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A SWOT Analysis of the Use of BIM Technology in the Polish Construction Industry

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Abstract: The present paper presents a SWOT analysis, the aim of which is to evaluate the strategic implementation of BIM technology in the construction industry in Poland. The authors created a SWOT matrix presenting strengths, weaknesses, opportunities, and risks associated with the use of BIM. Using literature analyses, own experience, and market reports, all elements of the SWOT matrix are described in detail. Basic indicators characterizing the strategic position of BIM on the Polish construction market are calculated. Finally, the matrix of strategic tasks and actions that should be applied in order to promote and develop BIM in Poland are defined.

Keywords: building information modeling; BIM; construction management; SWOT

1. Introduction

At present in the world, as well as in Poland, building information modeling (BIM) constitutes the fastest developing concept in the field of construction management. In many countries it is gradually becoming the standard for construction projects. In Poland, this technology is still being discussed and considered as an alternative to traditional planning and execution of construction projects. There exist considerable concerns about the introduction of a mandatory use of BIM technology in public works contracts. On the construction market one may notice a great deal of misunderstanding regarding this technology, lack of experience of the majority of participants in the construction process, and significant caution in its implementation.

However, the global literature emphasizes the major advantages of BIM. Approaches for acquiring 3D building information rely on using digital building information models and simplifying them (geometrically and semantically). BIM are object-oriented, semantically-rich, and up-to-date, thus allowing a query of necessary building parts in views [1]. This means that, according to the BIM idea, it is not only important to obtain information but, above all, to simplify the information contained in the model, systematize it, and use the information contained in the model. In contrast to standard models CAD, BIM models are now able to contain both geometric and semantic information as they develop during all stages of the life cycle of a building.

Due to the advantages and popularity of BIM globally, the authors of this paper decided to analyze the current situation in Poland, with the aim to examine the strengths and weaknesses of the introduction of the BIM technology in Poland, as well as the opportunities and risks it offers. In their analysis, the authors of the paper used a SWOT analysis, which is a tool employed mainly in the process of strategy building, but also in other areas of management. The challenges faced by both the Polish public administration and the participants of construction projects were presented. The authors also attempted to analyze the future trends in the development of BIM technology in Poland.

2. Methods—SWOT Analysis

The SWOT analysis is commonly used in strategic management when building the strategy of a given organization. It is a kind of diagnostic tool, often used at the very beginning of the process of defining future strategic plans. The SWOT analysis is a simple but powerful tool for sizing up an organization's resource capabilities and deficiencies, its market opportunities, and the external threats to its future [2]. SWOT is the acronym created from the initial letters of words that describe the characteristics of an organization's resources and its environment. The analysis has two dimensions: internal and external. The internal dimension includes organizational factors, also strengths and weaknesses, while the external dimension includes environmental factors, as well as opportunities and threats [3]. The SWOT analysis allows to obtain information on the possibilities of using strengths and enhancing the weaknesses in order to take advantage of the opportunities the environment offers and limit the risks that the environment can bring about. Strengths and weaknesses are of an internal nature, while opportunities and threats are of an external nature. Thus, the two dimensions generate four categories of factors:

- External positive (Opportunities)—opportunities (development opportunities in the environment).
- Internal positive (Strengths)—strengths of the organization.
- External negative (Threats)—environmental hazards.
- Internal negative (Weaknesses)—weaknesses of the organization.

The analysis performed by the authors aims to assess the opportunities offered by the introduction of the BIM technology in Poland, to evaluate risks, as well as analyze the strengths and weaknesses of support for the construction and the investment process using the BIM technology. The combination of strengths and weaknesses with opportunities and threats in the analysis strives for finding the best use of the potential that the BIM method offers in Polish conditions. The measure of the internal strength of the BIM technology, its strategic attractiveness and probability of strategic success will also be determined.

Advantages and disadvantages of the BIM technology will be presented in the analysis as strengths and weaknesses; moreover, the opportunities and risks of implementing BIM will be identified. The analysis will be performed in three stages:

- STAGE I—Identification of factors related to the implementation of BIM as positive or negative for the construction project and its environment, and assessment of these factors on a numerical scale from 1 to 5 where: 1—very weak factor influence, 5—very strong factor influence.
- STAGE II—Assessment of the strategic situation of the BIM method.
- STAGE III—Identification of the strategic tasks and actions by combining and analyzing the strengths and weaknesses of the BIM technology with opportunities and threats by using the strengths of BIM to obtain maximum benefits from the opportunities offered by the environment, overcoming the weaknesses by using the opportunities that exist in the environment, using the strengths of BIM to avoid threats from the environment, and minimizing the effects of the existence of BIM weaknesses to avoid risks from the environment.

