



Construction 4.0: An Industry Vs Academic Comparative Study

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Abstract

The advent of Construction 4.0 has played a major role in the construction industry of the USA and other developing countries through the improvement of quality performance. One of the parameters that have contributed immensely to the management of construction quality in the industrial revolution era is Industry 4.0, the Internet of Things (IoT), and Lean thinking concepts. Lean construction is characterized by a set of clear objectives in project delivery involving the concurrent design of products and processes. There was a need to check the status of construction 4.0 in Saudi Arabia. This work aims to carry out an exploratory study of the application of Construction 4.0 and Industrial 4.0 in the construction industry of Saudi Arabia. The work followed a survey design approach, and random sampling technique to carry out the graduation project. A literature review was carried out and a questionnaire used by a previous study was selected for modification according to the Saudi Arabia situation. For the academic and industry questionnaires, the questionnaire was submitted to several experts who were familiar with construction 4.0 to finalize both the survey instruments. An interview guide was prepared to conduct interviews with the experts in the academic and the industry. Data were collected, and the results were analyzed and discussed. In addition, eight interviews with experts in the field of Construction 4.0 were conducted and analyzed. Based on the analysis, several results are derived and documented. Results show that 81% of the academics are familiar with the technologies associated with the term construction 4.0. Results indicate that these technologies are mainly understood through graduation project and elective courses. On the industry side, the respondents revealed architects and civil engineers were more interested in these technologies. Around 46% of the employees in companies do not have sufficient skills to use these technologies. Interviews analysis emphasizes the need to digitize and automate the construction industry. Most of the technologies used in organizations are BIM, IoT, AI, and AR/VR. Some organizations use software such as Revit, Python, and Navisworks. The results indicate there is a need to improve collaboration between academics and the industry especially related to these technologies for mutual benefits.

Problem Statement

Construction 4.0 is a modern technology in the construction system and can promote this transformation to become more effective in the industry sector. With the 4th Industrial Revolution, this has got pace in an accelerated construction process using modern and advanced methods and simulating virtual reality for design and construction helping engineers. Nonetheless, it has many positives and some negatives, including less use of related codes and less knowledge about it. The researchers are conducting studies on it because it is modern science. For us, it is important to assess where the industry and academia are standing in holding the latest advancements that are currently happening in the industry. That is why this graduation project investigates the status of Construction 4.0 technology adoption in the industry and academia and measures the level of collaboration through mixed method data collection techniques.

Aim

Clarify the concept of construction 4.0 and know how to apply it in the industrial field by linking it to the academic field to improve the quality of the construction industry in Saudi Arabia.

Objectives

- ❖ Understand the concept of Construction 4.0 adoption in the industry as well as in academia by literature review.
- ❖ Finalize both the questionnaires and an interview guide to collect information about Construction 4.0 from academic professionals and industry companies.
- ❖ To assess the use of Construction 4.0 technologies between the academia and the industry companies.
- ❖ To assess collaboration between the academia and the industry companies related to Construction 4.0 technologies.

Methodology

The project was designed based on knowledge of construction 4.0 to do comparison between the industry and the academia (See Figure 1). To arrive at this comparison, research was conducted in this area. Two questionnaires were finalized to achieve the objectives. Both the developed questionnaires were distributed in the academia and the industry to achieve the set objectives. Eight interviews were conducted with the professionals who were familiar with the construction 4.0 system in the academia and the industry. To achieve the objectives of the research, the data were analyzed, and the results were documented.

