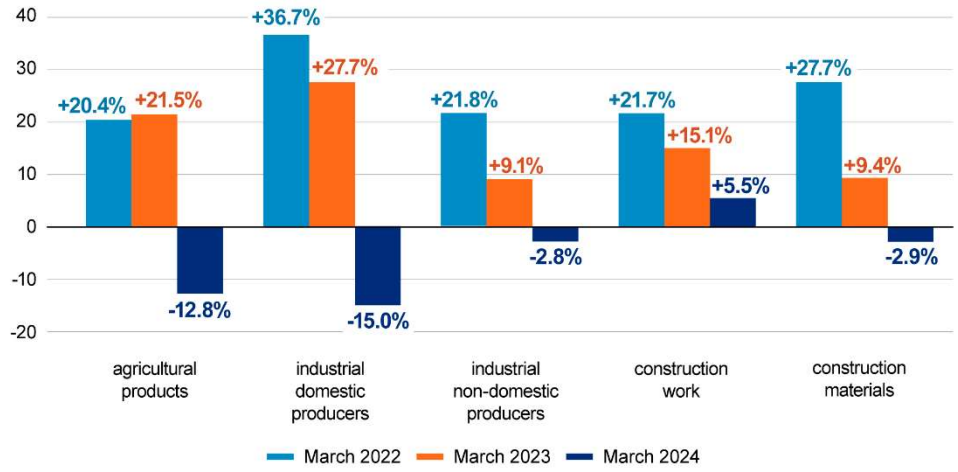

Figure 12 - The Situation in the Slovak Republic in the Listed Industries, Change in prices in the production sector (year-on-year in %)[76]

Construction prices (fig.12) were 5.5 percent higher year-on-year in March, but the growth rate increased by 0.7 percent compared to February. In total, for the first three months of 2024, construction prices were 5.9 percent higher year-on-year. Prices of materials consumed in construction were 2.9 percent lower year-on-year in March, falling for seven consecutive months. Compared to February, prices were 1.4 percent higher. In total, since the beginning of the year, prices of materials consumed in construction were 2.3 percent lower year-on-year.[77]

4.3 BUILDING MANAGEMENT FROM THE PERSPECTIVE OF CONSTRUCTION PRODUCTION

Another important indicator is construction production. It includes work on the construction, reconstruction, expansion, restoration, repair, and maintenance of construction objects. The definition of construction production also includes the assembly work of building structures and the value of the built-in material. In

[76] Slovak.statistics.sk, 2024. Price indices in production area in March 2024. [accessed at 2024-11-11]. Available at: https://slovak.statistics.sk/wps/portal/ext/products/informationmessages/inf_sprava_detail/5cf9c879-9851-48c6-9448

[77] Trend.sk, 2024. Ceny stavebných prác boli v marci vyššie, no materiál zlacnel. [accessed at 2024-11-09]. Available at: https://www.trend.sk/spravy/ceny-stavebnych-prac-boli-marci-vyssie-material-zlacnel

addition to supplier construction companies, there are also non-construction companies (construction plants).

The total construction production in the country for the year 2023 was made up of:
New construction, renovations, and modernizations – 63,8%.
Repairs and maintenance – 22,6%.
Other work - 3.6%.
Construction production abroad – 10,1%.

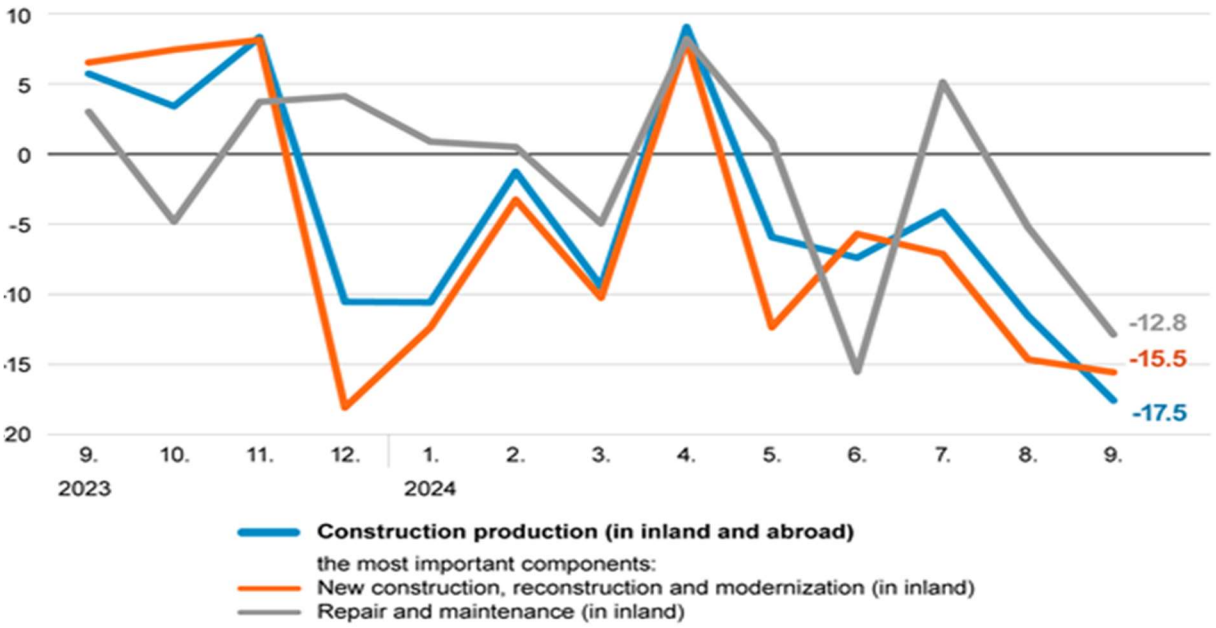

Figure 13 - Construction production of enterprises in the Slovak Republic (in constant prices, year-on-year in %)[78]

The lag in the construction industry (fig. 13) deepened in September 2024 to the highest value since October 2020. All components of production dropped by double digits, both domestic and non-domestic production.