3. BIM Technology

According the United States National Institute of Building Sciences (NIBS) "A BIM is a digital representation of physical and functional characteristics of a facility. As such, it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward" [4].

The task of the BIM technology is, therefore, to support the activities performed during the entire life cycle of a building by providing information on the geometry of the building as well as descriptive information on the building and its individual elements. The development of BIM and other digital technologies supporting the construction industry allows to improve the construction process and accelerate the implementation of buildings. Along with the development of such technologies as building information modeling (BIM), augmented reality (AR), virtual reality (VR), and the Internet of Things (for instance, near-field communication (NFC) and radio-frequency identification (RFID) sensors), new hardware and software tools have been introduced into the construction industry. These technologies allow the automation of construction processes, monitoring of construction works and management of information flow, as well as quality inspections [5].

The main advantage of BIM is the possibility to collect data in one place, namely in the BIM model, together with the method of geometric presentation of the building structure in a three-dimensional view. Collecting data through the design, construction, and operational phases would allow for further analysis of these data, generating new insights and simulations to identify clashes and interdependencies. Moreover, creating new methods of data visualization using visual and mixed reality improves communication and provides on-site information [6].

What should be emphasized is that, in comparison to the traditional construction process, not only the way of presenting geometric data (3D view) and collecting all the necessary data in the BIM model differ, but also the view and mentality of the participants in the construction process should also be changed. For example, the process of cost analysis benefiting from the availability of the BIM model differs in terms of quick extraction of information and data necessary as input for the developed predictive models [7]. However, every participant in a construction project has access to the data throughout the entire construction cycle. The cost data can, therefore, be adjusted on an ongoing basis. Moreover, each participant has access to the model and the data it contains, so they can, for instance, verify the data on an ongoing basis or have up-to-date information about the sample cost analysis and its changes.

Another advantage of BIM is the possibility to check the geometry and information included in the model easily and quickly. Revising the possible clash detection which can make works difficult to implement in order to discuss other solutions or remove errors occurring already at the pre-execution stage, is a significant advantage of the BIM technology. BIM is at the forefront of digital transformation in the AEC industry, [. . .] with a view toward streamlining a number of operations, such as collaboration and design review while addressing issues such as speed, cybersecurity, and data exchange integrity [8].

Considering the evolution imposed by the use of BIM, Table 1 summarizes the basic differences between the possibilities of using the BIM model in the construction process and the possibilities of CAD software supporting the traditional construction process.

Table 1. Comparison of CAD and BIM software capabilities (own study).

CAD Environment	BIM Technology
No link between drawings, any changes require manual correction	Parametric design allows automatic change of object and element parameters
2D view, no visualization of the 3rd dimension (height of the object and its elements)	3D, 4D, 5D, . . . , xD
The features of the elements are given by the designer. The drawing consists of 2D lines which are later interpreted as objects	Ready-made elements that already have their properties can be used. Specific relationships between the elements are established
Possibility of describing the properties of an element in a drawing or in a technical description for a project	The properties of the elements are correlated with the element and can be elicited at any time by selecting the element
Industry documentation is often created independently	The BIM model is a data source for all industries and integrates them
Collisions between industries are often detected only at the construction stage	Collisions between industries are detected at the design stage

Based on their research of publications on BIM published since 2004, Liu et al. [9] concluded that, in the recent decade, the research in the field of BIM was developing continuously, which had completely subverted the traditional operation mode of the AEC industry and attracted more and more researchers' attention at the same time. Considering the advantages of BIM technology and the pace of its development in many countries around the world, but also taking into account the disadvantages of this technology, the authors decided to investigate the trends in its development in Poland.

4. BIM Adoption in the World

The United States is the world leader in the field of BIM adoption, so it is difficult to be surprised by the dominance of the North American continent. Nevertheless, Europe should be put in second place, which, using American models, but primarily creating its own dynamically developments in the use of BIM technology. Australia and Oceania were considered the next most advanced and were strong in the design modeling. Asia is followed by strong leaders in the form of Korea, Hong Kong, China, and Japan. In South and Central America, despite close patterns flowing from the leaders from the USA and Canada, BIM adoption is much slower, only individual countries decide to introduce BIM in public procurement within a few years and there are not such large countries as Argentina and Brazil. BIM adoption in the Middle East and Africa is low. Private investors are eager to implement projects using BIM technology, while public investors only use BIM for infrastructure investments involving the construction of airports or passenger service terminals (e.g., Istanbul Grand Airport, Bahrain International Airport, and Abu Dhabi Midfield Terminal). The list and brief characteristics of BIM adoption by regions are shown in Table 2.

