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The Applicability of Using Automation in Construction in Iraq

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Abstract

Several governments around the world announced new strategies regarding their construction industry. These strategies focus on reducing construction projects' time, cost and improving their impact on the environment. To achieving these goals within the proposed time scale, these authorities advise their stakeholders to start to implement different methods in project delivery such as Building Information Modeling (BIM), Integrated Project Delivery (IPD), Geographic Information System (GIS), and many more. All these new technologies and methods will reduce human errors in the project lifecycle which will lead to reducing project waste. In addition, this will pave the road to automation in construction. Automation will help to mitigate the huge number of clashes and mistakes. Iraq an oil-depended country suffering from economic crises due to the considerable reduction in oil prices. This struggle must enforce the government to use this opportunity to solve current project problems such as project delays and budgets overrun and rethink how to reduce construction project time and cost. However, the applicability and understanding of these new methods and technologies need to be explored first among the Iraqi construction industry. This paper will investigate the understanding of automation in construction among different disciplines working with different experiences in the Iraq construction industry. The method of survey was used to sightsee their view regarding automation in construction understanding, benefits, and the challenges. The results reveal that there a positive view in terms of understating the meaning of automation in construction. In addition, several benefits are identified as the most effective gains if these new methods are implemented. Furthermore, more than a few challenges also have been acknowledged that need to be considered to increase the successfulness of implementing automation in construction.

Keywords: Automation, Construction, Iraq, BIM, GIS, IPD

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1. Introduction

Construction automation and robotics (CAR) is on a global level progressively documented as an innovative technology that may assist the construction industry to bridge the gap with the other industries [1]. There no single definition for automation in construction due to its involvement in all project life cycles from planning to operation and maintenance [2]. Automation of construction will address different and serious difficulties associated with construction. For instance, final product not matching the proposed quality, skilled labor crises, safety accidents, extreme weather, short project delivery, and lack of funds [3]. However, the term automation in construction is applied regarding information processing. In the civil engineering industry, the implementation of this kind of technology is approved via using computer aid design, drafting, estimation, scheduling, and accounting [3]. Several governments around the world such as UK, Germany, Australia, Canada, the USA, and Sweden have been published strategic plans to improve construction industry production via implementing different kinds of technologies and methods of construction [4]. For example, UK construction strategy targets can be summarized in four points:

1. Reduce whole-life greenhouse gas emissions in the built environment by 50 %.
2. Reduce construction time (measured from conception to completion) by 50 %.
3. Reduce whole-life costs for built assets by 33 %.
4. Reduce the trade gap on construction products by 50 %, which can be classified as environment, cost, time and production issues. These governments comprehended that these goals can be achieved or at least realized by implementing automation in construction principles [5].

Oil price instability is extending Iraq's economic difficulties. GDP tight sharply in 2020 driven by a sharp decline in oil production and non-oil output. Economic attitude is subject to oil market developments and reforms implementation World bank [6]. These issues prevent the governments from proceeding with their plan to improve Iraq's infrastructure systems (water, sewage, electricity networks) [7]. In addition, CAR can be used to solve current construction project problems such as project delays and budgets overrun [8]. All forth mentioned factors are forced the Iraqi authorities to think smartly in terms of reducing construction projects' cost and time. Areej and Redvan [9] stated that using modern technologies and methods of construction will help Iraqi construction projects to mitigate the risks early and reduce the total cost and time.

This research will investigate the applicability of using the new technologies and methods in the Iraq context through examine the common sense of these methods among Iraqi construction industry professionals.

The aim of this study will be met via sending several questionnaires to different practitioners who work for private and public projects. These questions have been divided into three parts. The first part discusses their understanding of the

term automation in construction. The second part discusses their understanding regarding the challenges that prevent these new methods from being implemented in Iraq. The final part discusses the most benefits that these methods can provide to the Iraqi construction Industry.

2. The Benefits and the challenges

Similar to any new changes to the traditional method of the construction project, automation in the construction concept has its advantages and challenges. As this study investigates this concept from a generic point of view, the main benefits and challenges will be discussed.

As declared previously, automation in construction terms can be implemented in all project stages from design to decommissioning. Therefore, its benefits can be many as hundreds of advantages, and the beneficiaries can be clients, contractors, and designers. For the purpose of this study, only the main benefits and challenges will be summarized through an extensive literature review.

