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Determinants of Management Efficiency Using IT Systems in the Context of Regionally Dispersed Construction Enterprises in Poland

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Abstract:

Purpose: *The aim of the article is to analyze the determinants that have the greatest impact on the effectiveness of management using IT systems in construction companies in Poland.*
Approach/Methodology/Design: *The main research methods are a review of national and world scientific and practical literature in the construction industry and case studies among business practitioners among construction companies in Poland.*
Findings: *The determinants of management effectiveness determined during the analysis through the appropriate use of IT systems in construction companies will allow the development of practical recommendations for optimal management in companies.*
Practical Implications: *The practical implications of the research results included in the article will constitute recommendations for activities in the management of construction companies that can be used in business practice, which will translate into higher financial results.*
Originality/Value: *The original value of the article is the analysis of factors that increase management efficiency among construction companies in Poland.*

Keywords: *Management, IT systems, management efficiency, construction enterprises, welfare development.*

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1. Introduction

Investments in IT technology constitute a significant percentage of all investment expenditures of enterprises operating in the knowledge-based economy (Lin and Lai, 2021). Today's construction companies are organizations that employ hundreds or thousands of employees, often scattered throughout the voivodeship or Poland, concentrated in administrative units or working in the field.

The management team tries to develop common goals with employees and encourage them to make more efforts to implement the company's strategy every day. Regardless of the size of the company, more and more activities related to everyday operations are replaced by IT systems (Cypryjański, 2012). This mechanism can be considered a natural result of technological development in the world, globalization and the continuous development of the information society.

Currently, it is difficult to meet all the requirements that information entails because the number of economic operations continues to grow. Large amounts of information are becoming increasingly difficult to process and analyze, which is why it has become necessary to implement IT systems that improve the flow of this information (Velinov *et al.,* 2023).

Moreover, it becomes impossible to ignore IT opportunities in business because companies reach new markets via the Internet, expanding the scope of their operations and acquiring new business and individual customers (Jokiel, 2009). The implementation of IT systems requires supervision of the processes taking place within the company: proper planning of the implementation and provision of the required resources for this purpose (Kadlubek *et al.,* 2022).

As previously indicated, an IT system creates an information system that constitutes a separate part of the social, economic or technical system, consisting of elements such as people, information processes and data resources. The main tasks of the information system include meeting the information needs of the company so that it is possible to make accurate decisions. The use of an IT system brings many benefits that are not noticeable from the point of view of individual users, but are of key importance for the entire organization.

2. Research Methodology

The research method used in this area is a review of national and world scientific literature and case studies among the business practices of construction companies in Poland. The implemented IT systems must be able to coordinate many different processes and tasks. It is therefore necessary to look for factors that should be taken into account in the methods of assessing the impact of implemented IT systems on the efficiency of management of construction companies.

3. Literature Review

In the literature on the subject, a construction company is defined as a complex system consisting of several or a dozen interrelated subsystems. It includes, among others, the production, financial, planning, logistics, quality subsystems, etc. Each of the above-mentioned subsystems contains processes. By linking individual subsystems, the management method in any of them affects the current state of the others (www.przegladbudowlany.pl, 2023).

The construction industry is characterized by various possibilities and multi-layered nature, due to the number of services that are included in construction services: construction, reconstruction, assembly, renovation, demolition.

Moreover, in the construction industry, one can notice differences in size, from large companies with their own machinery to small companies working only on commission. A characteristic feature of this industry is rapid development and constant demand for qualified employees. In construction companies, there are repeatable processes: starting from preparing a commercial offer, preparing construction, marketing, purchasing materials, ending with financial settlement and company administration.

One of the most significant advantages of this approach is that it indicates how to reduce waste of time and costs in the company by maximizing the use of resources and allows for faster response to changes (Kabus *et al.,* 2022). This gives you a significant advantage in the competitive market. The purpose of introducing a process approach is to improve the effectiveness of the company's operations in achieving the intended results (Thalassinos *et al.,* 2023).

