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The Impact of IT Systems on the Safety and Competitiveness of Construction Enterprises

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Abstract:

Purpose: *The article aims to show the impact of IT systems on the safety and competitiveness of construction enterprises.*
Approach/Methodology/Design: *The main research methods are a review of national and world scientific and practical literature and a quantitative survey among construction companies in selected European Union countries.*
Findings: *The growing importance of IT systems in construction companies contributes to their development, resulting in the availability of information to an increasing number of employees, which translates into a higher quality of decisions made and, in turn, a competitive position.*
Practical Implications: *The practical implications of the research results included in the article will constitute recommendations for activities in managing companies that can be used in business practice, which will translate into higher financial results.The need to replace software is dictated by the pace of scientific and technical progress, because the condition for purchasing it is the desire to have innovative IT tools that provide a temporary advantage over the competition.*
Originality/Value: *The original value of the article is the quantitative analysis of the impact of introduced IT systems on the competitiveness of construction companies.*

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Paper Type: *Research article.*

1. Introduction

In the era of continuous development, computerization of enterprises and automation of processes in enterprises, company management increasingly notices the importance of knowledge and its effective management as a key element in the development of enterprises. Knowledge is the main factor responsible for the development of a given enterprise, and modern organizations appreciate its importance as a key element of achieving success on the market (Miluniec and Miciuła, 2019).

The foundation of competitive advantage is the innovativeness of the enterprise, understood as openness to the implementation of new information technologies, including IT management systems that significantly support the flow of information in the enterprise and knowledge management, and finally, the automation of the processes themselves and their far-reaching optimization (Kraszewska and Pujer, 2017). Competitiveness on the construction market forces constant modernization of construction processes and services provided, as well as an increase in the standards applicable in the company.

Each participant of the supply chain in the construction industry tries to look for solutions that will primarily enable achieving and maintaining a competitive advantage, especially in the area of cost estimation and implementation of construction facilities.

It seems that the current economic realities are particularly favorable for the development of ERP systems, the main task of which is optimal management of resources and material flow, especially in multi-department and dispersed enterprises. From the point of view of construction, it is primarily important to reduce the costs of production, storage and transport, while maintaining the efficiency of these processes.

Considerations regarding competition date back to classical economics, according to which competition leads to the optimal allocation of resources and the maximization of social welfare. Thanks to its operation, resources go to the most productive uses,

and the selfish actions of individuals serve to increase prosperity throughout the economy (Gorynia and Łaźniewska, 2010). In the classical approach, the competition process itself forced market participants to behave in a certain way.

2. Literature Review

Shaping a high level of competitiveness of enterprises, sectors and entire economies is one of the most important challenges of the modern economy (Jałowiec *et al.*, 2020). However, gaining a competitive advantage by an enterprise is a complicated task because the determinants of competitiveness are not only the products and services offered by business entities, but above all the unique and specific knowledge in the enterprise that builds intellectual capital (Beyer, 2012).

The success of an enterprise is based on intangible resources (intellectual capital). A necessary condition for further development of knowledge management in enterprises is a developed information infrastructure, which in turn requires additional investment outlays (Zakrzewska and Miciuła, 2021).

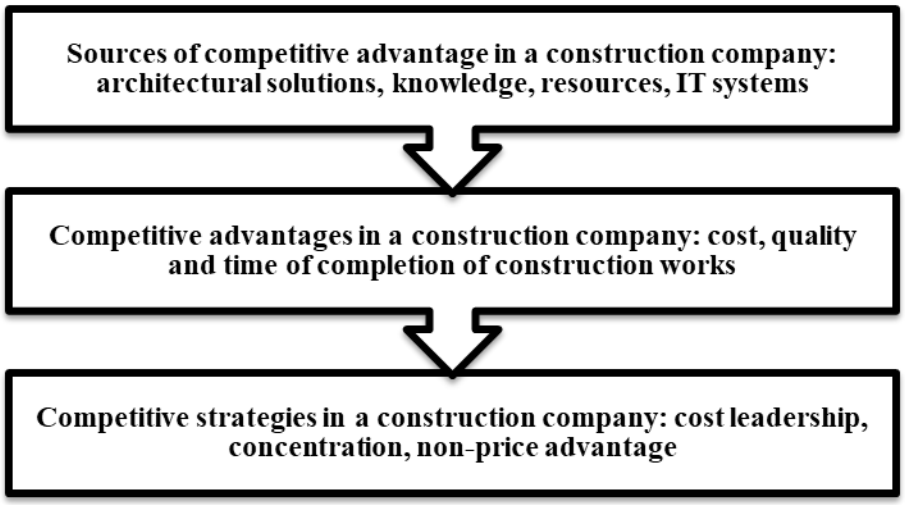
The benefits of introducing knowledge management in an enterprise may be multi-faceted, such as improving communication, accelerating the decision-making process, increasing the enterprise's innovativeness, accelerating the creation of a product offer, shortening the time of solving key problems, improving the company's operating efficiency on the market or expanding the competences and knowledge of employees (Budziewicz -Guźlecka, 2007; Tyagi *et al.*, 2023).