Production of construction enterprises in September 2024 reached EUR 672 million, year-on-year after conversion to constant prices, it dropped by up to 17.5%. This is the deepest decline in monthly results since October 2020. The

[78] Slovak.statistics.sk, 2024. Construction production in September 2024. [accessed at 2024-11-11]. Available at: https://slovak.statistics.sk/wps/portal/ext/products/informationmessages/inf_sprava_detail/!ut/p/z1/rVPLctowFP2WLlgKXcuyLS0NSQwEmBrHPLzpyJIMqsE44DpNv76iaadpMgQWtWas17lXV

construction sector has been slowing down (year-on-year) since December last year, with the exception of April this year. Compared to August, construction production decreased by 3.9%.

All components of construction production ended in a double-digit decline. Domestic new construction dropped by 15.5%, repairs and maintenance by 12.8%, the smallest component – other construction works by more than a quarter. Domestic construction production represented more than 89% of the total volume of construction.

In the 4th quarter of 2023, completion of dwelling construction progressed dynamically to record values and helped to increase a year-on-year value of completed dwellings. At the end of the year, issuing of building permits was also more dynamic, but it could not compensate for the negative developments of the three previous quarters, the start of construction decreased by double digits in the summary for whole year.

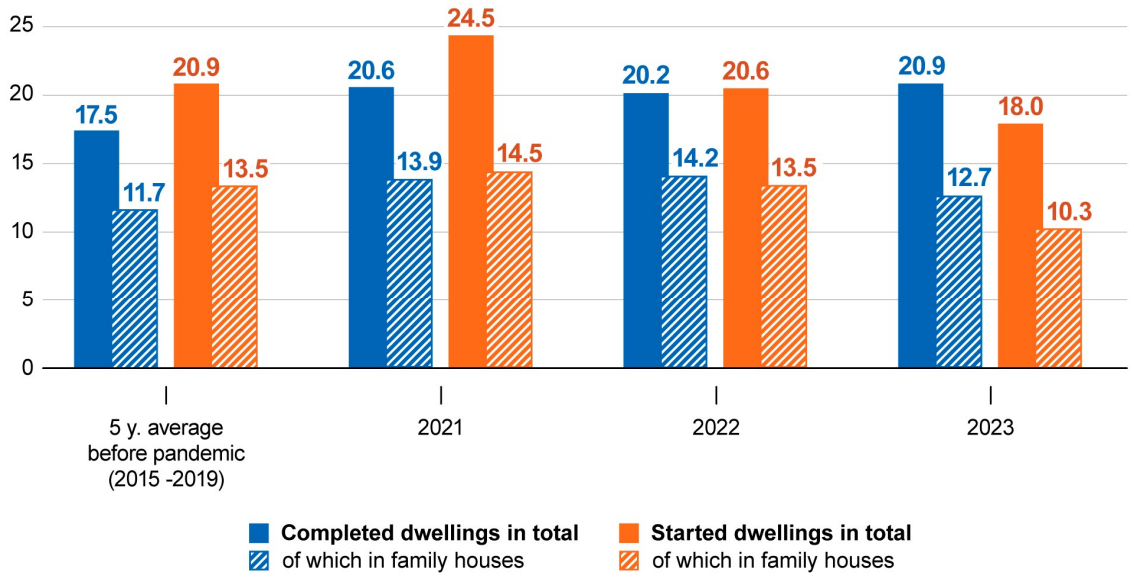

Figure 14 – Housing construction in the SR, number of dwellings in thousands[79]

[79] Slovak.statistics.sk, 2024. Housing construction in the 4th quarter and in 2023. [accessed at 2024-11-09]. Available at: https://slovak.statistics.sk/wps/portal/ext/products/informationmessages/inf_sprava_detail/!ut/p/z1/rZNfc5pAFMU_Sx58XPcCu

In total, for the first nine months of 2024, the value of construction production exceeded EUR 5.1 billion, which was by 7.2% less year-on-year. They slowed down all its components, the dominant new construction by 8.7% and repairs and maintenance by 3.3%. In terms of the production focus, construction of buildings decreased by 4.8% and works on engineering constructions by 13.3%. Works abroad also lagged behind, by 3.1%.

Higher number of completed dwellings, a decreasing construction rate and a slower starting of new construction characterized dwelling construction in 2023 (fig. 14), a total of 20,891 dwellings were completed in the SR, it was only by 3.3% higher than in 2022. In the long term, current construction was more dynamic than before the pandemic2), the number of completed dwellings exceeded the pre-pandemic average by a fifth. In 2023, the current number of completed dwellings represented the second highest value since the establishment of independent Slovakia. The number was higher than last year only in 2020.

The current situation of building management with ensuring functional, trouble-free and above all efficient operation of buildings is challenging. One of the important tasks is timely and mutual communication between building managers and the strategic management of organizations for correct decision-making and policy in the management of organizations. In this way and with their experience, managers can internally help and facilitate the operation of organizations. However, external organizations and businesses in the current situation need support from the state, by ensuring both energy supplies and energy prices, stabilizing and reducing prices in all areas, or measures and assistance for organizations.

Building management faces several challenges that are influenced by changes in technology, legislation, economics and social expectations. The most significant include the pressure to reduce greenhouse gas emissions and the transition to renewable energy sources and the ever-increasing demands for energy efficiency in buildings. These include: replacing old heating and cooling systems with more modern and energy-efficient solutions, implementing intelligent systems to optimize energy consumption and increase user comfort, using green infrastructure to improve energy efficiency and biodiversity, digitalization and

automation, using sensors and the Internet to monitor and control technical building systems. The latest challenges include the application of artificial intelligence for predictive maintenance, optimizing operations and increasing safety, improving indoor air quality and ensuring a healthy working environment. A separate category is the lack of young professionals in the field of building management, as well as the need for lifelong learning, constantly changing technologies and requirements require regular training of workers. Rising prices for energy, materials and services are putting ever-increasing pressure on cost reductions, so it is necessary to find new ways to reduce the operating costs of buildings.