The scope of activity of construction companies is very broad and covers issues related to the design and implementation of construction facilities. The implementation of investments by construction companies requires maximum efficiency from the management staff, both middle and top level (Jałowiec *et al.,* 2020). This means that the implementation of IT tools becomes necessary, and a solution dedicated to the construction industry should enable planning and control of construction production in close connection with external tools used at all stages of contract implementation.

Information technologies are intended to support changes in business operations, and their basic functions include: automation, information and transformation (Zuboff, 1989). Automation involves eliminating human work through the use of IT tools (Dudycz and Dyczkowski, 2007). It has a direct impact on the efficiency of the organization, because eliminating human work is most often associated with reducing costs resulting from employment reduction and shortening the cash turnover cycle by reducing the duration of economic processes.

The second function, i.e., information, consists in providing decision-makers with information that facilitates making decisions, which becomes easier by reducing the time consumption of collecting, transmitting and presenting data. The information function increases the organization's benefits indirectly, because benefits arise only when the information is properly used, and not from the fact of having it. The transformative role of information systems is to enable change in the way of conducting business by:

1) reorganization of economic processes,
2) providing new products and services,
3) creating new relationships with value chain participants,
4) generating new distribution channels.

Through the strategic use of information technology mentioned above, the transformative role appears to be potentially most important in creating competitive advantage. IT systems facilitate the creation of products with individualized features, optimization of the method of their delivery and strengthening relationships with the customer. These factors may influence the positive perception of the company and its offer, and, consequently, lead to an increase in the added value generated by this enterprise.

In the literature, the terms transforming function and organizational function are used interchangeably. However, it seems that the organizing role of IT systems should be considered when it improves the functioning of the company in a way other than by transforming the way it operates. There is a significant group of applications of systems in which economic processes do not change significantly, and yet there is an improvement in the way the organization operates.

In addition, a prestigious role is also mentioned, influencing the company's image. An enterprise using information technology can be perceived as modern, which in turn affects its market value. It should be emphasized that the role of IT systems is variable over time and systems are constantly evolving (Hasanah *et al.*, 2022). However, the possibility of transforming business through the tool of IT systems cannot be questioned.

Nowadays, when a construction company decides to invest in an IT project, it should be subject to the same selection criteria as in the case of other investments. Among companies operating on the Polish and foreign markets, an increase in economic awareness can be observed, which affects the rationality of decisions made and the accurate definition of goals aimed at the operational and strategic area of the company's activity.

Companies are considering what their financial success will depend on in the future, whether only on modern fixed assets and financial liquidity, or on correct relationships with customers, building a solid product brand, information flow and

accurately made strategic decisions based on processed data (Wojtaszek and Miciuła, 2019). Therefore, it can be assumed that achieving economic efficiency by the company is its primary goal. With such extensive IT projects, assessing the economic benefits brought by the system seems to be a complicated issue. The costs of implementing an IT project are not the only ones that the investor must bear.

Investing in IT technologies often requires significant expenditure, and the direct and indirect effects of implementing an IT project almost always occur with a significant delay in relation to the costs incurred (Oluyisola *et al.*, 2022). Proper planning of the implementation of the IT system, determining the required costs and knowledge of the time distribution of the necessary expenses and estimating the expected effects allow making rational investment decisions. For this reason, the decision to initiate an IT project supporting business processes should be preceded by a thorough examination of its effectiveness, i.e., estimation of time, risk and, above all, costs and effects (Osuszek and Stanek, 2018).

The role of IT systems in enterprises is related to the identification of benefits resulting from the implementation of an IT system (Stempnakowski, 2013). Characterizing all possible benefits seems to be impossible, due to the fact that IT systems are constantly evolving, so there is the possibility of new applications of the systems and with them new benefits.

Moreover, implementing the same solution may lead to different benefits depending on, among others: ways of implementing the project. Additionally, the benefits obtained cannot always be presented in economic terms, as they are very often intangible, organizational and social benefits. J. Kisielnicki and H. Sroka (1999) distinguish the following groups of effects of implementing IT systems:

1) technical effects related to the use of computer technology. The following include, increasing the speed of information processing, increasing the accuracy of processing, increasing the detail of information, improving the security of confidential information,

2) economic effects - indirectly related to the increase in efficiency and speed of decision-making. If improving the decision-making process increases management efficiency, this translates into economic effects. Another category of economic effects are reductions in personnel costs (reduction of employment), administrative costs, telecommunications costs, etc.

