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Abstract

With the expansion of the global application of building information modeling (BIM) in the architecture, engineering and construction (AEC) industry and the benefits of this approach to everyone, the application of this new method in many countries, including Iran, is facing many obstacles. Therefore, one of the necessary actions to increase the adoption and implementation of this new approach in Iran is to study the obstacles and challenges facing it. In this paper, using a questionnaire, the importance of obstacles and challenges from the perspective of experts was assessed. Analysis of collected data with the help of Kendall ranking showed that the most important challenges and obstacles facing the adoption and implementation of BIM in the Iranian AEC industry are: Lack of policy and roadmap in the organization, lack of knowledge and support of senior management, lack of readiness of the manufacturing industry, lack of attention to various aspects of BIM in current contracts and lack of guidelines and application standards. Also, those in charge of overcoming these obstacles and challenges were identified at four levels of decision-making: (1) government, (2) professional institutions and associations, (3) organization, and (4) inter-organizational. In the mentioned questionnaire, the level of responsibility of each level in front of removing obstacles was also evaluated and using risk analysis method, prioritization of obstacles and challenges for different levels of decision making was determined.

Key words: Building Information Modeling, BIM, BIM implementation, BIM barriers, decision making levels

Introduction

Today, despite the expansion of the global application of BIM in AEC industry, the application of this Method in developing countries, including Iran, is facing many obstacles, including social, organizational, technical, legal, contractual and economic barriers. Emphasizing these obstacles and challenges, Hosseini et al. [1] stated that Iran's AEC industry is at a lower level of acceptance and implementation of BIM compared to other countries in the Middle East. Despite the huge benefits of BIM and its global expansion, the slow adoption of this new approach in some countries, including Iran, has raised many concerns.

Research on BIM barriers and challenges began in 2005 and increased dramatically from 2014 onwards. In 2017, the main challenges faced by the Egyptian AEC industry were the lack of training programs in organizations and the lack of related studies about the economic benefits of BIM [2]. At the same time, Zhao et al. [3] examined existing barriers to the development of this technology in Australia and the lack of relevant knowledge and expertise, technology issues, data ownership issues and poor data sharing and sharing were amongst pivotal challenges. In 2018, Iraqi Construction experts working in the private and public sectors stated that the three main factors holding back BIM development are importance, weak government efforts, low level of awareness of BIM benefits, and resistance to change, respectively [4]. Another study conducted in China in 2019 also identified factors such as inadequate government support and leadership, organizational problems, legal problems, high implementation costs, resistance to change, and insufficient external incentives as factors hindering the spread of BIM. Is [5]. Latest study [6] in Nigeria on barriers to BIM implementation in small and medium-sized enterprises shows the strong impact of barriers such as resistance to change and the high risk of BIM implementation.

Research related to the status of barriers and challenges of BIM implementation in Iran is limited and insufficient. In 2015, Kiani et al. [7] examined the barriers to BIM implementation in the planning and scheduling phase of Iranian construction projects. In this study, barriers to lack of legal support from the authorities, lack of skilled BIM software operator, high cost of BIM software, lack of benefits of using BIM and non-demand for BIM by the employer were identified as the most important obstacles. Also, in 2015, Hosseini et al. [1] investigated the barriers and challenges of BIM in Iran. This study emphasizes the role of government officials and states that increasing the use of BIM depends on government financial support and legislation in this country. Therefore, first objective of this study is devoted to identify the factors that have hindered or delayed the implementation and acceptance of BIM in Iran.

Many studies have considered BIM as a technological innovation and viewed it from the perspective of innovation diffusion theory [8]. Poirier et al. [9] proposed a model based on this theory in which the key factors affecting the acceptance of BIM are in four contexts of industry, institution or institution, organization and project. Each of these four areas has profound implications for BIM adoption and implementation. Therefore, the second purpose of this study is to identify authorities who are responsible for removing obstacles and challenges in implementing BIM. In this regard, four effective performance levels inspired by the mentioned substrates have been proposed by researchers. These levels include government (industry on a larger scale), professional institutions and associations, organization and inter-organizational.

Methodology

In this study, due to the existence of several similar researches, the questionnaire survey was identified as the most concise tool which provided comprehensive information in a short time. The main goal of the questionnaire used in this study is to examine the importance of barriers and challenges in BIM implementation, applying a 7 point Likert scale. Unfortunately, due to the emergence of BIM in Iran, the exact number of users and companies that use this method is not available. As a result, the statistical population in this study is hidden from the population [10] and the size of the population in this study is not known. Eventually, Size of sample reached to 73 which satisfied KMO factor of 0.5. Also, Cronbach's alpha index which is the common methods of measuring reliability was employed. This coefficient for the whole questionnaire was 0.744 which indicated the appropriate reliability of the measuring instrument [11].