Construction production (graph 1) in the Slovakia for the year 2023 was made up of 22,6% by **repairs and maintenance,** it represents a high proportion of maintenance and repair costs, which is due to the lack of attention to maintenance itself.

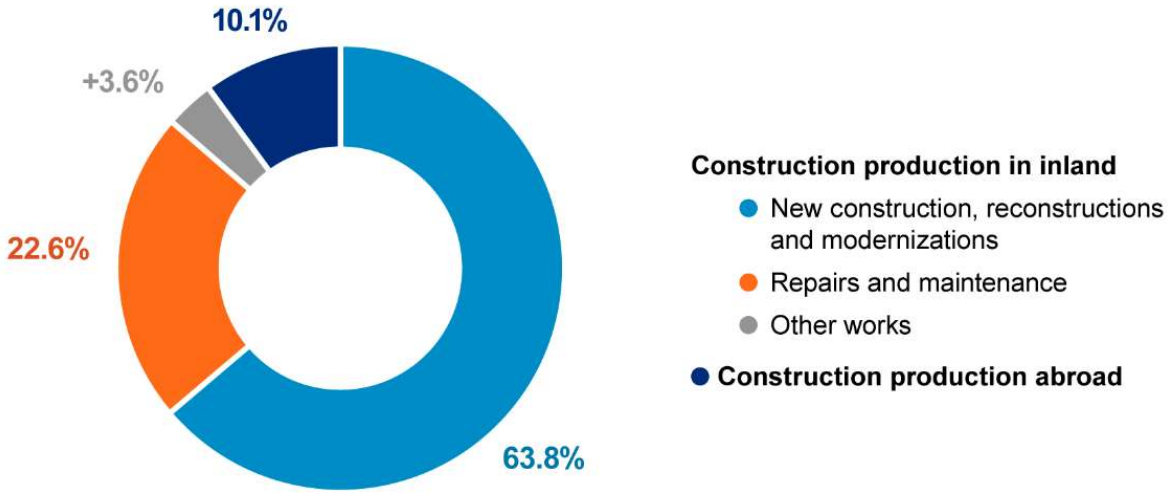

Figure 14 – Structure of the Construction Production in 2023 in Slovakia (in % of the total)[80]

[80] Statistical Office of the SR. Construction production in October 2024. slovak.statistics.sk, 2024.

4.4 PERFORMANCE OF THE BUILDING MANAGER ACCORDING TO THE LAW

Building management is a complex activity that includes all actions related to maintaining a building in good technical and functional condition. This is a long-term process that requires a systematic approach and expertise. Building management is important, especially from a financial point of view.

Regular maintenance and repairs extend the life of the building and delay the need for costly renovations or even new construction.

Energy efficiency, optimization of water consumption and regular revisions of technical equipment significantly reduce operating costs.

Good building management increases the value of the property and improves its attractiveness to potential tenants or buyers.

Regular inspections and repairs ensure the safety of building occupants and increase their comfort.

The management of the building must comply with the legislation in force to avoid penalties.

Key areas of building management from a financial point of view:

Energy efficiency: Implementation of energy-saving measures such as insulation, replacement of windows, installation of solar panels or heat pumps.

Maintenance and repairs: Regular inspections and repairs of all technical equipment, such as heating systems, air conditioning, electrical installations, etc.

Refurbishment: Planning and executing major renovations that are essential to maintain the functionality and value of a building.

Insurance: Ensuring comprehensive insurance of the building and its facilities against various risks.

Facility management: Comprehensive management of all services related to the operation of the building, such as cleaning, security, management of green areas, etc.

Financial aspects of building management:

Budgeting: Drawing up a detailed budget for maintenance, repairs, and refurbishments.

Evaluating the return on investment: Analysis of the costs and benefits of individual measures.

Cost optimization: Finding the most advantageous suppliers and materials.
Financing: Raising funds for the implementation of investment actions.

Building management is a strategic activity that has a significant impact on the economy of the owner or operator of a building. A well-managed building is a long-term investment that brings savings, increases the value of the property and ensures the comfort and safety of its users.

4.4.1 BASIC TERMS

Floor area: the area of all rooms of an apartment or non-residential space without the area of the balcony, loggia and terrace, except for the terrace, which is not a common part of the buiding; the floor area of the apartment also includes the area of rooms that make up the accessories of the apartment.

Common part of the building: the part of the building necessary for its essence and safety, in particular the foundations of the building, the roof, the corridor, the walls in contact with the exterior, the façade, the entrances, the staircases, the terrace, the attic, the attic, the horizontal load-bearing and insulation structures, the vertical load-bearing structures, as well as the room of the building, which is intended for the common use and location of technological equipment, in particular the laundry room, boiler room, drying room or pram room.

Common equipment of the building*:* technological equipment that is intended for common use and serves exclusively this building, even if it is located outside the building, in particular:
- an elevator,
- equipment for the production of heat and hot water,
- air conditioning,
- common electrical and telecommunication wiring,
- lightning rod,
- chimney,
- water connection,
- heat transfer connection,
- sewer connection,

- electrical connection,
- gas connection,
- telecommunication connection.

Accessories of the building: buildings located on the adjacent land, which are intended for common use and serve exclusively this building, while they are not a construction part of the house, in particular shelters, sheds, gazebos

Operation: activities and means necessary for the regular maintenance of the common parts of the house, common facilities of the building, accessories of the building and the adjacent land in a condition suitable for their proper use; mandatory revisions of technical equipment according to the Act No. 314/2001 Coll. on Fire Protection[81], Act No. 124/2006 Coll. on Occupational Health and Safety and on Amendments to Certain Acts[82], Act No. 355/2007 Coll. on the Protection, Promotion and Development of Public Health[83] and on Amendments to Certain Acts, Act No. 56/2018 Coll. on Product Conformity Assessment, Making a Specified Product Available on the Market[84] and on Amendments to Certain Acts.

Maintenance: activities that are necessary to maintain the original standard and quality of the common parts of the building, the common facilities of the building and the accessories of the building, as well as the elimination of deficiencies detected by the service inspection.