Table 2. BIM adoption by regions (own study).

Region/Continent	BIM Adoption Brief Characteristic
North America	In the US, BIM is mandatory since 2008—a definite leader in BIM adoption. In Canada, the BIM adoption program has been running from 2014 to today. North America apparently ranked as the most advanced continent in every approach.
South and Central America	It is planned to introduce BIM obligatory in government projects in the years 2020–2022 in a few countries.
Europe	Open BIM standards and mandate in a few countries (especially in Scandinavian countries and Great Britain), many countries are preparing to introduce BIM standards or to make BIM obligatory in public procurement).
Asia	Korea and Hong Kong are becoming leaders in the region, China and Japan have great government support in implementing BIM standards. The level of adoption on the continent, however, must be assessed low, despite these four strong leaders.
The Middle East	Unlike many Far East countries, BIM adoption in the Middle East is low. Individual projects are implemented, but there are no specific actions for the adoption of BIM in individual countries of the Middle East.
Africa	South African government's growth targets in respect of technology usage in South Africa would be beneficial to BIM stakeholders. However, there is a lack of efforts to adopt BIM on the continent. Only representatives of architecture, engineering and construction (AEC) recommended the adoption of BIM techniques in Egypt, starting with the acquisition of full awareness of the BIM framework, different levels and BIM stages also in the perspective of the entire life cycle of construction projects.
Australia and Oceania	Mandate in place in Australia, in New Zealand there is government support and significant BIM promotion.

In Europe, the prevailing trend can be seen that western and northern countries have adopted BIM earlier and some of them, primarily the United Kingdom and Scandinavian countries are leaders on the BIM market. Southern and eastern countries are taking BIM at a slower pace. The situation is similar if we look at government initiatives, where especially Finland, Norway, Great Britain, France, and Italy dominate in the scope of solutions introduced in public procurement. Poland belongs to the second group of countries that are just planning to introduce standards or an obligation to use

BIM in public procurement and the adoption of BIM is slightly slower. In Poland, there is a lack of both generally used BIM standards and government support and mandatory solutions introduced in public procurement. It seems, however, that market awareness, especially of designers, is growing and dozens of public procurement, mainly related to the BIM model designing, have already been announced and carried out.

5. The SWOT Analysis of the Use of BIM Technology in Poland

The subsequent steps of the SWOT analysis described in chapter 2 are presented below. The analysis concerns the assessment of the strategic use of the BIM in the Polish construction industry.

5.1. Stage I—Identification of Factors

Factor identification was based on the analysis of both Polish and foreign literature, authors' own experience in implementing BIM in Poland and reports published by Autodesk:

- In October 2015 [10] on behalf of Autodesk, the Millward Brown Institute conducted a study in a group of 350 companies from the architectural and construction industry (architectural studios, construction design and installation companies, and development companies), called "BIM—Polish perspective".
- In October 2019 [11] on a sample of 287 companies, the Kantar Poland Institute (commissioned by Autodesk) prepared and published a study "BIM, cooperation, cloud in Polish construction".

Table 3 presents strengths and weaknesses, opportunities and threats of the BIM technology implementation in Polish construction projects. The Table also includes the evaluation of elements in the SWOT matrix on a numerical scale from 1 to 5, where: 1—very weak impact of the element and 5—very strong impact of the element. The assessment was made subjectively by the authors on the basis of market data, reports, and their own experience.

Table 3. Strengths and weaknesses, as well as opportunities and threats of BIM technology implementation in Polish construction projects (own study).

STRENGTHS (S)		WEAKNESSES (W)	
Better documentation	5	No universal software platform	2
Reduction of costs of the construction project	5	High labor consumption of the correct BIM model	5
Reduction of construction material waste	3	Errors in reflecting the true form of the building	4
Automation of drawing execution	4	High costs of BIM implementation in a company	1
TOTAL	17	TOTAL	12
OPPORTUNITIES (O)		**THREATS (T)**	
High interest of the leaders of the construction market	4	Lack of legal regulations and binding standards concerning BIM in Poland	5
Implementation of the BIM technology in many countries	3	Lack of qualified and experienced staff	5
Developing higher awareness among all stakeholders	5	Unwillingness of the contractors/clients/users to employ BIM	3
Educating students in BIM	2	-	-
TOTAL	14	TOTAL	13

The elements of the SWOT matrix which were qualified to its individual components are briefly described below.