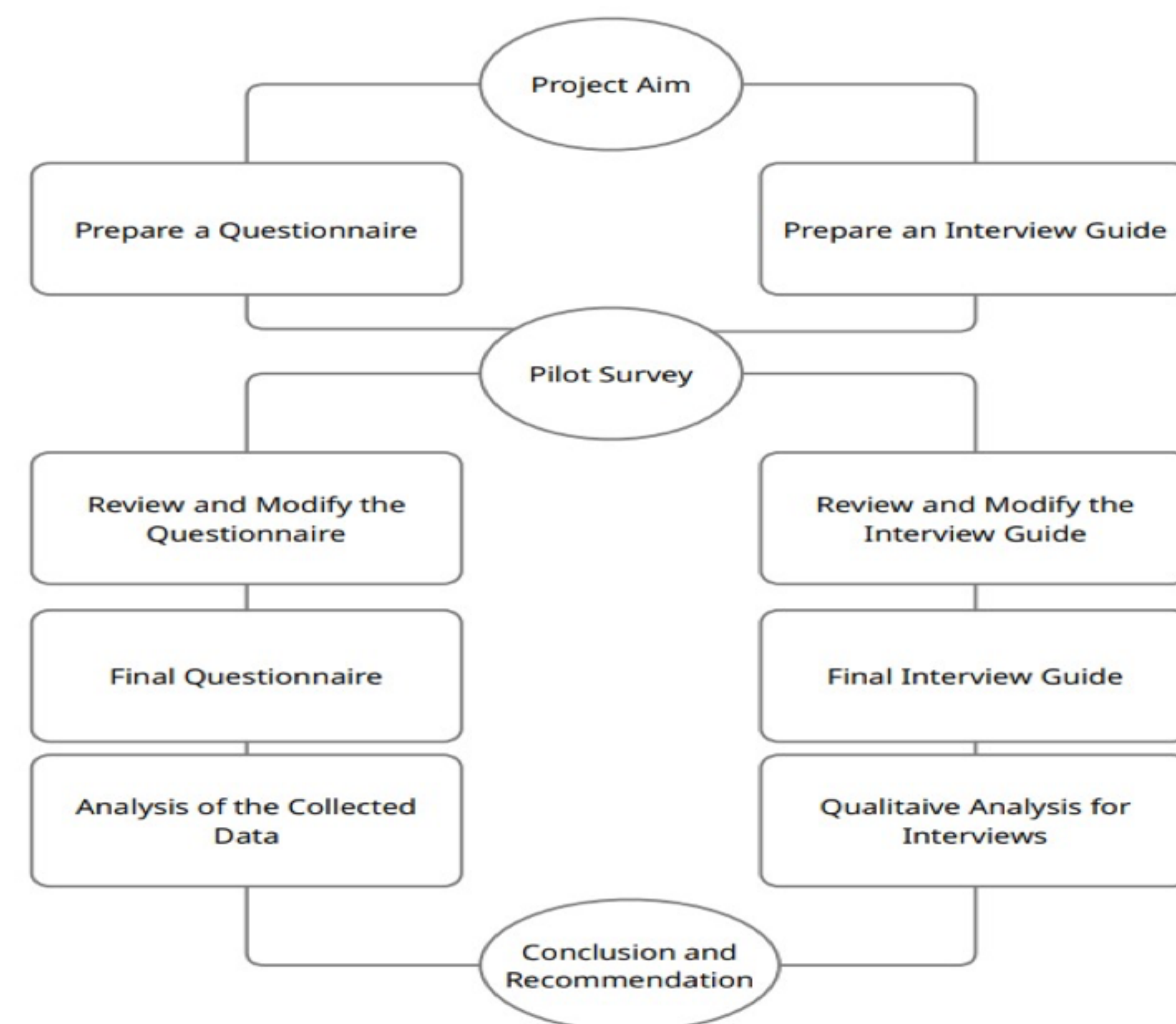


Figure 1. Research methodology flow chart

The literature review serves as guidance for developing the questionnaire. A cover letter was issued for the responders to comprehend the project and complete the questionnaire for the academia and the Industry. Academia questionnaire comprises on 12 questions while the industry consists of 15 questions. Interview guide consists of 10 questions. Table 1 shows the domains of the survey questionnaire.

Table 1. Domains of the Survey Questionnaire

No.	Domains	Number of Questions
1	Academia Questionnaire	12
2	Industry Questionnaire	15
3	Interview Questions	10

Results

Results for Academia

Analysis of the data shows that most of the academic were familiar with the technologies associated with the term construction 4.0. Results show that the most preferred method for introducing these technologies was the "Graduation Project" followed by "Elective Courses" (See Figure 2). When asked about Construction 4.0 technologies research projects collaboration with the industry. The results were almost half-half. Results show a low level of collaboration between the academia with the industry.