Repair: removal of partial physical wear and tear or damage to the common parts of the building, common facilities of the building and accessories of the building due to their restoration to their previous condition or working order.

Reconstruction: interventions in the common parts of the building, common facilities of the building and accessories of the building, which mean a change in their quality or technical parameters.

[81] Act No. 314/2001 Coll. on Fire Protection, as amende.
[82] Act No. 124/2006 Coll. on Occupational Health and Safety, as amended.
[83] Act No. 355/2007 Coll. on the Protection, Promotion and Development of Public Health, as amended.
[84] Act No. 56/2018 Coll. on Product Conformity Assessment, Making a Specified Product Available on the Market, as amended.

Modernisation: renewal, improvement or extension of the facilities and usability of the common parts of the building, the common facilities of the building and the accessories of the building.

Storage space: a part of the non-residential space in the building designated by the occupancy certificate of the building authority for storage, which is physically separated from other parts of this non-residential space, if it is not an accessory of the apartment.

Building Rules: a set of rules and principles of observing good morals in the exercise of the rights and obligations of owners and tenants of apartments and non-residential premises in the building, persons who live with the above persons in the same household, as well as persons staying in the building, when using the common parts of the building, common facilities of the house, accessories of the house and adjacent land approved by the owners of apartments and non-residential premises in the building.[85]

4.4.2 Building management

Building management is carried out by the association of owners of apartments and non-residential premises in the building (hereinafter referred to as the "community") or by another legal entity or natural person with whom the owners of apartments and non-residential premises conclude a contract on the performance of administration (hereinafter referred to as the "building manager (BM)").

Owners of apartments and non-residential premises in the building are obliged to ensure the building management by the community or BM. The obligation to manage the building arises on the day of the first transfer of ownership of the apartment or non-residential space in the building. **The obligation to manage** a building **does not apply to family houses**, **houses in which all apartments and all non-residential premises are owned by the same owner**; the obligation to manage arises if at least one apartment or one non-residential premises is acquired by another owner.

[85] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

Building management is **the procurement of services** and goods by which the BM or community provides the owners of apartments and non-residential premises in the building:

- **operation, maintenance, repairs, reconstruction and modernization** of common parts of the house, common facilities of the house, adjacent land and accessories,
- **services** related to the use of an apartment or non-residential premises,
- **maintaining** a house account in a bank,
- **recovery of damages, arrears** in the operation, maintenance and repair fund and other receivables and claims,
- other **activities that are directly related to the use of the** building as a whole by individual owners of apartments and non-residential premises in the building.

Several forms of building management must not be agreed at the same time for the administration of the building. For administration in one building, there may be a contract with only one BM or only one contract of community.

4.4.3 Community

Community is a legal entity established pursuant to Act 182/1993 Coll., which manages the common parts of the building and the common facilities of the building, non-residential premises that are co-owned by the owners of apartments and non-residential premises (hereinafter referred to as "common non-residential premises"), accessories and adjacent land, including their maintenance and renewal. The community provides services related to the use of apartments and non-residential premises in the building.

A community is established on the date of entry in the register of communities kept by the district office in the seat of the region (hereinafter referred to as the "administrative authority") competent according to the seat of the community (hereinafter referred to as the "register").

An application for entry in the register must be submitted by the elected chairman or the authorized owner of an apartment or non-residential premises in a building within 30 days of the approval of the community agreement or by the BM when the community is established by law.

An application for the registration of changes or termination of the registered data must be submitted to the competent administrative body by the chairman or the authorized owner of the apartment or non-residential premises in the building within 30 days from the date on which the change occurred.

The authenticity of the signature on the application for entry in the register must be officially certified. The application for entry in the register shall include the community agreement in two copies or its amendment in duplicate if it concerns the change or termination of the data entered in the register, the minutes and attendance list of the assembly or meeting of the owners of apartments and non-residential premises in the building (hereinafter referred to as the "meeting of owners") or the voting list and the result of the written vote; this does not apply in the case of the establishment of a community by law, the data of the elected chairman necessary to request an extract from the criminal register, in the case of a proposal for the first entry of data in the register or a change in the person of the chairman, data necessary for the purpose of verifying the ownership right to the house, in the case of a proposal for the first entry of data in the register, termination of a contract for the performance of administration, in the case of a change in the form of administration, proof of payment of the administrative fee. Owners of apartments and non-residential premises of several houses can also establish a community.

The Community may only carry out activities defined by Act 182/1993 Coll. **manages the payments** of the owners for services related to the use of the apartment or non-residential premises, **except for** payments for those services and works that the owner of the apartment and non-residential premises **in the building pays directly to the supplier** (hereinafter referred to as "payments for services"), and the operation, maintenance and repair fund, which consists of contributions from the owners of apartments and non-residential premises in the building, as well as with the assets acquired through their activities.

The property of the community does not include apartments and non-residential premises in the building. A community may not acquire ownership of apartments, non-residential premises or other immovable property. On behalf of the apartment

owners, the community may rent common non-residential premises, common parts of the house and house equipment, accessories and adjacent land.

The association concludes contracts in the name and on behalf of the owners of apartments and non-residential premises in the house within the scope of its activities in accordance with Act 182/1993 Coll., in particular on the supply of services related to the use of apartments and non-residential premises, on house insurance or on rental.[86]

The community decides on the allocation of the costs of house management and payments for services to individual owners of apartments and non-residential premises in the building. When allocating, the community is obliged to take into account the degree of use of common parts and common facilities of the building by the owners of apartments and non-residential premises in the house. The community may enforce the fulfilment of the obligations of the owners of apartments and non-residential premises in the building in its own name pursuant to Act 182/1993 Coll.

The community is obliged to submit to the owners of apartments and non-residential premises in the building **a report** on its activities for the previous year related to the building, in particular on the **financial management** of the building, on the condition of the common parts of the building and the common facilities of the building, as well as on other important facts related to the building management, by 31 May of the following year at the latest. At the same time, it is mandatory to account for the use of the operation, maintenance and repair fund, payments for services distributed to individual apartments and non-residential premises in the building.