5.1.1. STRENGTHS (S)

Better Quality of Documentation

Due to the greater transparency of the documentation presented in a 3D view and the requirements concerning the degree of model development (Level of Development, LOD), it is possible to obtain documentation of better quality and adapted to the requirements at a given stage of investment (for example, requirements in accordance with the LOD 100, ..., LOD 500 classification). Additionally, BIM tools allow to detect spatial collisions of elements in the BIM model, the so-called "clash detection". Thus, it is possible to detect early irregularities and design mistakes and, thus, reduce cost-generating errors during construction.

According to [12], clash detection with the use of BIM caused a significant reduction in RFIs (Requests For Information) on all surveyed projects. In case studies presented by [13], RFIs were reduced by 34% on a small tilt-wall project, 68% on a three-story assisted living facility, and 43% on a midrise commercial condominium project. The number of change orders was reduced by 40%, 48%, and 37%, respectively. In accordance with reports [10,11], the greatest benefit of implementing the BIM technology was the creation of better quality projects (2015—61.4%; 2019—69.4%) and the possibility of minimizing errors (60.5%, 51.0%), both in terms of design and implementation.

Final rating of the feature (on a scale of 1–5): **5** (due to over 60% the highest rating in surveys).

Reduction of Construction Project Costs

Information entered into the model and accuracy of take-off calculations have a considerable impact on calculated costs of a construction project [14]. By gathering information in one place, granting access to this information for all investment participants, improving the information flow process and clash detection, BIM allows to reduce the cost of the entire investment. In case studies presented by [13], the ROI (Rate On Investment) of BIM varied greatly from 16% to 1.654%. According to the report [10] the greatest savings are generated by the stage of redundancy and cost estimation (as stated by 70% of respondents), implementation (about 55% of respondents) and use (about 50% of respondents). In 2019, a similar hierarchy was maintained. The greatest controversy was caused by the architectural design stage, since about 55% of respondents declared that BIM reduced the costs of this process, while 30% claimed that it increased the costs. Generally speaking, it can be said that BIM definitely has a positive impact on the reduction of costs of a construction project in the whole process of the construction of a building.

Final rating of the feature (on a scale of 1–5): **5** (due to 70% of respondents' support for opinions on cost savings when using BIM).

Reduction of Construction Material Waste

The BIM technology helps to reduce building material waste by making accurate measurements based on the BIM model. Therefore, BIM allows to control the amount of material that should be used at a given stage of a construction project. With flexible purchasing and delivery management, waste and unused materials can be reduced by both contractors and subcontractors. However, environmental benefits are not prioritized in Poland, hence, the much lower assessment of this element.

Final rating of the feature (on a scale of 1–5): **3** (due to the relatively low assessment of environmental benefits in Poland).

Automation of the Drawing Process

The drawing process based on the BIM technology is automated. Changes made to the model immediately generate corrected drawings, thus saving time that can be used to refine the model. At the moment, these design methods are regarded to be an area of professional skills, connected with computer techniques [15]. The use of parametric design allows to create even very complex shapes. It uses advanced algorithms which are based on the parameters entered into the computer. Parametric design allows to set parameters for certain element sizes, when appropriate values are entered and, thus, the shape of the element is updated. In this way a series of types is created without having to draw all the changes.

Kapliński in [16] includes BIM modeling and the integrated BIM process in construction as construction trends shaping the industry in 2016 and beyond. In report [12] the respondents highly appreciated the possibility of improving the way of designing, as well as the possibility of creating more efficient projects (2015—38.4%; 2019—34.7%).

Final rating of the feature (on a scale of 1–5): **4** (due to the high position in the respondents' opinions in the report, but lower than creating better quality projects).

5.1.2. WEAKNESSES (W)

No Universal Software Platform

Cooperation of models created in programs from one manufacturer is not a problem; however, when there is a need to exchange data between software from different manufacturers, smooth data exchange and information loss issues may occur. Figure 1 shows the loss of data in the export and import of models to the various stages of investment. The bottom graph presents problems arising from data loss in the model due to the lack of a universal data exchange platform and a lack of interoperability between the software used in the construction process. The downward spikes at the end of each project phase means loss of geometrical and/or non-geometrical data. These losses usually occur when the project is exported from BIM to 2D CAD format, but also during the export to IFC format or from the IFC format the model is converted to native formats. The top line represents a practically ideal situation in which data and knowledge are gradually increased throughout the duration of the project (the model is successively updated and supplemented with new information, no data loss).