2.1. Automation in construction benefits

Construction automation has the potential to improve the industry from against the technology to empower it and transform the method where projects are executed from start to finish. This should consequence in an enormous productivity enhancement. In addition, automating inefficient or risk processes is a positive environment; this will assist projects to maintain the proposed schedule and stay on the planned budget while concurrently ranking employee safety.

In Table 1, the generic benefits of automation have been listed with supporting previous research.

Table 1 Automation in construction benefits.

No	Benefit	Supporting research
1	Reduce time	Chen et al. [10]
2	Reduce cost	Faghihi [11]
3	Reduce construction difficulties	Balaguer [12]
4	Improve final product quality	Richard [13] Kamaruddin [14]
5	Reduce waste and corruption	Castro-Lacouture [15]
6	Improve the industry reputation	Oke et al. [16]

Despite the remarkable benefits that can be achieved by implementation automation in construction methodologies, the organization's capabilities also can be considered as a key factor [14]. Reducing project duration occurs when unpredicted delays such as, severe weather, design conflict, and equipment failure will lead to significant delays in the project's proposed time scale which can be mitigated by implementing automated information management. Resource management software as one of the options in automation in construction can review critical project financial indicators such as costs, revenue, profit margins, and overheads. Chasing project financial information supports to prevent budget overruns. Project leaders can manage costs by intermittently pursuing and associating the real expenses in contradiction of the planned budget. If there is an alteration, essential counteractive actions can reduce project costs. Constructability (or construction problems) is a project management technique to evaluate construction processes from start to finish during the pre-construction phase via automation in construction methods and software. It is to recognize complications beforehand a project is essentially built to decrease or avoid errors, delays, and cost overruns. In general, using these new technologies and methods of construction will motivate all construction participants to develop their skills via training courses which improve Iraq's construction industry capabilities and advance its reputation global wide.

2.2. Automation in construction implementation challenges

Due to the remarkable change that the implementation of automation in construction demand, there are challenges that need to be addressed for successful application. However, some specific barriers can affect these new methodologies' execution that needs to be understood and mitigated. These barriers and challenges are listed in Table 2 with supportive former studies.

Table 2 Automation in construction challenges.

No	Challenges	Supporting research
1	Corruption	Chen et al. [10]
2	Lack of professional	Faghihi [11] Balaguer [12]
3	Lack of strategic planning	Richard [13] Kamaruddin [14]
4	High initial investment	Castro-Lacouture [15]
5	Lack of time to change	Oke et al. [16]
6	Economic and political factors	Dadhich et al. [17]
7	Lack of awareness	Cai et al. [18]
8	Lack of academic research	Bakis et al. [19]

One of the main benefits of automation is reducing necessary work and improve transparency which will reduce corruption. Therefore, all the systems that get benefits from corruption will stand against these new methods. In addition, the lack of professionals that capable to practice these methods can represent one of the main challenges. The absence of government support via a strategic plan to motivate clients, contractors, and designers also can be considered as one of the main barriers. Initial cost and time to change represent the main challenges especially for small companies that unable to afford these sources despite the benefits. Iraq in particular passing through a difficult situation in terms of a politically unstable environment and also economic crises which prevent any long-term solution to be adapted notwithstanding its benefits to solve these issues. Lack of awareness among the construction industry participants and real evidence or academic research that can support this huge change represents one of the main barriers to implement automation in construction.

There are definitely more challenges that can face any participant to start using this new methodology. However, this research will focus only on these challenges due to a lack of understanding of this new term in Iraq and also try to make the survey simple as much as possible.

3. Research Methodology

In order to achieve this study's aim to find the applicability of implementing automation in construction in the Iraq construction industry, this study employed objectivism as a research philosophy. Survey as one of this philosophy tools has been implemented due to its advantages to reach many participants with different backgrounds to respond to the diverse kind of questions regarding these research objectives [20].

The questionnaire consists of two main parts. The first part will discuss the participant's background in terms of specialty. This question proposed as an open question to let participant express about themself freely. The second question in this part was about the place of work is public or private. This question is designed to examine the work environment effects of employee views regarding this change. The third question is regarding the participant's experience which will help to check the experience effect of the readiness of the participants to change.