The community cannot participate in the business of other persons and cannot conclude silent partnership agreements. The community is obliged to collect funds collected from the owners or obtained through its own activities only in bank accounts. The owners of the account of the house established by the community in the bank are the owners of apartments and non-residential premises in the building; The community is competent to dispose of the funds in the account

[86] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

of the building and to exercise the rights and obligations of the depositor to this account under a special law on deposit protection. If a community consists of several biuldings, it must keep separate analytical accounts separately for each building.

Owners of apartments and non-residential premises in the building are obliged to pay funds to the fund of operation, maintenance and repairs and payment for services.

The Community may conclude a credit agreement for the repair, reconstruction or modernisation of the common areas, common facilities and accessories of the house. If the community consists of several houses, the guarantee applies only to the owners of apartments and non-residential premises in the building to which the loan relates. The owner of an apartment or non-residential space in a building is liable for the obligations arising from the loan agreement in proportion to the size of the co-ownership share in the house up to the amount of the price of the apartment or non-residential space according to an expert opinion.

4.4.4 Building Manager

Building manager (BM) may be a legal entity or a natural person entrepreneur who has **the** management and maintenance of the housing stock in the scope of **business or in the subject of activity**; manager who manages apartment buildings must also meet the conditions under special regulation 246/2015 Coll. The activity of the building manager may be performed only in accordance with Act 182/1993 Coll.
Any change, cancellation, merger or merger of building managers cannot be to the detriment of the owners. The building manager is obliged to immediately inform the owners of apartments and non-residential premises in the building about this fact.

Building manager is obliged **to keep** separate analytical accounts separately for each house he manages. The funds obtained from payments for services from the owners of apartments and non-residential premises in the building and the funds of the operation, maintenance and repair fund (hereinafter referred to as the

"property of the owners") must be kept **separately** by the BM from the BM's bank accounts, separately **for each managed building**. The owners of the house account opened by the BM in the bank are the owners. The BM is competent to dispose of the funds in the account of the building and to exercise the rights and obligations of the depositor to this account according to Act 118/1996 Coll. on Deposit Protection.

The property of the owners is not part of the property of the BM.

The property of the owners may not be used by the BM to cover or pay liabilities that are not directly related to the activity associated with the building management.

The BM may not use the property of the owners for his own benefit or for the benefit of third parties.

The property of the owners cannot be part of the bankruptcy estate of the BM or the subject of enforcement of a decision under special regulations directed against the property of the building manager.

The building manager is liable to the owners of apartments and non-residential premises in the building **for all damages** incurred **as a result of non-fulfilment** or insufficient performance **of his obligations** arising from Act 182/1993 Coll. or from the contract on the performance building management.

Owners will conclude a written contract **with BM** on the performance of administration. A contract on the performance of building management, its amendment or termination is binding for all owners, if they are signed by the BM and a person authorized by the owners, while the authenticity of the signatures of these persons must be officially certified. Owners cannot terminate the contract on the performance of building management. The BM is obliged to deliver the approved contract and, if it is amended, the full text of the contract to each owner within 30 days of its approval by the owners of the apartments and non-residential premises in the building.

The contract for the performance of BM includes, in particular:

1. mutual **rights and obligations of the BM and owners** when ensuring the operation, maintenance and repairs of the building,
2. **the manner of managing** the common parts of the building, common facilities of the building, common non-residential premises, accessories and land,
3. **principles** with the funds **of the Operation**, **Maintenance and Repair Fund**, including the scope of authorisation to dispose of them,
4. the principles of payment **and management** of payments for performances,
5. principles for determining **the amount of management payments**;
6. scope and content **of the report on the activities of the** BM.[87]

The building manager **is obliged** to **submit** to the owners a **report on his activities** for the previous year related to the building, in particular on the financial management of the building, on the condition of the common parts of the building and the common facilities of the building, as well as on other important facts related to the building management, by 31 May of the following year at the latest. At the same time, he is obliged to account for the use of the operation, maintenance and repair fund, payments for services distributed to individual apartments and non-residential premises in the building.

On the day of the end of the building management, all rights and obligations arising from contracts related to the building management and which were concluded on behalf of the owners of apartments and non-residential premises in the building, or from contracts concluded on the basis of the decision of the owners, to a new BM or to the community.

If the building manager fails to submit to the owners a report on his activities for the previous year concerning the house, a statement of the use of the fund for operation, maintenance and repairs and payments for services within the period referred to in paragraph 2 in Act 182/1993 Coll, he shall not be entitled to payments for the management until they are submitted; The BM is also not entitled

[87] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

to payment for management if he does not submit a repair plan for the following calendar year by 30 November of the current year. If, on the day of the end of the building management at the latest, the BM does not transfer the balance of funds in the house account in the bank to the account established by the new administrator or the community, he is obliged to pay interest on late payment to the account of the house established by the new BM or community.

Communication between the owners and the BM is ensured by the representative of the owners elected by the owners. Only the owner can be a representative of the owners. The owner's representative informs the owners about the activities of the BM and about important issues related to the building management. The representative of the owners is obliged to apply the requirements of the owners to the BM in accordance with the contract on the performance of BM and the adopted decisions of the owners. The representative of the owners is not entitled to decide on matters that can only be decided by the owners.

4.4.5 Building Management Contract

The contract on the management of the building is concluded with the BM **in writing** for an indefinite period of time. Owners in the building can terminate the contract on the performance of building management only on the basis of a decision. The notice period is three months, unless the parties agree otherwise in the contract on the performance of building management. The notice period begins on the first day of the calendar month following the delivery of the notice.

With the **transfer of ownership** of an apartment or non-residential premises in a building, the rights and obligations arising from the management contract **are transferred to the new owner** of the apartment or non-residential premises in the building. If the owner has acquired an apartment or non-residential space in a building on the basis of a contract for the construction or extension of a building, he or she enters into a contract for the performance of building management.

By transferring or transferring an apartment or non-residential space in a building to a new owner, the current owner of an apartment or non-residential space in a building withdraws from the contract for the performance of building management.

