Engineering Training and its Importance for Building Information Modelling

Hala Salami, Kheder Alothman

Building Informaion Modelling and Management Master Programme Students
Emails: hala_177580@svuonline.org; kheder_173111@svuonline.org

Abstract

The AEC industry in Syria is facing different issues, such as poor management and performance, and the increase in costs of change orders due to the poor implementation on site. These reasons made the issue of training engineers an urgent demand to become qualified to enter the engineering labour market and help implement the construction projects the right way, especially that the reconstruction phase might take place in the near future. In the last decades, BIM proved to be of a great help for engineering projects for it can integrate work within projects and help engineers in all the project phases to introduce sound models and documentation with less time and more efficiency. In this article, a survey has been used to measure different parts of engineering work reality to know how it would serve Syrian engineers in applying modern technologies and methodologies, like BIM, in their projects. This research would provide more knowledge about the engineering reality in Syrian companies, and thus it would open the door for preparing plans and strategies to get the Syrian companies more involved in adopting new technologies and methodologies, especially BIM, in their projects and training. The research showed that Syrian educational bodies need to allocate more time and effort to qualify engineers and help them keep up to date with the latest technologies. Also, Institutes are taking a huge amount of time to implement the digital transformation. All that is due to the lack of engineering and technological knowledge and experience that is influencing the AEC sector in Syria, where most engineers didn't experience working in new-technology-and-methodology-based projects. This research is a sample from the work that is being done to survey greater segments from all the Syrian governorates, with the analysis of the engineering training and its importance in adopting BIM and digital modeling.

Keywords: Building Information Modeling (BIM), Digital Modeling, Syria, Engineering training

1. Introduction

Organisations play a vital role in structuring communities and meeting people's social, economic, and educational needs. Educational and professional bodies in Syria, therefore, sought to play their role in improving engineers' educational level and to support the engineering work, which was due to the need for successful and effective mechanisms to develop and improve the engineers' technical and professional abilities.

Engineering Faculties (Civil, Architectural, Mechanical, and Electrical Engineering) in Syrian universities have thousands of graduates annually, and due to this, there is a critical need to develop engineering teams' skills in the field and closely link it with the office work necessities. This kind of interactive learning and training became essential to help engineers enter the engineering labour market and practice engineering work in the right way.

It is very important to consider all aspects of training, not only the professional aspect, but also the technical aspect, which has become a-daily-basis need for any engineer. The link between the technical and professional aspects will establish the bridge to reach engineering solutions that save money, time, and effort, and serve to achieve the desired end for the engineering projects. Also, training might be more effective when considering the work environment, for the The construction work conditions make the industry very risky [17] and thus needs more training and expertise.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

Recently, the Architecture, Engineering, and Construction (AEC) industry is considered the most influential contributor to development all over the world. However, the AEC industry is facing a myriad of challenges due to the vast construction evolution [17, 14, 12, 16, 15, 6]. This starts with the client's early perception passing to predesign and the design stages, construction, Operation, and Maintenance (O&M) until the demolishing of the building [14]. The crucial need for innovative sophisticated, and complex Architectural, engineering, and construction (AEC) industry projects with in-depth details makes traditional methods inappropriate for the completion of projects with desired efficiency, performance and productivity [15].

The delay of the projects and the excess cost have become a common feature due to the increasing complexity of the modern construction industry and its multiplicity Thus, the BIM system provides the opportunity to speed up processes that were usually executed sequentially. In additio, BIM allow us to perform some activities simultaneously or in parallel, e.g. synchronization of design processes with execution and execution with operation. BIM proves its capability to reduce project time and increasing profits [15]

Syrian Engineers, alongside the Syrian government, are willing to reconstruct Syria with the help of Syrian experts and professionals [1]. And in the light of that, BIM study programmes plans are being emerged into Syrian universities, in addition to holding workshops, conferences, and lectures that would contribute in the transmission to BIM in Syria [1]. The Syrian Virtual University now has a Master programme in Building Information Modeling and Management, which qualifies engineers to apply BIM and Management principles and methodologies in different projects.

2. Literature Review

Syrian companies are suffering from different problems, such as schedule delays, poor performance and quality, and running over budget [5]. Most of the solution lies in having modern technologies and management tools for the construction projects [9]. Thus, Companies need to digitalize their works, depending on electronic files instead of paperwork. According to [1] about the survey in 2014, which was done to demonstrate the BIM awareness among Syrian Engineers in the public sector, 63% of the respondents indicated that companies are currently using electronic and paper-based documentation all along with each other, using electronic copies in only 15% of the work.