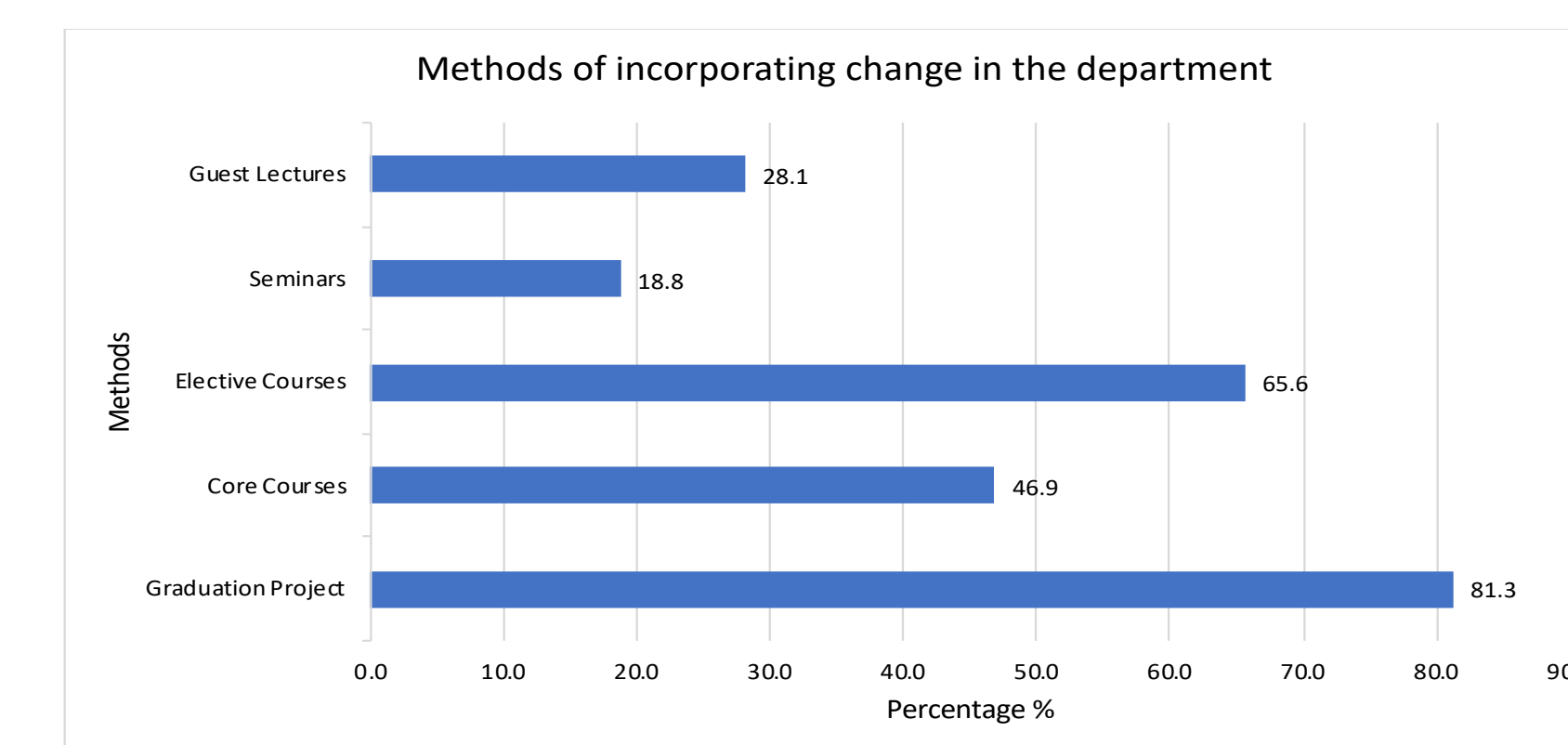


Figure 2. Ways to implement technologies

Results for Industry

When asked about what Construction 4.0 technologies that are employed in your company. The data analysis shows that BIM is mostly employed, followed by big data, and AI in the industry companies (See Figure 3). Results indicate that companies are "very well prepared" to "moderately prepared" to adopt BIM followed by AI (See Figure 4).