Competitive advantage in construction should be understood as the ability of a construction company to differentiate and distinguish its products and services from the competition and constitutes the company's asset. In the case of construction companies, these factors include: price, quality, completion date and innovative technology offered. Behaviors in construction depend on the adopted strategy of action and are determined by the possibilities of applying them in the enterprise.

Construction companies usually do not have a specific strategy or use market competition, where primarily the low price determines the selection of the contractor's offer. The lack of a specific competition strategy influenced the implementation of IT systems in construction companies. The way to look for a competitive advantage in a construction company is to analyze the values generated for the customer by individual departments, separated in M. Porter's model called the value chain.

One example is cooperation with material suppliers based on the latest technologies. Figure 1 shows a diagram of the relationship between competitiveness and information systems in relation to the M.E. theory Porter.

Figure 1. *Competitiveness in a construction company*



Source: Own study.

Competition in the construction industry is very strong. In the competitive fight, companies should focus on highlighting their advantages and benefits, not on reducing quality. The literature on the subject contains information that one of the main strategies adopted in construction is non-price advantage. It involves giving a service or product unique, original features that, in the eyes of recipients, make the offer better compared to the offers of other competing contractors or design offices.

However, it should be remembered that none of the known strategies guarantees long-term effects without continuous analysis of competitors' activities, ongoing cost control or implementation of modern IT solutions.

IT systems are one of the sources of competitive advantage of construction companies, building it in two ways. The first one assumes the use of information technologies to improve existing business models. It is worth emphasizing that deep and well-thought-out integration of business and technological solutions can lead to the redesign of the enterprise to a model in which IT solutions are the source of competitive advantage.

The second way is to use the dissemination of information technologies to build a completely new enterprise model based on one selected element of the value chain, as well as models in which companies provide management services for many entities or activities with the help of IT solutions (Softtutor, 2024).

According to the literature: as a result of the growing competitive struggle of enterprises, their owners see an increasing need to implement information systems in order to increase the profitability of the enterprise, aiming to maintain or improve its

current market position. It is in information systems that have been successfully implemented in every sector of economic activity that the factor that is most important in the competitive fight is beginning to be seen (Piątkowski, 2015).

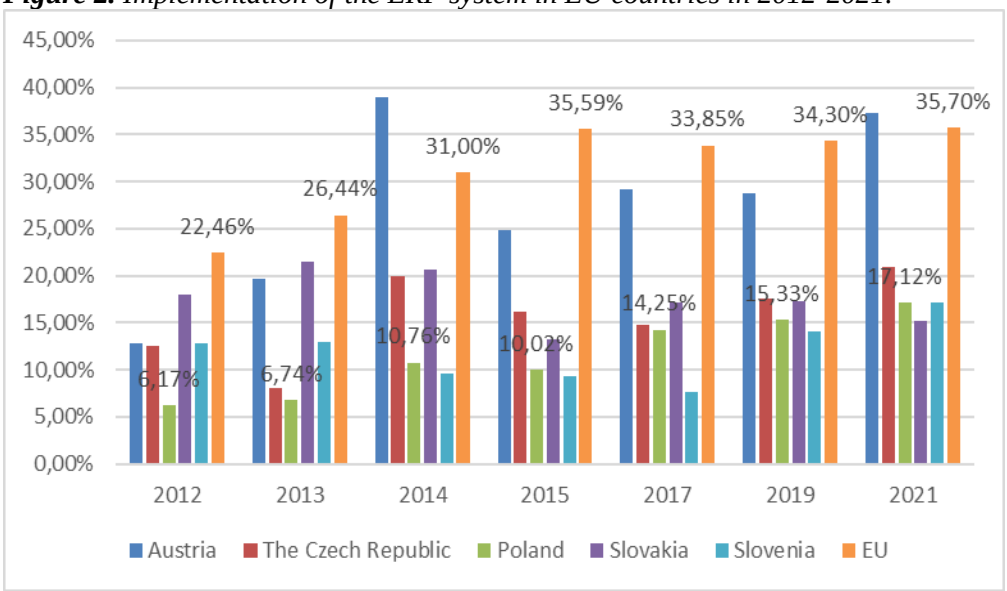
According to the report "Innovations in construction 2020" conducted by BauAPP and ConQuest, digital solutions are a factor influencing the development of innovation in the Polish construction industry. The authors of the report emphasize that in order to build a competitive advantage, construction companies must adapt to the ongoing digital changes, using cloud solutions, control and digitization of processes (PWC, 2020).