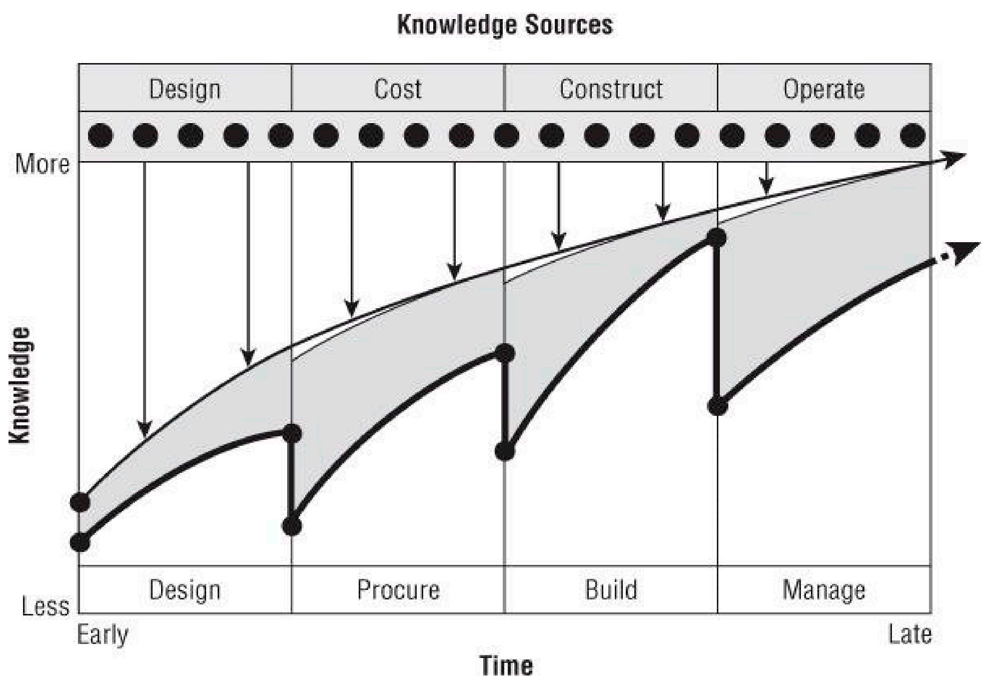

Figure 1. The BIM curve shows data loss without interoperability at project milestones (After: [17]).

Appropriate interoperability helps to eliminate the problem of the lack of a universal information exchange platform. It seems that the activities of the buildingSmart organization striving to provide a universal foundation for sharing information and improving processes in the design and construction industry. This goal is implemented through actions to develop standards, norms, and tools supporting the exchange of information regardless of the IT platform used. Authors think that focusing on one format—IFC—and its development is the right thing to do. Working on common standards, e.g., within the EU, and a common dictionary of building terms and the BIM dictionary (which Bilal Succar does creating the new BIM Dictionary platform) and promoting such activities can lead to solutions to many problems.

Final rating of the feature (on a scale of 1–5): **2** (subjective assessment).

High Labor Consumption of Developing the Correct BIM Model

Creating a correct BIM model which will be properly made and filled with information required at a given stage of the project is strongly laborious according to the designers. Research results in Poland [10,11] reveal the respondents' mentioning the most frequent barrier in connection with the implementation of BIM in Polish companies, namely extremely low prices of projects, which is directly related to the labor consumption of their implementation (2015—83.9%; 2019—67.4%).

Final rating of the feature (on a scale of 1–5): **5** (due to the highest rated BIM development barrier in Poland by respondents in reports).

Errors in Reflecting the True Form of a Building

The availability of design software on the market is relatively high; however, there are few specialists able to properly design a building in accordance with world standards promoted by the AIA (American Institute of Architects). In the research [10,11] competence gaps were mentioned (few BIM specialists): shortage of qualified staff (as stated in [10]—71.4%, according to [11]—58%) and a low level of knowledge about BIM in Poland (60.2% and 68.4%, respectively).

Final rating of the feature (on a scale of 1–5): **4** (due to the second most important barrier to BIM development in Poland).

High Implementation Costs of BIM in a Company

The requirements for hardware supporting BIM applications are much higher than for CAD applications, due to the large size of BIM files and the higher graphic demands. Implementing BIM often involves the purchase of new computers and software. Examples of the costs of implementing BIM in a construction company are presented in Table 4.