The second part of the survey is made up of four main questions. The first question is to observe the participant's understanding of the automation of construction. Therefore, they have been asked what they think automation in construction means, is it using new technologies and robotics only or is it a new method of construction, and VR only or it is both of the previous options. The second question is related to what they think if the Iraq construction industry ready to implement and use automation in their construction project or not. The third question is to choose from the list the most common challenges that facing automation in construction from being widely used in Iraq. The list of the challenges is exactly the same as mentioned in the previous section. The final question is the contributors have been asked to choose from the list which the most benefits that they may gain if they implement automation in construction in their project. Also, the list of the main benefits is matching the list mentioned in the previous section.

The Google forms template has been used to create the questionnaire due to its flexibility and affordability. Social media such as LinkedIn, Facebook, and others have been used to send and discuss the participant's question and their feedback. To mitigate authors' effects on participants' selection, a third party has been used to assist to send and receive the questionnaire and the responses between the authors and the participants. Excel program used to analyze responders' answers and drive the final results and relationships. Finally, a thank full message was sent to all the people who contribute to this research with the option to put their email if they are interested to see the final results.

4. Results and Discussions

In order to focus on each result and information and discuss it deeply, this section will be subdivided into four parts as follows.

4.1. Participants' background

As mentioned in the methodology this section aims to explore the background of the contributors and its effect on their answers. 173 participants who successfully fill the questionnaire and their answers can be classified as valid. Firstly, as shown in Fig. 1. the 62.4 % of the participants are working in civil engineering, 13.9 % Mechanical engineer, 6.5 % electrical engineer, 6.4 % architect-engineer. The rest of the contributors are classified as computer, Oil, Surveyor, technical, chemical, telecommunications engineers. This variety of specialties will definitely enrich this research output.

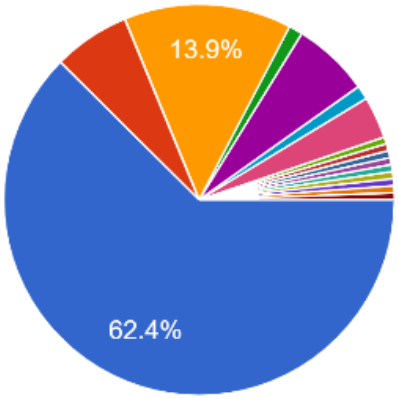

Fig. 1 Participants specialties.

Regarding participants' experience (Years), from Fig. 2. It can be concluded that most of the participants 48 % have experienced between 10 to 20 years. This can boost the research results as these participants have enough time to examine construction difficulties with different kinds of projects. Fresh engineers with experience of 1 to 10 years represent 17% of the total. This kind of engineer may have more knowledge regarding the new technologies and software in the construction industry which will also improve the reliability of the results. The third class of participants whose experience is more than 20 years represents the group may stand against new change due to the long period they spent in their traditional way of doing their daily job. Investigating their view will add more value to this research productivities.

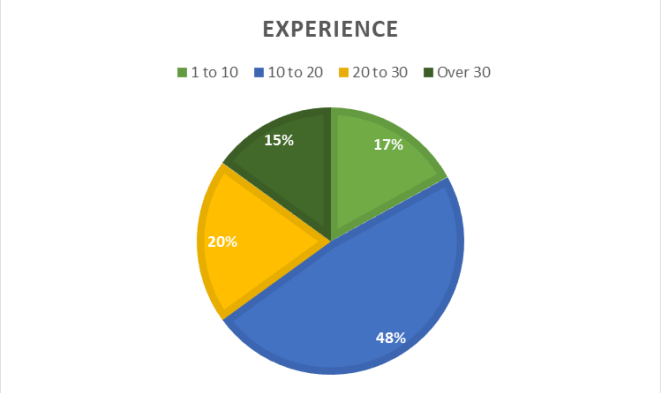

Fig. 2 Participants' experience.

The third and last part of this section will study the participant's work environment in terms of public or private or mix. Fig. 3 reveals that most of the research sample is working with public organizations with 51 %. The private organization represents 29 %. The rest working for a mixed organization such as oil companies with 20 %. The mixed working environment will assist to explore the correlation between the working environment and the acceptance of using and implementing the method of automation in construction.