Although digitization in the construction sector remains low compared to other sectors, over the last 25 years there has been an increase in investments in the digitization of enterprises. According to an ING report, the value of software quadrupled during this period, citing the emergence of the mobile Internet as the main reason for this effect. Because devices such as tablets and mobile phones have enabled access and exchange of information between the construction site and the company's headquarters (ING, 2022).

3. Research Results

Figure 2 shows the dynamics of ERP systems implementation in Central European countries compared to all European Union countries in the construction industry.

Figure 2. *Implementation of the ERP system in EU countries in 2012-2021.*



Source: *Own study based on: OECD, 2023. https://stats.oecd.org/Index.aspx?DataSetCode=ICT_BUS#*

As shown in Figure 2, over the years 2012-2021, the number of implementations of ERP systems in construction companies in Central European countries is constantly increasing. In Poland, in 2012, only 6.17% of construction enterprises had an ERP system implemented, while in 2021, this level increased to 17.12%.

This means that construction companies' awareness of the impact of IT systems on competitiveness is increasing. It can be noticed that over the course of ten years, the level of implementation among the indicated countries has become even. Until 2019, Slovakia was the leader in the implementation of ERP systems, but in 2021 other countries significantly increased the level of implementation, especially the Czech Republic (20.99%).

The driving factor behind the implementation of ERP systems in the construction industry are the increasingly individual needs of customers and the trend of personalization of products and services.

The literature on the subject emphasizes that IT systems are a tool enabling far-reaching organizational changes. One of the strategies for gaining a competitive advantage using IT systems involves purchasing products on new markets through purchasing platforms. A purchasing platform should be understood as a type of e-service, of a technical and administrative nature, enabling purchasing procedures to be carried out electronically.

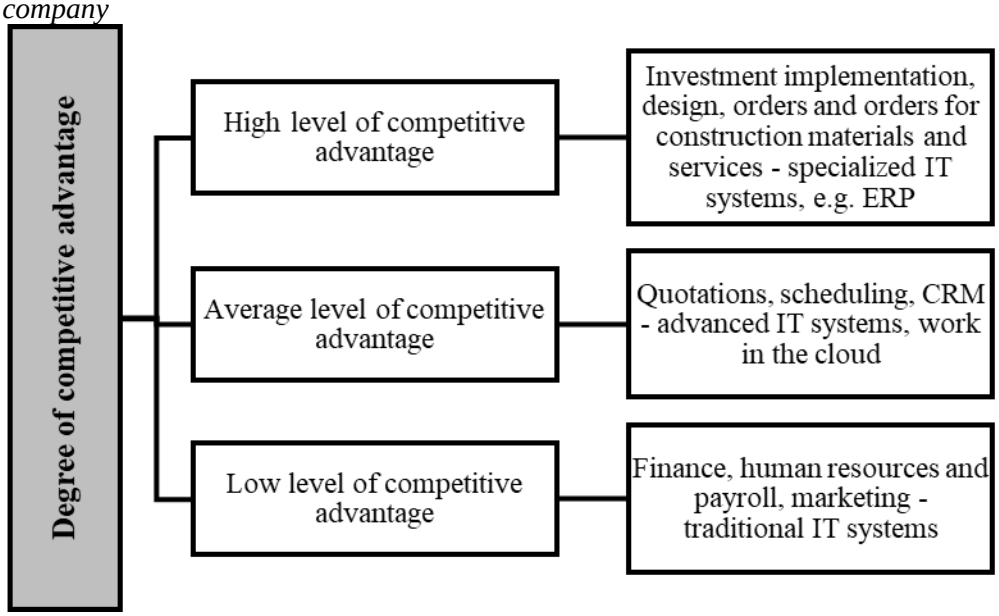
Many of the existing purchasing platforms offer functionality that goes beyond supporting the purchasing process, creating comprehensive tools aimed at improving the efficiency of enterprises - both cost and process. Modules such as payment management, e-catalogs and expense analytics are intended to serve this purpose. In order to tailor solutions to their own needs, construction companies create their own purchasing platforms.