Table 4. Costs of implementing BIM in a construction company.

Software Type	Example Software	Number (unit)	Unit cost (PLN/unit)	Cost (PLN)
Design	Archicad/Revit	1	10,000	10,000
Cost estimates	BIMestiMate	3	2190	6570
IFC browser	SMV/BIM Vision	3	0	0
	TOTAL			16,570

Moreover, there are additional costs related to training. Sending three employees to post-graduate studies means a cost of approximately 6000 PLN per person.

Final rating of the feature (on a scale of 1–5): **1** (due to relatively low costs for large and medium companies)

5.1.3. OPPORTUNITIES

High Interest of the Construction Market Leaders

Large companies (both investors and construction contractors) that are leaders in the construction industry are highly interested in the implementation of the BIM technology due to the wish to reduce the costs of construction investments and to increase the attractiveness of their company. The interest of large public procurers is also slowly growing, as proved by the first pilot programs performed by infrastructure procurers, such as the Polish State Railways, the General Directorate for National Roads and Motorways and the Polish Power Grids.

Final rating of the feature (on a scale of 1–5): **4** (subjective assessment).

Implementation of the BIM Technology in a Number of Countries

The implementation of BIM technology is currently taking place all over the world. Some countries already have legislation in place and in some countries BIM is mandatory in public procurement. The state of global adoption of BIM for 2017 is depicted in Figure 2.

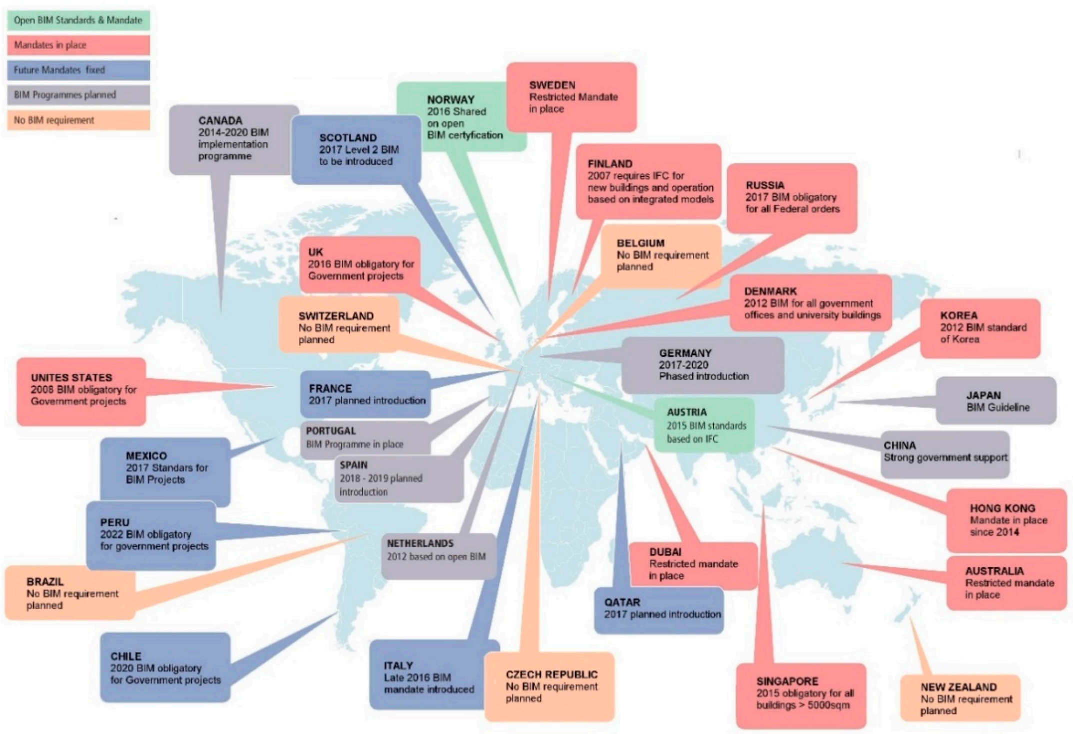

Figure 2. Overview of global BIM adoption [18].

Final rating of the feature (on a scale of 1–5): **3** (compared to other European countries, Poland is only on the path of planned BIM adoption)

Developing Higher Awareness among All Stakeholders

Increasing stakeholder awareness regarding both the benefits and losses associated with running an enterprise using BIM technology will cause less distrust on the market. More investors, knowing the benefits and potential threats, will decide to impose the use of BIM by designers and contractors in the construction process.