The obligations arising from this Treaty are extinguished only when they are arranged. The new owner of the apartment or non-residential space in the building is also bound by legal acts relating to the building, the common parts of the house and the common facilities of the house, accessories and land carried out before the transfer or transfer of ownership of the apartment or non-residential premises in the building.[88]

If the BM has terminated the contract on the performance of building management, he or she may not terminate the performance of building management if the owners of apartments and non-residential premises in the building do not have a contract on the performance of building management with another administrator on the date of expiry of the notice period or a community has not been established. Legal relations between the owners the BM after the expiry of the notice period are governed by the provisions of the terminated contract on the performance of building management. If the **owners do not have a contract on the performance of building management** with another BM **within one year** or do not establish a community, **the community is established by law.**

All rights and obligations arising from contracts related to the building management and which were concluded on behalf of the owners, or from contracts concluded on the basis of the decision of the owners, are transferred to the community. The BM is obliged to inform all owners in the building in writing about the establishment of the community and to ensure the registration of the community with the relevant administrative body. In this case, the chairman of the community is appointed by the BM.

If the BM has been removed from the list of BMs, the contract on the performance of the management of the apartment building expires on the effective date of the contract on the performance of building management concluded with the new BM or on the date of establishment of the community, but no later than six months after the deletion from the list of BMs.

[88] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

After being removed from the list of BMs, the current BM is obliged to:

1. inform the owners **of this fact** within seven days of the entry into force of the decision to remove them from the list of BMs,
2. to carry out the necessary activities aimed at **terminating the performance of the building management** and handing it over to the new BM without undue delay after the BM has been elected by the owners or the established community; if the BM is not elected or the community has not been established within six months of the entry into force of the decision to remove it from the list of BMs, the community is established by law and the current BM is obliged to use the appropriate procedure,
3. **until the conclusion of the contract** on the performance of building management with a new BM or the establishment of the community**, to ensure the operation of the apartment building and to ensure the removal of the defect or defect,** for a maximum period of six months from the entry into force of the decision to remove it from the list of BM.

4.4.6 Obligations of a building manager

When managing a building, the BM is obliged to:

1. **manage the property** of the owners with professional care in accordance with the terms of the contract on the performance of building management,
2. ensure the **protection** of the rights of owners and prioritize their interests over their own,
3. **represent** the owners **in the recovery of damage** caused to them by the activities of third parties or by the activity of the owner,
4. **exercise rights** to the property of the owners only in the interest of the owners,
5. **monitor payments** for performances and payments of advances to the maintenance and repair operation fund from the owners and recover the arrears that have arisen,
6. **convene a meeting of** owners as needed, at least once a year, or when requested by the owners who have at least a quarter of the votes,
7. **to prepare** and submit annually by 30 November to the owners **a repair plan** for the following calendar year, which will take into account in particular the wear and tear of materials and the condition of the common

parts of the building and the common facilities of the building, and to propose the amount of the fund for the operation of maintenance and repairs of the building for the calendar year,

8. submit a proposal for a voluntary auction of an apartment or non-residential premises in a building to satisfy claims on the basis of a decision,

9. file an **application for enforcement proceedings**,

10. to ensure **all other activities** necessary for the proper performance of the building mabagement in accordance with the contract on the performance of building management and Act 182/1993 Coll,

11. to publish on an ongoing basis on the spot in the building usual in the common parts of the building or on the website of the BM, if he has one, the procedure for the procurement of goods and services, as part of ensuring the operation, maintenance, repair, reconstruction and modernization and all other activities related to the building management, including individual price offers.

When procuring **services** and goods, **the BM is obliged to negotiate the most favorable conditions** that could be negotiated for the benefit of the owners. **The BM is obliged to follow the decision** of the owners on the selection of a supplier, unless it is a matter of ensuring professional inspections and tests of technical equipment, which the BM is obliged to perform during the building management.[89]

4.4.7 Common provisions on the building management

The rights and obligations arising from liability for defects and damages against the contractor of the building are transferred from the original owner of the building to the owners of apartments and non-residential premises in the building.

Legal acts relating to the building, the common parts of the house and the common facilities of the building, accessories and land are binding on all owners of apartments and non-residential premises in the building. The BM and the community are responsible for the liabilities incurred in the performance of the building management up to the amount of payments paid for services or up to the

[89] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

amount of the balance of the operation, maintenance and repair fund in the respective building. If these liabilities are not covered by paid payments for services or payments of advances to the operation, maintenance and repair fund, the owner is liable for liabilities in addition to the payments for services paid or advances to the operation, maintenance and repair fund to the extent of his co-ownership share.

The BM or the community is entitled **to process the personal data** of the owners of apartments and non-residential premises in the building for **the purposes of the building management in the scope of name, surname, date of birth, birth number, address of permanent or temporary residence, apartment number, telephone number, e-mail address, account number and bank code**.

For the purpose of protecting the property of the owners, the BM or the community is entitled to publish a list of owners who have the total amount of arrears on advances to the fund for the operation, maintenance and repair of the building and on payments for performance in the amount of at least three times their current monthly designation. The list shall include the name and surname of the owner and the amount of the arrears on advances to the fund for the operation, maintenance and repairs of the house or on payments for performance. The list is published in the usual place for the notification of information in the building.