The United States is the first country to implement the BIM system, the General Services Administration (GSA) has printed the BIM Manual Series, the National 3D-4D-BIM Program and its applications in more than 35 projects, and the US Army Corps of Engineers has developed a plan for the full implementation of this system on all projects in 2012 [15].

Currently, in developing countries, the majority of BIM usage is at level 0 or level 1 andbridge between level 1 and 3 is getting wider. The AEC industry in a crucial need to upgrade to Level 2 to see the significant advantages of BIM and get out of 'Lonely BIM.' In the UK, the Department of Business Innovations and Skills (BIS) has a significant effort in developing their BIM roadmap. Their roadmap has helped to classify the maturity level of each UK companies and outline what they need to reach the government aim by 2016 and think about BIM future. Most of the UK construction companies are in level 1 and the best in class are experiencing significant benefits in level 2 [14].

BIM is rarely used in KSA. Recently, construction companies in KSA; local and international, are seeking BIM expertise to work in KSA. The adoption of BIM has seen a slow, but gradual upward trend within SA in recent years. In 2014, Anwar Al Qasmi from Tekla as software provider reported that they participate in prominent projects in SA using BIM such as the Capital Market Authority Headquarters, King Abdullah Financial District, and the King Abdulaziz Center for World Culture, 11 world-class stadiums, and King Abdullah Sports City complex in Jeddah [14]. Also, according to the questionnaire done in [12] it was obvious that there is a lack of awareness about BIM in the KSA.

2.1 Imprtance of Training and Development

Syrian companies rarely use BIM, and these companies are in the 0 level of BIM application [6]. AEC companies require having qualified professionals, especially regarding the new technologies. Also, applying BIM requires individuals with high technical levels [3]; and companies, to implement BIM successfully, has to plan correctly, to have organized coordination, and to continually keep track of work, thus training is required to qualify engineers to participate in applying BIM, whether training is related to increasing productivity or to providing engineers with the suitable information that would help them improve technically and professionally.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

According to [1] the study showed that 50% of the respondents have basic knowledge regarding BIM; 31% of them depended on self-training, and the others underwent official training.

2.2 Building Information Modelling (BIM)

There are different definitions for BIM according to different references. [7] defined BIM as "a verb or adjective phrase to describe tools, processes, and technologies that are facilitated by digital machine-readable documentation about a building, its performance, its planning, construction, and later its operation." BIM helps us create an information-rich model, not only 3D model, but also a descriptive model that contains all the information about element, in addition to the simulation for the building process [7].

[13] describes BIM as an environment that effectively combines all liabilities and endeavours from all project stakeholders through diverse project phases to deliver a functional sophisticate and innovative product replying all parties and project objectives.

The American Institute of Architects (AIA) defines the BIM as a "*model-based technology model linked to the database of project information.*" In the Encyclopedia of Engineering, Wikipedia states that the BIM system includes engineering dimensions, spatial relations, the geographic information, the quantities and properties of the components of the building/project properties [15].

BIM is seldom adopted on the government level, especially in the developing countries [12]. Syria has multiple problems in regard to AEC projects; these problems can be solved with the help of BIM [6]. According to NBS, the adoption of BIM application increased 8% in the last six years, and according to [8], only 20% of the Middle-East companies are using BIM in the process of adopting BIM Application.

The transition from the traditional method to the BIM concept requires dramatic changes in many disciplines such as software and hardware upgrade, changes in processes, and changing the organisational culture to reap BIM benefits. In the traditional methods, the considerable impact occurs in the construction documentation phases which in turn cause several issues to arise, delaying the project delivery and increasing the overall project cost. Many developed countries such as (USA, Canada, UK, Germany France Finland, Singapore, Norway, Denmark, South Korea Australia, Hong Kong, Netherlands) mandated BIM in their public AEC industry projects motivated by its benefits, while others adopted strategic plans for mandating BIM. However, almost all developing countries did not mandate BIM yet, but they are on the road too. UK has also achieved a steady increase in adoption from 31.0% in 2010 when UK announced BIM requirements to 39% in 2012 [18] and 54.0% in 2013 then actually mandated BIM in public sector in 2016 to level 2 [14].

Currently, the focus of the construction industry is on eliminating waste and inefficiency to improve quality and profitability. However, BIM proved its competence in this way which motivated developed countries to use and mandate BIM [16].