Developing higher awareness was placed in reports [10,11] as the first BIM activities that should be implemented in Poland so that the architectural and construction industry could fully use BIM

(2015—40.4% and 2019—55.3% respondents believe that BIM awareness is currently the most important activity that should be carried out in Poland).

Final rating of the feature (on a scale of 1–5): **5** (due to the most important activity that should be carried out in Poland).

Students' Education about BIM

The awareness of future engineers and architects about BIM is increasing. The universities offer master's and post-graduate courses to develop knowledge about the BIM technology. Therefore, there is a chance that, in a few years' time, the current lack of personnel in the field of BIM knowledge will be filled with young professionals.

Final rating of the feature (on a scale of 1–5): **2** (subjective assessment).

5.1.4. THREATS

No Legal Regulations and Binding Standards Regarding BIM in Poland

Poland lacks regulations, or at least standards, in force, regarding the use of the BIM technology. In public procurement, investors use the provisions of the British specification PAS 1192-2:2013 (in 2017 replaced by BS EN ISO 19650) or LOD (level of development) specified by the AIA (American Institute of Architects). In the reports [10,11] it is proposed to create Polish BIM standards as the second most important action to be taken for the development of BIM in Poland, immediately after building investor awareness (2015—36.0% and 2019—51.1% respondents believe in that).

Final rating of the feature (on a scale of 1–5): **5** (due to the one of most important barrier to BIM development in Poland).

Lack of Qualified and Experienced Staff

An efficient use of the BIM technology requires new skills and experience and, thus, time, which in turn prolongs the construction project when creating the first BIM projects. A survey conducted on 30 September 2016 for the Ministry of Infrastructure and Construction shows that the main problem in the implementation of investments in Poland with the use of BIM is the lack of competence of the staff (Figure 3).

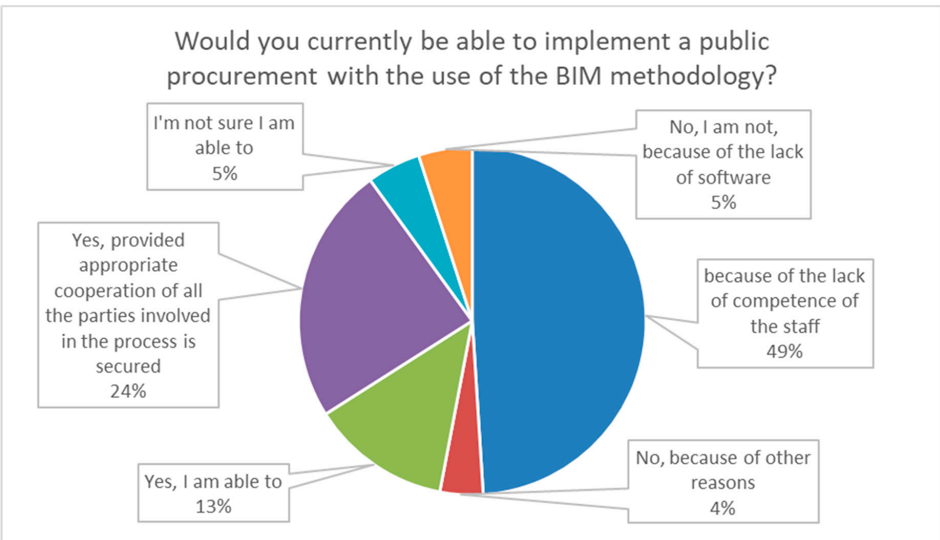

Figure 3. Survey on the implementation of BIM [19].

Final rating of the feature (on a scale of 1–5): **5** (due to lack of competence of the staff—49% respondents of survey point out on that problem).

Unwillingness of the Contractors/Clients/Users to Use BIM

Most of the participants of the construction market in Poland do not see or are not aware of the benefits of BIM. The participants do not want to change the way they work because of their habits. Internal barriers are quite important, that is: reluctance to change or no openness to new solutions, which is a common and typical behavior in the case of all novelties.

Final rating of the feature (on a scale of 1–5): **3** (subjective assessment).

5.2. Stage II—Assessment of the Strategic Situation of the BIM Method

Table 2 shows the total points for each of the four forces (S, W, O, T). It is important to note that:

$$S = \sum_{i=1}^{4} S = 17 > W = \sum_{j=1}^{4} W = 12$$

$$O = \sum_{k=1}^{4} O = 14 > T = \sum_{l=1}^{3} T = 13$$

This means a maxi-maxi strategic position, which gives BIM a privileged position in the market because of the advantage of the strengths over the weaknesses and opportunities over the threats. The strategy of further proceedings concerning the BIM technology on the Polish market should aim at maintaining its current position.