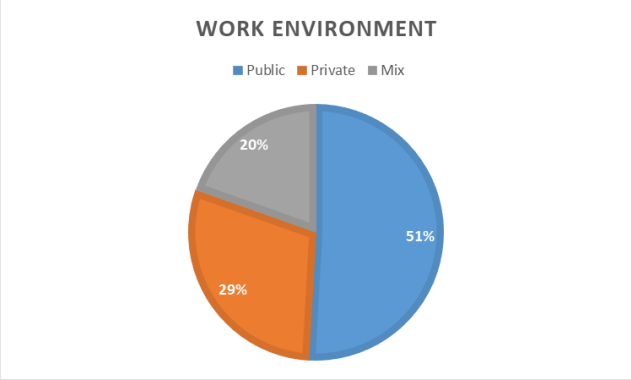

Fig. 3 Participants' work environment.

4.2. Automation in construction common sense

This section will discuss participants understating regarding automation in construction meaning. Despite the lack of implementation, participants show that they have a very good understanding related to this new term Fig. 4. This may result due to the media and training courses which can definitely enhance the implementation process.

The second question in this section also provides a good sign regarding the applicability of using this new concept in the Iraq construction industry. Most of the participants believe that the construction industry in Iraq is ready or may be ready to start implementing these new technologies and methods as shown in Fig. 5. Despite the readiness of the industry has gained 14 % from the total participant but still, 53 % of the participant has a positive view that Iraq industry may be ready to implement these changes which means they believe in their capabilities and competencies to start to use these new concepts and achieve the desired benefits from them.

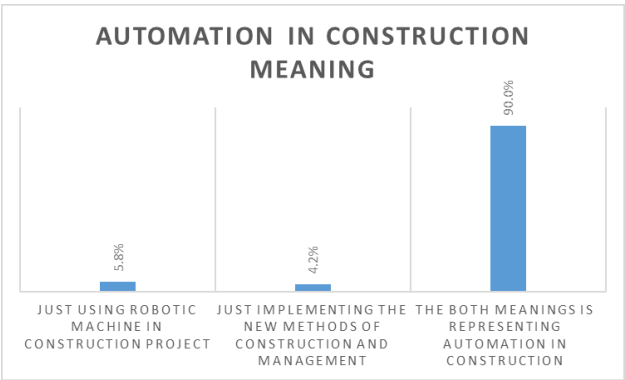

Fig. 4 Participants understating relation to automation in construction meaning.

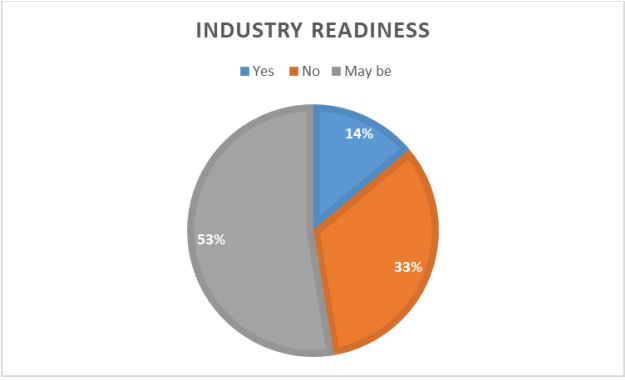

Fig. 5 Industry Readiness.

4.3. Benefits and challenges

In this section participant's views regarding benefits and challenges identification will be discussed in detail.

Firstly, the contributors select the most important challenges that currently facing automation in construction from being implemented Fig. 6. The corruption and lack of strategic planning are the most significant barriers with selection percent more than 65 %. This reveals that the top management authorities still not believing in this new concept due to a lack of understanding and well to change. This connected to third ranking challenge the economic and political environments which prevent any long-term planning. This clearly can be used to identify a real problem in local organizations which lack of longstanding planning and changing the organization objectives by changing the top management. Lack of professionals and lack of academic support correspondingly identified as significant barricades against any changes such as automation in construction. With training courses and a university degree in this field can minimize this barrier. In addition, academics must be motivated to focus on these most valuable techniques in their research and find the most effective frameworks to implement. High initial cost and lack of time have the least important percentages. This can be explained that participants thought that the benefits are far important than these economic difficulties and this can be mitigated via rich and valuable strategic planning.