The BM or chairman **is obliged to ensure the removal of a defect or malfunction of technical equipment** that has been detected by checking the safety status of technical equipment **if it poses an immediate threat to life, health or property,** even **without the consent of the owners of apartments and non-residential premises in the building.**
The BM or chairman is obliged to ensure the **removal of defects, malfunctions or damage to the common parts of the building, common equipment of the building and accessories, even without the consent of the owners, if they pose an immediate threat to life, health or property.**

The community and the BM are obliged to:

- record and store all decisions taken by the owners, including minutes of meetings, meetings of owners and the results of written votes, including voting papers,

- keep a list and documentation of lawsuits relating to the building,

- continuously update the records of decisions of the owners,

- to be responsible for the correctness of the records,

- allow the owner to inspect documents relating to the building management or the drawing of the operation, maintenance and repair fund upon request, to make extracts, depreciations and copies of them, or to make copies of them at the expense of the owner,

- to ensure the protection of personal data,

- to exercise the rights of owners arising from liability for defects in the building, common parts of the building, common facilities of the building, common non-residential premises, accessories, land developed by the house and adjacent land against third parties.[90]

If the contract on the community or the contract on the performance of building management expires, or if the BM or the community terminates its activities, the current community or the previous BM is obliged to submit a report on its activities related to the house to the owners no later than on the day of termination of the contract or on the day of termination of the activity, and to transfer the balance of the owners' property in bank accounts to a new account of the house established by the new BM or the new community. At the same time, the existing community or the current BM is obliged to hand over to the new BM, the chairman of the established community or the owner of the apartment or non-residential premises in the building authorized for this purpose all documentation related to the building management, in particular supplier contracts, employment contracts and insurance contracts, accounting documents, technical documentation of the house, settlements of payments for performances and accounts of the operation fund, maintenance and repairs, minutes and decisions of the owners, as well as other documents necessary for the proper performance of the building management by a new person.

[90] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

The community and the BM are obliged to administer the building independently in the name and on behalf of the owners. The community and the BM represent and act on behalf of the owners in their own name before the court and other public authority. This representation continues unless the conflict of interests of the community or the BM with the interests of the represented owners is proven in proceedings before a court or other public authority.

The community and the BM also represent the owners in proceedings before the court and other public authority:
- against whom an application for the initiation of proceedings filed by the declared owner is directed, a motion to initiate proceedings for injunction with the enforcement of a lien or a prohibition on the enforcement of a lien filed by another owner of an apartment or non-residential premises in a building
- who seek payment of a debt or other obligation by the owner.

Owners are obliged, in accordance with the community agreement or the contract on the building management**, to make monthly advances in advance** to the operation, maintenance and repair fund, from the first day of the month following the entry of the ownership right in the land register. The amount of the advance payment to the operation, maintenance and repair fund is usually determined by the owners of apartments and non-residential premises in the house for one year in advance in order to **cover the expected costs of operation, maintenance and repairs of the** common parts of the house, common facilities of the house, common non-residential premises, accessories and adjacent land, as well as expenses **for the renovation, modernization and reconstruction of the house.**

Owners make payments to the fund of operation, maintenance and repairs according to the size of the co-ownership share; if a balcony, loggia or terrace is adjacent to the apartment or non-residential space in the house, for the purpose of creating the fund of operation, maintenance and repairs of the building, 25% of the floor area of the balcony, loggia or terrace is included in the size of the co-ownership share. When determining the advances to the operation, maintenance and repair fund, the owners will take into account the degree of use of the common

parts of the building and the common facilities of the house by the owners of the non-residential premises.[91]

The income of the building operation, maintenance and repair fund is:

- monthly advances of owners,
- income for the rental of common parts of the building, common facilities of the building, common non-residential premises, accessories and adjacent land,
- income from a building account maintained in a bank,
- income from the proceeds of the execution of an apartment or non-residential premises or from a voluntary auction of an apartment or non-residential premises, in the amount of receivables against the owner of the apartment from a statutory lien that arose under Act 182/1993 Coll.
- contractual penalties and interest on late payments arising from the use of funds from the Building Operation, Maintenance and Repair Fund.

The Operation, Maintenance and Repair Fund finances expenses related to the costs of **operating, maintaining and repairing** the common parts of the building, common facilities of the building, common non-residential premises, accessories and adjacent land, as well as expenses **for the renovation, modernization and reconstruction of the** building. The Operation, Maintenance and Repair Fund also finances repairs of balconies, loggias and those terraces that are common parts of the building. The funds of the Operation, Maintenance and Repair Fund can be temporarily used to pay for services related to the use of apartments and non-residential premises in the building in the event of a temporary shortage. After bridging the lack of funds to pay for this performance, the said funds will be returned to the Operation, Maintenance and Repair Fund.

The community and the BM shall keep the funds in the operation, maintenance and repair fund separately from the funds collected from the owners for payments for services, while the purpose of using these funds must be maintained. If the community consists of several houses, a fund for operation, maintenance and repairs is established separately for each building.

By transferring or transferring the ownership of an apartment or non-residential premises, the current owner of the apartment or non-residential premises in the

[91] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

building is not entitled to return an aliquot part of the balance of the operation, maintenance and repair fund from the community or the BM.

Owners are **obliged to pay payments for services in advance monthly** to the building's bank account. When allocating payments for services, the degree of use of common parts of the building and common facilities of the building by the owners is taken into account. In addition to services and works that the owner pays directly to the supplier, the supply associated with the use of the apartment or non-residential space is considered to be mainly the lighting of the common parts of the buildin, waste removal, cleaning of cesspools, use of elevators, cleaning, supply of heat and hot water, supply of water from water companies and sewage disposal.

The owner that is not used cannot claim a waiver of the obligation to pay advances to the operation, maintenance and repair fund, payment for services and payments for management.

4.4.8 Rights and obligations of owners of apartments and non-residential premises in the building

The owner has **the right to inspect documents** related to the building management or the drawing of the operation, maintenance and repair fund and make extracts, depreciations and copies of them.

Owners are **obliged to enable the elimination of deficiencies** identified by checking the safety status of technical equipment. If the owners of apartments and non-residential premises in the building do not allow the removal of the identified deficiencies in the technical equipment, they are responsible for the damage caused.

The owner who is structurally modifying an apartment or non-residential premises is obliged to **grant access** to the apartment or non-residential premises to the BM or the chairman **in order to check whether the building modifications do not endanger, damage or alter the** common parts of the building or the common facilities of the building. If the owner does not allow entry to the apartment or non-residential premises, the BM or chairman is obliged to notify the relevant building

authority of the implementation of construction modifications to the apartment or non-residential premises.

The ownership is inextricably linked to the co-ownership of the common parts of the house, common facilities of the building, accessories and co-ownership or other common rights to the land.