Moreover, using the data from Table 2 for the SWOT analysis, it is possible to determine the attractiveness of the environment (AS) of the BIM technology, which is a function of opportunities and threats AS = f (O,T), calculated from the following formula:

$$AS = \frac{O}{O+T} = \frac{14}{14+13} = 0.519$$

The market position of the BIM technology can also be determined (SP—internal strength), as well as the likelihood of strategic success (PSS—probability of a strategic success):

$$SP = \frac{S}{S+W} = \frac{17}{17+12} = 0.586$$

$$PSS = \frac{SP + AR}{2} = \frac{0.59 + 0.52}{2} = 0.552$$

Assuming that the PSS limit value is 0.5, it can be concluded that the BIM technology has a chance to develop, though probably slowly and not without problems.

5.3. Stage III—Defining Strategic Tasks and Actions

Each analyzed pair created by the strong or weak side of the use of BIM technology in Poland and by the opportunities and threats related to the environment, delimits a certain framework of a specific problem. In order to solve it and to indicate the ways of further proceedings, the before-mentioned SWOT matrix and associative techniques can be used.

The matching technique may be a specific heuristic method, such as brainstorming, as well as direct or symbolic analogies. Combining strengths and weaknesses with opportunities and threats in order to make the best use of the potential of the BIM method is illustrated in Table 5.

Table 5 shows the matrix of tasks and strategic actions that should support the development of the BIM technology in Poland. The application of heuristic methods results in the proposed strengthening of strategic activities undertaken in Poland, for example S1O3, S2O1, and W2O4, proposals to implement actions not yet taken, such as W4O2, and showing the dangers, for instance W1T1, W2T3.

Table 5. Matrix of strategic tasks and activities.

	STRENGTHS (S)	WEAKNESSES (W)
	1. Creating better quality projects 2. Decreasing the construction project costs 3. Decreasing the amount of construction waste 4. Automation of drawings	1. No common software platform 2. High labour consumption of creating a correct BIM model 3. Errors in reflecting the real form of the building 4. High costs of BIM implementation in a company
OPPORTUNITIES (O)		
1. High interest of the construction market leaders	S1O3—higher quality of projects should contribute to developing higher awareness of all participants in the project	W1O1—the interest of market leaders can help to create universal tools and software platforms
2. Mandatory implementation of BIM in public procurement in many countries	S2O1—reducing the cost of construction projects will increase interest of market leaders in BIM technology	W2O4—education of students on BIM will allow to introduce to the market people able to quickly perform the correct BIM model
3. Developing higher awareness among all stakeholders 4. Education of students in BIM	S4O4—automation of work should increase students' interest in BIM technology	W4O2—implementation of BIM in public procurement in Poland may result in increased investment in the implementation of BIM in the company
THREATS (T)		
1. No regulations or binding standards concerning BIM in Poland	S2T3—reduction of construction project costs should convince all the reluctant to introduce this technology	W1T1—the lack of a universal software platform may discourage the government from creating legal regulations and hinder the creation of the standards of conduct
2. No qualified or experienced staff 3. Unwillingness of the contractors/clients/users to use BIM	S4T2—design automation should encourage young engineers in particular to learn the BIM technology	W2T3—high labor consumption and low wages may discourage designers from using BIM technology W4T2—high costs for software and staff training may discourage employers from training their staff

6. Summary and Conclusions

The SWOT analysis shows that the implementation of BIM in Poland currently has a favorable position on the market, resulting from the existence of strengths over weaknesses and opportunities over threats. However, it is difficult to count on a fast dynamics of changes in Poland in terms of the implementation of BIM in construction.

The best strategic solution for the implementation of the BIM technology seems to be an aggressive development strategy, which is recommended for "maxi-maxi" situations. Such a strategy is based on maximizing the use of strengths and opportunities to streamline the dynamic implementation of BIM for everyday use. The strengths of BIM should be fully exploited when the environment provides an opportunity to do so.

The promotion of BIM should take advantage of the interest of companies that are leaders in the construction market, who should be reminded about reducing investment costs, which should encourage the use of BIM.

Introduction of fields of study specializing in BIM at universities should, in turn, allow to fill in the gaps in the staff able to proficiently use various BIM applications in a few years.

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