3) organizational effects, which are primarily related to improvements in the organizational structure and processes taking place in the enterprise. Improving the efficiency of document circulation, eliminating unnecessary administrative work, improving task coordination, eliminating errors.

4) socio-psychological effects - related primarily to the expansion of the scope of communication between employees, improvement and objectification of the employee evaluation system, improvement of organizational culture, etc.

In the literature on the subject, you can find a lot of information regarding economic and management efficiency relating to the result obtained in relation to the actions taken, as a ratio of the effects obtained to the expenditure incurred. Economic determinants include issues such as, employment level, budget, investment plan, and the financial condition of the company. Entrepreneurs, looking for the most effective ways to use capital, make decisions based on the criterion of economic efficiency (Sharma *et al.*, 2021).

Assuming that investment decisions are made rationally, they should be based on economic calculation. Rational management, which is the basis for economically effective business activity, involves managing economic processes in a way that takes into account the achieved level of economic knowledge and, at the same time, is expedient due to the existing conditions and resources.

Economic effectiveness depends on the adopted selection criterion, analysis methods and tools, and on the information these entities have about existing decision-making situations and the expected effects of the solutions undertaken. The company's financial system should ensure the highest possible level of efficiency understood as cost savings through optimized internal processes and appropriate quality of financial and management information. This approach allows you to achieve or maintain a competitive advantage on the market.

4. Research Results

By implementing an IT system, construction companies assume the possibility of reducing workload, which can be understood in two ways. By reducing employment, but above all by reducing the workload of employees, thus using their potential in other tasks such as project valuation or accelerating the construction process. Financial information coming from both office employees and people working on construction sites constitutes the basis for building the company's budget.

A budget is a plan expressed in numbers for a certain period of time. Construction companies deal with the budget on two levels: company-wide and when planning investment costs. Budgeting allows you to effectively use the company's financial resources and thus improve decision-making related to individual business processes. It should be remembered that enterprises are focused on results and development in the future, therefore budgeting requires the ability to predict and accurately plan, which is possible thanks to information.

The numerical presentation of the plan imposes some kind of order, making it possible to find out what funds and by what organizational units will be used. spent,

where and what costs will be incurred and what revenues will be obtained. The budget combines the functions of planning and control. An additional feature of the budget is the presentation of the economic balance to which the company's operations are to be subordinated. In a well-run company, the planning process is ongoing. As a result, there are always patterns of performance and benchmarks for assessing task performance.

A feature of a good budget is flexibility, which entails mutual variability of economic values (Adamowicz and Łuniewska, 2015). In the case of investments, a budget is prepared to determine the costs and profits expected after the completed project. The cost plan is created to take into account all construction costs and other project elements such as salaries and funds to cover possible losses. Two concepts appear in the literature on the subject: budgeting and cost plan. The budget assumes a spending limit for the project, while the cost plan provides information on what financial resources will be spent and when.

Taking into account the current market situation, i.e. difficulties in purchasing materials, budgeting and reliable preparation of warehouse stocks seem to be a reasonable solution. The rapid development of technology and mass production that took place at the end of the 19th century and the beginning of the 20th century initiated the process of planning and control in companies.

This means that the previous intuitive operation was to be replaced by planning processes, and then by approved tasks to be performed - budgeting, and to provide the opportunity to control the degree of completion of these tasks. In construction companies, financial data is processed by various departments and sometimes also branches.

IT systems are a tool supporting budget creation, thanks to which the company receives reliable output data. In a construction company, budgeting takes place in various departments of the company and at various stages:

1) The company's budget in the overall aspect - costs of: maintaining office staff and administration, office maintenance, purchase of office supplies, legal services, representation, purchase of IT tools, including computers and software, mobile phones.

2) Budget planned in the project cost estimation process - costs: purchase of materials, provision of services (including general construction, specialist), maintenance of construction facilities, employee remuneration.