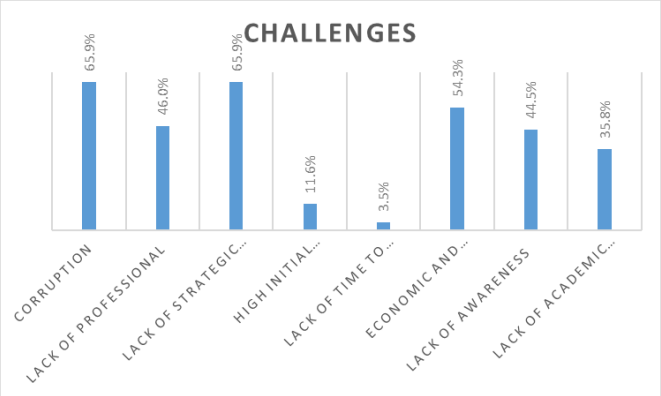

Fig. 6 Challenges.

Regarding the benefits, it can be seen from Fig. 7 that there no huge difference between the benefits in terms of their importance. With 76.7 %, reducing cost is the most vital benefit the participants spotted which represents great motivation to the government to adopt this concept in its construction project. Reduce time and improve the final product quality are the second-ranking benefits which give the sight that these new technologies and methods can solve a huge amount of buildability problems in the design stage which very low-cost impact. Reduce waste and reduce construction problems have the least importance with a percentage of around 45 %. The reason beyond the participant's view is the lack of real projects that implement these methods in Iraq, the absence of such evidence will make it difficult to make sure that automation in construction will reduce waste and reduce problems during the construction stage.

Most of the participants rely on their understanding more than any valuable evidence to justify their selection in terms of the challenges and benefits. However, their selection matching the global trend to the most important barriers facing automation in construction implementation globally and likeness in benefits identification.

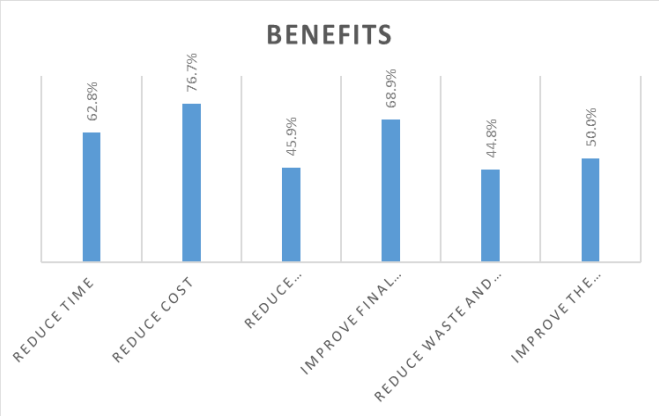

Fig. 7 benefits.

4.4. Correlation

This section will elaborate on the correlation between participants' experience, place of work with their common understanding regarding automation in construction.

First of all, the data show that participants with experiences more than 20 years less likely to believe that the Iraq industry is ready to implement this new concept. This behavior can be explained due to the high level of resistance against any kind of change in general. This resistance comes from working for a long period using traditional methods and basically, they are not able to figure out any problems in the traditional methods. This obstacle can be overcome by educating this kind of professionals and wide their knowledge to reduce their uncertainties that they may lose their jobs if these new concepts are implemented.

The second correlation that has been identified through the study is the relationship between the work environment and the readiness to implement these new methods and technologies. The professional working in the private sector is more likely ready and believes in automation in construction. This may explain due to their work with international professionals and observed their experience with international projects that implement this concept before. In addition, Iraq's public organization is less likely to implement any change due to the complicated legislation that prevents any ambitus manager to implement any new technology that can make daily work more efficient.

These correlations support the importance of strategic planning that will boost automation in construction implementation.

5. Conclusions

This study aims to investigate the applicability of implementing automation in construction in the Iraq industry.

The research reveals several conclusions points as follows:

1. There good understanding regarding this new concept among professionals working in the Iraq construction industry.
2. Most of the participants believe that the Iraq industry is ready or may be ready to implement these new technologies and methods.
3. Corruption and lack of strategic planning are representing the most effective barriers facing automation in construction from being widely used in Iraq.
4. All benefits are well observed by the participant with a little preference to reduce the cost as the most effective and most needed benefits in the current Iraq economic crises.
5. Further research is needed in this field to support professionals to implement automation in construction effectively.

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