The owner has the **right and obligation to participate in the building** management and to decide by voting as a co-owner on all matters relating to the building management, common parts of the building and common facilities of the building, common non-residential premises, accessories and land developed by the building or adjacent land.

Decisions of the owners are made at the meeting of the owners or by written vote. For the purpose of deciding on the owners, the meeting of the owners is also considered to be the meeting of the owners.[92]

[92] Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

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CONCLUSION

The textbook outlines the concept and importance of building management, which includes maintaining and supervising a building's physical infrastructure such as HVAC systems, lighting, plumbing, elevators, and security systems. Building management applies to both commercial and residential buildings and ensures occupant **comfort, safety, and efficiency** through careful planning and maintenance.

Building Management Systems or Building Automation Systems, serve as central control points for monitoring and controlling a building’s mechanical and electrical equipment.

The implementation of a BMS offers numerous benefits, such as **reduced energy consumption**, improved occupant comfort, enhanced safety, and decreased operational costs. BMSs facilitate better asset management, offer energy and emission compliance reporting, and bolster building security.

The cost of a BMS is influenced by factors including the building's size and type, existing system integrations, system openness, and the installation environment. Open platforms provide better integration and adaptability, while costs vary between new installations, retrofitting, or legacy system upgrades.

The textbook outlines the fundamental characteristics and operational dynamics of construction companies, highlighting their economic and legal independence. Construction companies engage in multiple functions such as business, production, economic management, **technical innovation**, social responsibility, **environmental protection**, and organizational efficiency. The companies operate in a market economy adhering to principles of private ownership, autonomy, and profitability.

During the procurement phase, construction processes are financially and organizationally intensive, requiring design and implementation approvals. Each construction project is unique, involving various professionals and exposed to environmental factors. Construction companies exist within micro and macro environments, affected by demographics, economic, natural, technological, political, and cultural factors.

In Slovakia, common legal forms for businesses include individual trade, limited liability companies, and joint-stock companies. The life cycle of businesses often

involves establishment, growth, stabilization, crisis management, and possible extinction. Effective business plans are vital, serving to assess feasibility, secure funding, and guide operations.
Startups, defined as rapidly growing companies often within technological sectors, focus on **innovation** and scalability. A successful construction business model involves defining the business scope, identifying customers, and appropriately managing resources and marketing efforts. Contractors may offer general or niche-specific services, while production companies manufacture construction materials. Suppliers distribute materials to contractors.
Overall, the textbook emphasizes the importance of thoughtful **planning** and adaptation to market conditions for business success within the construction industry.

The advent of digital technologies has brought about a swift transformation at construction sites. This is due to the development of new technologies, such as the Internet of Things (IoT) and big data along the value chain. The construction industry is a decentralized, decentralized industry, with so many different stakeholders involved in the construction process. This textbook reviews the current state of the art of the construction industry and discusses the emerging trends in the field of construction technology. The global engineering & construction industry should take a leading role in proposing that the global project management community combines their wisdom, intelligence, and resources to advance the role of project management in improving the world, implementing positive global changes and in solving challenging global problems. New construction technologies are emerging as transformative developments reshape the E&C industry - from innovative technologies to revolutionary construction techniques.

The financial considerations entrepreneurs must address when **starting a business**, focusing primarily on the planning of **financial resources** for the first quarter, including start-up capital. This capital covers one-time costs, operating expenses, and the purchase of asset. Entrepreneurs detail these financial plans in a business plan, which is crucial when seeking loans, as it highlights the gap between required start-up capital and available personal funds. Textbook categorizes start-up costs into one-time expenses and operating costs. One-time

costs vary by business type but generally include registration fees, legal services, notary fees, and employee training. Operating costs are recurring expenses essential for business operations and are indirect, being necessary for administration, management, and support functions.

For construction companies, operating costs directly impact the pricing of construction work through overhead surcharges, calculated via direct cost percentages, hourly rates, or cost center allocations. Effective management of these costs is critical for profitability, involving budgeting, cost analysis, process optimization, and possibly outsourcing or energy management.

The textbook also discusses the importance of property for business operations, differentiating between non-current and current assets. Non-current assets include tangible and intangible items expected to last longer than a year, while current assets are consumed or converted into money within a year. Proper management of these assets ensures the business operates **efficiently and sustainably.** Lastly, the balance between assets and capital is emphasized, aligning with the principle where property must equal liabilities, crucial for a business's financial stability.

Challenges and current state of building management in Slovakia, emphasizing the role of facility management in adapting to global issues like the pandemic and economic instability. FM optimizes building operations, involving activities from technical services to administrative tasks. It aims to ensure buildings are functional, safe, and cost-effective. The Slovak economy faces difficulties, impacting FM due to rising costs and regulatory changes. Key factors influencing building management include rising energy costs, international sanctions, and legal regulations. COVID-19 prompted adaptations such as remote work and increased cooperation between clients and FM service providers.

Construction costs have risen due to factors like energy prices, supply chain issues, and labor shortages. These, combined with increased demand for infrastructure, lead to higher prices beyond previous levels. Construction production in Slovakia has declined since December 2022. Despite dynamic dwelling construction, overall production slowed, with a notable decline in all production components by September 2024.

Core management areas include energy efficiency, maintenance, refurbishments, and insurance. Financially, it requires budgeting, cost optimization, and investment analysis. Effective building management is strategic, boosting property value and economic benefits. Mandatory by law, management is conducted by a community of owners or a designated building manager, covering maintenance, operation, and necessary upgrades of common and individual property components.

The textbook outlines the roles, responsibilities, and legal obligations of a building manager in managing housing stock. The BM can be a legal entity or an entrepreneur tasked with managing apartment buildings, following specific regulations such as Act 182/1993 Coll. The BM is liable for any damages resulting from failure to fulfill obligations. The BM must submit annual reports and a repair plan. Furthermore, the BM is required to act professionally, protect owner interests, and obtain favorable conditions in contracts for services and goods.

ECONOMICS AND BUILDING MANAGEMENT II

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