3) Budget for the implementation of the investment - costs: purchase of materials, provision of services (including general construction, specialist), maintenance of construction facilities.

All the budgeting stages indicated above are interconnected. This is due to the specificity of construction companies, in which the investment process begins with acquiring an investor, through the valuation of the implementation and to the construction process itself. The investment cost estimation process plays a key role because the success of the tender depends on it. The budget related to office maintenance can be assumed to be relatively stable.

Deviations may be related to increased employment or an increase in employee maintenance costs (salary increases, bonuses), or to unforeseen expenses, e.g. for legal services. On the IT systems market, you can find many IT systems that supervise the entire work of a construction company or have the ability to combine several solutions to create a budget. This solution allows for ongoing control over processes in the company, support for the implementation and maintenance of the quality system, and acceleration and ensuring the reliability of information flow.

For construction companies, the ability to precisely plan the time and costs of works and services, track currently incurred costs and resource consumption, and quickly detect deviations from the plan will also be of particular importance; introducing better work organization and, as a result, achieving savings related to the purchase and delivery of materials and avoiding penalties for delays (www.iwb.com.pl, 2023).

The last element of the budgeting process is control, which involves the need to:

1) measurement and registration of current effects of action,
2) comparison of current effects with planned ones,
3) establishing a permanent link between the budget, existing deviations and modifications to plans,
4) control of the actual status in relation to the assumed plans and schedules.

The main task of the control is to ensure the implementation of the tasks included in the budget and to constantly check whether the forecasts and reality match each other. However, if deviations are noticeable, they should be reported and the reasons for their occurrence explained. Hence, the control aspect is of particular importance when managing the budget.

In order to conduct effective financial control, it is primarily important to be able to obtain information from many different areas, previously not covered by the system, continuously or depending on specific needs related to control, analytical or planning tasks performed at a given time. This is extremely important because for many years the information from the financial accounting system has not been sufficient for decision-making purposes, also in car transport companies.

Therefore, the possibilities offered by ERP systems are in fact a response to the need of modern business for information required in the decision-making process. This

system uses specific modules, for example for cost accounting, budgeting, controlling.

The budgeting data is linked to the ability to forecast and simulate sales. Sales forecasting is one of the most important elements of running a business. This means that the sales forecast has a significant impact on production plans, inventory levels and also affects the planning of cash expenses in the company. In construction companies, due to the length of the construction process, dynamically operating companies on the construction market have the opportunity to build a budget.

Moreover, in the construction industry, companies plan their investments and sell services and investment products well in advance. Sales forecast is considered one of the basic tools in business management, which is why it has become the subject of many studies and considerations.

The forecasting process often raises many doubts as to its validity. When forecasting sales volume, special attention should be paid to the selection of appropriate forecasting methods and models, which should be adapted to the specificity of the sector and the needs of a given enterprise.

Moreover, it must be remembered that it is impossible to have complete knowledge about buyers, and increased competition activities may reduce the effects of planned promotional and sales activities in a given company. Additionally, market conditions and the marketing environment are constantly changing, which undoubtedly affects the accuracy of forecasts. IT systems that have a sales, inventory control and production module make it possible to collect data necessary to forecast demand.

Specially designed programs are practical tools supporting the investment process by enabling the development of a reliable construction cost estimate. The most popular ones contain a full database of KNRs (Catalog of Material Expenditures), many options for editing cost estimates, allow cooperation with the most popular price lists, and also offer advanced options for creating and controlling documents.

The most important features of cost estimating programs include: the ability to create simplified and detailed cost estimates, FIDIC calculations or just bill of quantities, support for three-dimensional BIM modeling files. The advantage of this type of software is its cooperation with programs for planning and scheduling construction works.

Using network analysis, the systems determine the project time, the critical path, and time reserves for individual activities. As a result of scheduling, material outlays, costs and needs for work resources are spread over time in relation to a selected scope of works (a subset of tasks) or the entire project. In addition, activity scheduling software enables resource management, automatic planning of material

deliveries, and the effectiveness of task execution is assessed in the context of inputs, time and effects.