The Kendall W test can be used to determine the degree of consensus among respondents and to prioritize barriers according to this degree of consensus. This coefficient is a number between zero means disagreement and one means complete agreement [12]. Also, another result of this test is ranking based on the average rank, in which obstacles and challenges have been ranked in this research. To fulfill the second goal of this study, the traditional risk analysis method was used to measure the level of responsibility of each decision-making level. traditional method of risk assessment is based on risk matrix. This matrix uses two components, "probability of risk occurrence" and "severity of risk outcome". With these two components in hand, the "risk index" can be calculated [13]. In the present study, the score obtained from Kendall W ranking of barriers is assumed as the severity of the risk outcome and the frequency of assigning a barrier to one of the decision-making levels (government, professional institutions and associations, organization and inter-organizational) as the probability of that risk. In this way, higher priority risks can be identified for each level of decision making.

Result and Discussion

According to result of Kendall W, the "lack of policy and roadmap in the organization" barrier with an average of 27.51, has the highest rating. Afterwards, the "lack of knowledge and support of senior management of BIM" is not significantly different from the previous barrier and is ranked at the second place. Consequently, the barriers of "unpreparedness of the manufacturing industry", "lack of attention to various aspects of BIM in current contracts" and "lack of guidelines and application standards" ranked third to fifth, respectively. Primitive result of this study outlines that socio-organizational category barriers are scattered across all the list. After that, the barriers of the legal-contractual category are of high to medium importance. Economic barriers have mostly accumulated in the middle of the chart and technical barriers at the bottom of the chart.

According to the results presented in this section, most of the important obstacles and challenges belong to the socio-organizational and legal-contractual categories. These results indicate that the Iranian AEC industry is still at the lower BIM acceptance stage and organizations has not fully entered the implementation phase. Acceptance of BIM in the AEC industry requires the creation of legal infrastructures such as determining the ownership of the model and liability for model defects and errors, and the submission of standard BIM contracts by the legislature. Also, removing barriers and challenges that are of socio-organizational nature, opens the way for the implementation of BIM in development projects. AEC industry will not embrace BIM unless the awareness of managers and employees of organizations about the benefits of BIM increases and the use of BIM as an effective method is in line with the goals of organizations. After awareness and long-term goals, acquiring specialized knowledge related to this field and making the necessary changes in work processes are other necessary steps. Finally, it can be predicted that the importance of barriers related to economic and technical categories will increase in the stage of full implementation of BIM, because the construction industry is still in the acceptance stage and has not fully faced these challenges.

Another goal of the present study was to determine what barriers o each level of decision-making is responsible for removing and which of these barriers have a higher priority than the others. To achieve this goal, using the risk formula, obstacle removal priorities were determined for each level. The level of government decision-making is responsible for overcoming infrastructure barriers and challenges (such as legal infrastructure and IT). The barrier "Implementing BIM requires a change in legal procedures" has the highest rating at this level. The decision-making level of professional institutions and associations is responsible for guiding and directing the construction industry. The "lack of guidelines and application standards" barrier has the highest rating at this level. level of organization plays a significant role in the face of all obstacles and challenges. This is because ultimately it is the organizations that are primarily responsible for implementing BIM and must subsequently take steps to remove barriers. The "lack of knowledge and support of senior management of BIM" barrier has the highest priority for this level. In the end, the level of inter-organizational decision-making is less responsible than other levels. This may be because this level only faces obstacles and challenges in which two or more stakeholders are involved. The "weak partnership between consultant and contractor" barrier has the highest rating at this level.

Conclusions

The results of this study shed light on a general issue for readers. Obviously, the identified obstacles and challenges can be overcome only with the cooperation of different decision-making levels. The application of BIM in the Iranian manufacturing industry will become widespread when the level of government and the level of associations and guilds in the first stage to introduce this new method and awareness to organizations and in the second stage to legislate, develop relevant practical standards and standard BIM contracts. To pay. In this case, the infrastructure needed to enter the BIM implementation phase in organizations is provided. Once the acceptance phase is complete, the organization level, which has a huge responsibility in dealing with obstacles, will take action to implement BIM. After implementing BIM in organizations, the inter-organizational level will take action to address the problems and challenges that arise when stakeholders participate.

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