Enterprises operating in competitive conditions operate based on processes that M.E. Porter divides them into supporting and main. With regard to ERP systems, construction companies and M.E. assumptions.

Porter that companies should build their competitive advantage based on the key services and products offered, Figure 3 presents the relationships between the level of competitive advantage and processes in a construction company.

Other issues include the issue of adapting ERP systems to specific customer needs. Companies achieve a competitive advantage because their system is different and better than that of their competitors. While adapting an ERP system to your own needs can be considered a source of competitive advantage, there has been a discussion about the temporary nature of this advantage for many years (Carr, 2003).

Figure 3. *Relationships between competitiveness and the IT system in a construction company*



Source: *Own study.*

What makes all resources truly strategic - that is, what creates their potential as the basis for sustainable competitive advantage - is their limited, not universal, availability. The basic functions of ERP technology have become generally available, which means that ERP systems are losing the character of proprietary technologies, which are the property of individual companies and are increasingly becoming infrastructure technology.

Due to their specific features, all infrastructure technologies inevitably acquire the character of a common good over time and become part of the generally available business infrastructure. As noted by N.G. Carr, infrastructure technologies not only pave the way for new, more efficient operational methods, but often become the trigger for broader market changes (Wasilewski *et al.,* 2017).

Especially in times of economic slowdown and crisis, enterprises are forced to constantly control costs, monitor the financial situation, make reliable demand forecasts and effectively manage processes. It is also important to make deliveries while maintaining low levels of inventory and prices. Budgeting that is adapted to changing market conditions becomes important.

Therefore, some construction companies decide to implement Business Intelligence (BI) solutions, which provide immediate access to current information about the company's financial condition and aggregated reports. BI is a concept that refers to management philosophy and a tool that helps companies manage and improve

information to make more effective decisions. The main task of the Business Intelligence system is to collect information from various sources (e.g., ERP, CRM, marketing systems), which allows for cross-sectional analyzes (Soszka, 2018).

BI systems can be widely used in the area of construction project management, enabling in-depth analyzes of efficiency and effectiveness and supporting reporting between the executive team and the enterprise. BI systems are divided into several segments, taking into account their purpose (Sagra, 2024):

1) Customer Relationship Management (CRM) – a customer relationship management system. The role of this solution is special as a tool for building a competitive advantage of construction companies in the face of price competition among construction contractors. Additionally, it supports processes related to sales, customer relations and service services.

2) Executive Information Systems (EIS) – a system intended for management. In the case of construction companies, it allows for ongoing monitoring of the investment progress while identifying threats.

3) Decision Support Systems (DSS) – a system thanks to which employees can make decisions based on the data obtained. It is used in decision-making, mainly by management staff and analysts by receiving reports and summaries.

4) Geographic Information Systems (GIS) – a system for processing geographic data to support the decision-making process. This system is used for land and building records. This information is used by urban planners, surveyors and constructors. Additionally, it allows you to create, manage, analyze and plot data on maps, integrating location data with descriptive information.

5) Management Information Systems (MIS) – a system to support enterprise management.

6) Online Analytical Processing (OLAP) – systems of this type are used to make strategic business decisions.

4. Conclusion

The fundamental condition for formulating an effective strategy on the construction market is understanding the relationships between resources, capabilities, competitive advantage and its profitability.

It is also very important to understand the mechanisms by which an advantage can be maintained over a longer period of time. This requires designing a strategy that would make maximum use of the company's unique advantages. In the case of

construction companies, especially small and medium-sized ones, such unique features include: flexibility of operation, low implementation costs, less bureaucracy in the organization.

Small companies do not have the ability to shape the environment in which they operate, therefore they are forced to adapt to market conditions and requirements, in particular to the procedures of companies acting as general contractors of construction works.

For some companies, the need to replace software is dictated by the pace of scientific and technical progress, because the condition for purchasing it is the desire to have innovative IT tools that provide a temporary advantage over the competition.

The modernity of IT products results either from the manufacturer's own initiative, which improves its products, stimulated by the level of sectoral competition in the IT industry, or from the initiative of strategic users who indicate needs, e.g. the result of their market experience (Ficoń and Krasnodębski, 2017).

The growing importance of IT systems in construction companies contributes to their development, resulting in the availability of information to an increasing number of employees, which translates into a higher quality of decisions made and, in turn, a competitive position.

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