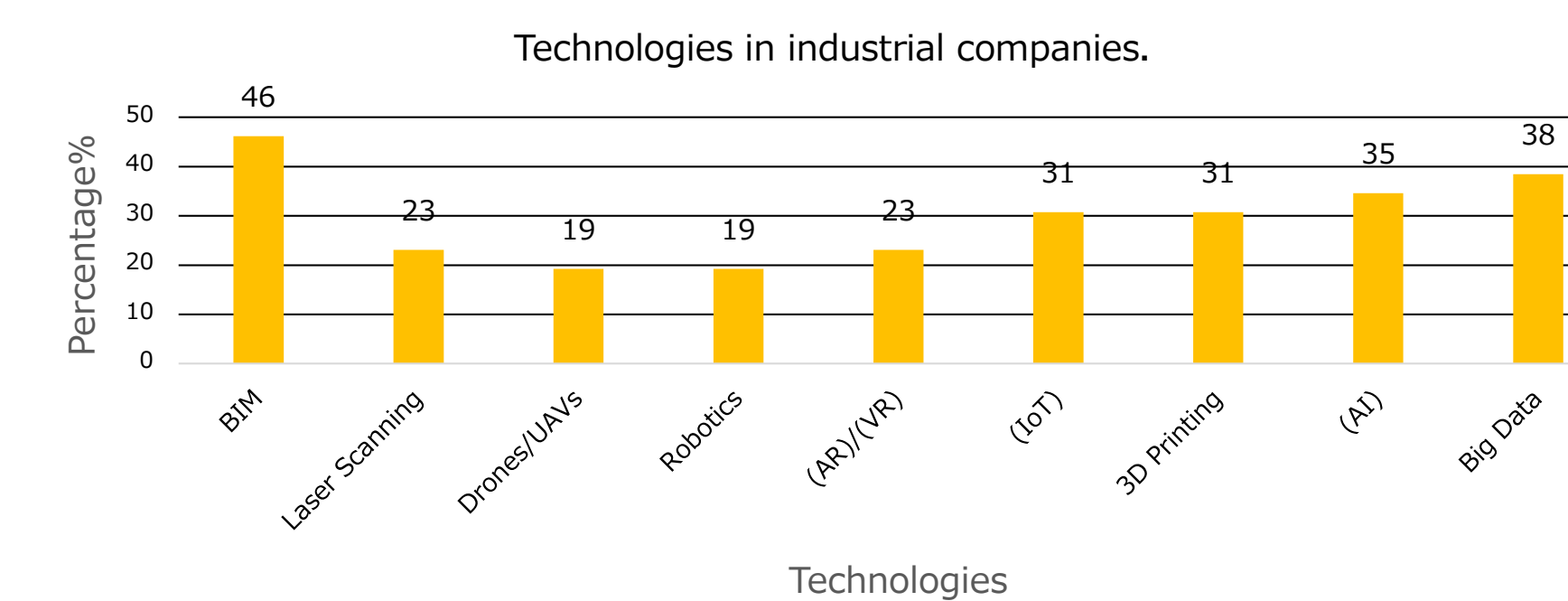


Figure 3. Use of technologies in the industry companies

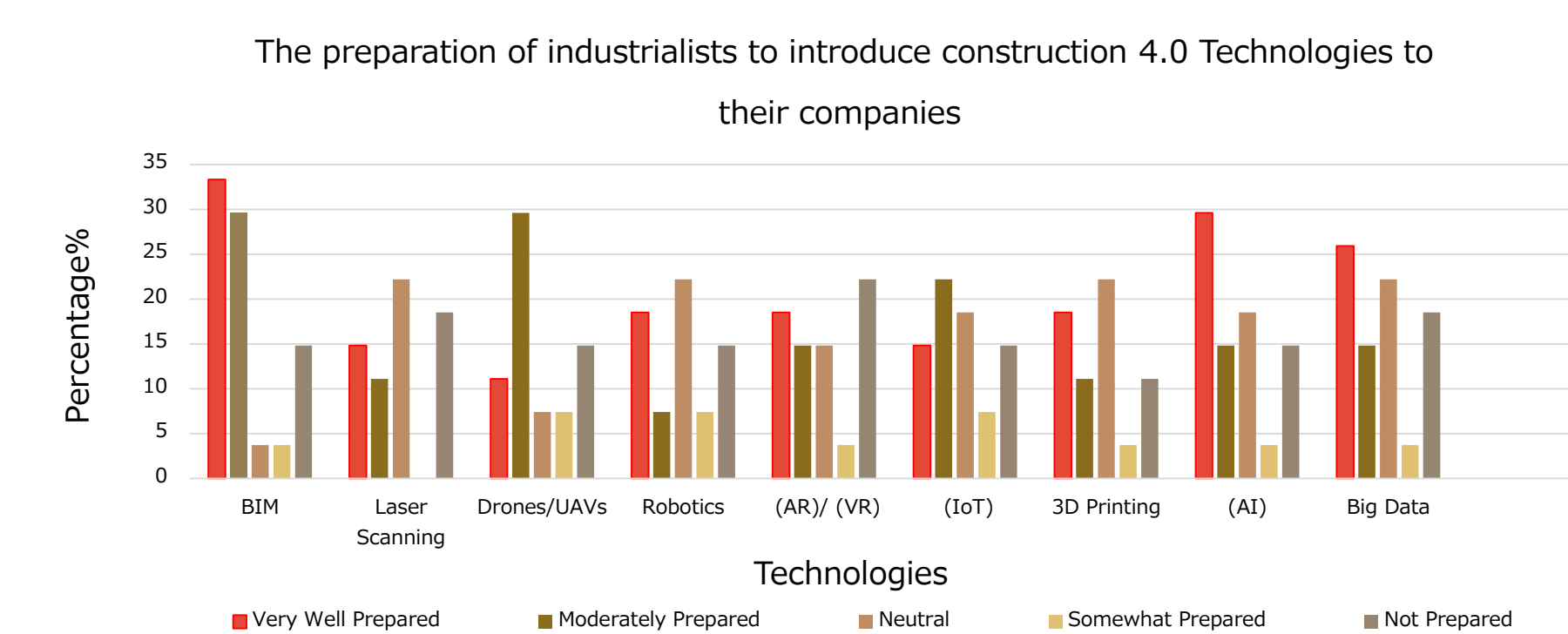


Figure 4. The Industry preparedness to adopt new technologies

Results of Interviews

Interview results revealed that the fourth industrial revolution, which is based on the use of new technologies gave rise to the idea of construction 4.0. These innovations are geared toward the automation of the construction sector. Improving construction quality, increasing production, and reducing construction times, are facilitated by construction 4.0 technologies. BIM, IoT, AI, and AR/VR make up most of the technology used in organizations. While some companies don't use construction 4.0 related software, others use software such as Navisworks, Revit, and Python. Because of their usefulness, many experts have suggested using Revit, MATLAB, Navisworks, and Fusion 360 software programs in design.

Conclusion

Findings for Academia

Approximately 81% of the academics are familiar with the technologies associated with the term construction 4.0. Nearly 90% of the respondents agree that these technologies should be taught to the student preferably in their master's programs. Results indicate that these technologies are mainly introduced through graduation projects and the score was 81%, and via elective courses and the score was 66%. The results indicate a low level of collaboration between the academia and the industry related to research cooperation. Despite low level of collaboration, academia is positive in adopting new technologies.

Findings for Industry