Automatically controlled material transport systems (horizontal and vertical), remotely controlled transport vehicles, and material dosing systems (e.g., in concrete production) are increasingly common, not only in construction. Thanks to the automation of transport and reloading processes of bulk materials with various properties, such as various types of lime, cement or construction mixtures, it is possible to quickly transfer any amounts of bulk materials, even over relatively long distances.

Importantly, the lack of appropriate IT software in the field of materials management is an important factor reducing the effectiveness of logistics management in the company (Piętowska-Laska, 2012).

Depending on the form of activity of a construction company, a new trend can be noticed on the market: the centralization of purchasing. This action is a response to the perception of purchasing as an area of company activity. The current perception of purchasing departments as a supplier of components for the construction process is evolving towards taking into account purchasing processes in the strategic management of the company. It is increasingly believed that effective purchasing processes are an important factor that has a positive impact on the financial result and competitiveness of the entire enterprise.

However, regardless of the specificity of the industry or market in which a given company operates, some goals in the area of Procurement are universal and including them on your list is almost always a good decision of the manager managing this area. The three goals I should mention here are (Turek, 2016):

- reducing purchasing costs,
- streamlining the purchasing process,
- increasing the transparency of expenditure.

The efficiency of purchasing activities depends on the use of IT capabilities that automate purchasing processes and support decisions in this area. A conscious purchasing policy aims to buy only what is needed, when it is needed, in the right quantity and on optimal commercial terms.

Systems such as ERP offer modules for purchasing and materials management, because a well-thought-out purchasing policy allows companies not only to significantly reduce operating costs, but also helps to conduct investments more efficiently. Moreover, in the purchasing sector, an appropriate IT system can become a source of gaining a competitive advantage by allocating the saved money for investments in, for example, employee training or marketing campaigns.

This behavior leads to a reduction or complete elimination of warehouse costs, minimization of financial resources frozen in inventories and thus to the release of these funds for other company purposes. This action is beneficial, but at the same time it can be risky. A fixed purchase price of materials may have a positive impact on the implementation of the investment, but at the same time a drop in prices relative to the contract with the supplier should be taken into account.

5. Conclusion

The implementation of IT systems makes it possible to make decisions based on the developed level of knowledge, and as previously indicated, the basic resource of modern enterprises has become the production, distribution, and above all, the use of knowledge. It is intellectual capital that is the main determinant of economic efficiency (Miciuła, Kadłubek, and Stępień, 2020). Proper use of intellectual capital resources enables quick, efficient and effective responses to dynamic changes in the economy.

The market policy of construction companies is based on a pro-customer strategy and the growing importance of building lasting relationships with suppliers, contractors and economic environment institutions, as well as relationships with competitors. Many enterprises are not yet fully aware of the complexity of market capital management, perceiving each of the presented elements of its structure individually, and not as a coherent and mutually dependent market environment.

In the case of construction companies, developed relationships with customers are most important for the company's value in terms of achieving the company's basic goals, which include market share and range of influence. IT systems allow maintaining information about customers and their investments.

Customer capital from the perspective of the company's customer portfolio and the ability to acquire new customers is the basis for the valuation of its market value. It gives you the opportunity to assess current profits and develop forecasts for the future. Market capital can effectively influence the company's efficiency through the reach of the manufacturer's brand and product, as well as market shares achieved thanks to intensive marketing work.

Market capital will support the creation of high intellectual capital in the company through: active customers who are satisfied with the value provided to them, introducing new or modified products thanks to knowledge about market expectations. Cooperation with suppliers and research and scientific institutions will result in knowledge about new technologies and raw materials.

The main goal of implementing IT systems by construction companies is to improve the flow of information within the company and increase productivity based on better use of company resources, improving work efficiency, optimizing working

time, and thus shortening the time of preparing commercial offers and the construction process. In addition, the functions of integrated IT systems create the opportunity to collect and share resources for joint use, control and storage of commercial data.

By linking common document databases, it is possible to respond to changes faster. Conducting construction means coordinating a number of tasks and processes. IT systems used in the construction process facilitate the coordination of many, usually different processes, from formal and legal issues to managing cooperation with subcontractors.

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