The respondents that were most interested in construction 4.0 technologies included architects and civil engineers. Technologies such as BIM, big data, artificial intelligence are mostly employed in the industry companies. Around 46% of the new employees in companies do not have sufficient skills to use these new technologies. Industry companies are "very well prepared" to "moderately prepared" to adopt BIM followed by AI.

Findings for Interviews

Interview results complemented the results of the questionnaire survey. The construction 4.0 technologies focus on automating the construction industry. Some organizations use software related to construction 4.0 that includes Revit, Python, and Navisworks. It is crucial for academic and industry circles to work together, and they can do this through training programs, visit and workshops. Unfortunately, civil engineering field is slow in adopting the new technologies as compared to other industrial sectors.

Recommendations

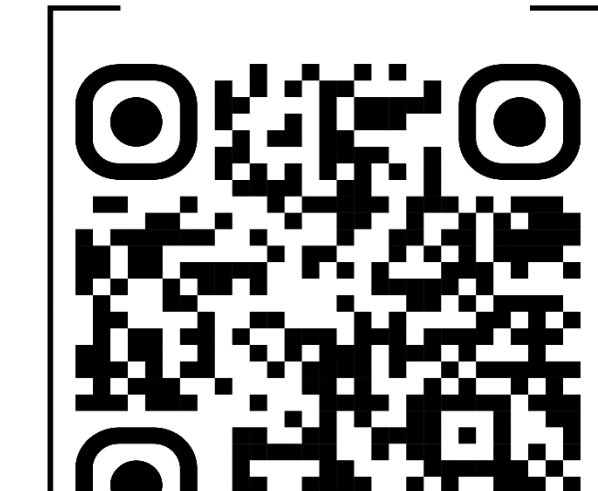
1. The academic community should be keen to teach construction 4.0 technologies to students to keep pace with the modern technological revolution.
2. We recommend that students should study construction 4.0 technologies such as Revit software and the use of BIM technology.
3. We recommend that the Saudi construction industry should adopt these new technologies such as BIM, AI, IoT, and AR/VR to improve the quality and efficiency of the construction industry.
4. We recommend that industrial companies should conduct training courses for their workforce to prepare them to use new technologies efficiently.

QR Code

Academia Questionnaire



Report



Industry Questionnaire