2.3 Benefits of Building Information Modelling (BIM)

Several researchers have considered BIM as a panacea to enhance communication and collaboration among the AEC industry key players, where BIM currently has shown its competency to improve AEC industry performance and enhance collaboration among various project parties [12], where The traditional systems deal with each project phase and its teams separately, and the main feature of BIM is the integration of the different project phases (project management life cycle) and its teams [15].

In last two decades, BIM proved its competencies to integrate with various concepts and new knowledge which resulted in enhancing its efficiency and performance and provide new alternative solutions and outcomes [14].

All participants in the AEC industry benefit from BIM [7], where The AEC industry, like other industries, benefits from Information and Communication Technology (ICT). Features of BIM could be predestined in different ways depending on how far users have experienced either beginners or experts [12]. But that's only if dealt with it as an organized methodology, following procedures correctly to achieve the optimal use of BIM [7]. According to the survey in [1] 61% of the respondents described that companies and workers in the AEC industry can benefit from BIM in the "Design" phase, 21% of them confirmed that BIM would be useful in the "Design and Construction" phases, and 8% said that it is impossible to use BIM now.

According to [7] BIM has multiple benefits in different phases in the project. BIM facilitates cooperation between all departments; Structural, Architectural, and MEP, and provide users with the capability of making fast decisions based on the information available. BIM decreases the duration of implementation, because the

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

work won't stop due to the clash detection that was done in the Design phase. Also, BIM can help in the early quantity take-off, in decreasing wastes, in easily modifying models in a way that all modifications done in any part of the model take place in all the related parts in the model automatically. In addition, BIM helps in the maintenance process, and in cost control to decrease the projects' cost.

Developed countries have recognized the benefits of BIM and considered BIM as the AEC's future language. For example, in the UK, the government mandated BIM in the AEC industry since 2016. Similarly, the USA and several European countries have mandated the use of BIM. However, developing countries are still in the early stages of exploring BIM and trying to find appropriate practical strategies for its implementation [16]

BIM has modified the way construction projects are designed, constructed and operated, where BIM enables architects, engineers, and project managers to deliver projects on time and within budget, providing reliable feasibility studies for the design, building, and operating phases [14].

The most important factors for increasing BIM benefits are: improved interoperability between software applications, improved BIM software functionality, more clearly-defined BIM deliverables between parties, more owners asking for BIM, more 3D building product manufacturer content, reduced cost of BIM software, more internal staff with BIM skills, more use of contracts to support BIM, more external firms with BIM skills and more entry-level staff with BIM skills [16].

According to [12] The key findings pertaining to the benefits of BIM are: (1) the richness of the information within the BIM Model enhanced the collaboration among stakeholders, (2) Reduced financial risk, (3) Improved project performance, (4) accurate BOQ and cost estimation, (5) promoted the off-site prefabrication, (6) increasing profitability and (7) reduced change orders and disputes.

2.4 BIM benefits for Undergraduates

The increasing demand for implementing projects using BIM encouraged Academic researchers to include BIM in educational curricula, and there are more than 103 universities around the world that teach BIM within their programmes. In addition, the Association of Collegiate Schools of Architecture (ACSA) had a partnership with Autodesk to integrate BIM and IPD in architecture curricula [10]. The 3D modeling with BIM helped students to understand the integration of building systems in more depth. Also, Education with BIM drive their creativity, their understanding of drawings, and their ability to learn how to manage projects, comprehend the relationship between the different specializations in the project, and to do quantity take off, and time and cost estimates.

2.5 BIM benefits for Graduates

The current and future indicators all indicate that large construction projects will be designed and implemented with using BIM [2]. Most of the European countries headed to the BIM-using road with the 2000s emerging; the UK, for example, established a document which states that using BIM is mandatory for the government-funded projects with the start of 2016 [7]. In the Arab region, Dubai issued circular number (207) in 2015 that obliges the use of BIM for buildings and structures with special conditions [7]. Accordingly, all construction companies should use the latest technologies [3] to stay competitive in the market. All these indicators show the importance of training engineers on using BIM, otherwise they won't play effective roles in the engineering future, for most companies nowadays require that fresh graduates know how to use BIM, and this requirement will increase in the future to become mandatory. For the reconstruction phase in Syria, companies should provide the best services with the best prices, that should include using the latest technologies with highly qualified professionals; this encourages companies in the public sector to stay on track and contribute in the reconstruction phase [2].

2.6 BIM application challenges

BIM application is challenging, but if it is adopted, it will have great benefits. Such benefits are especially notable in regard of productivity, for BIM facilitates creating elevations, sections, and visualization, in what helps in using the information in the construction, maintenance, infrastructure, and facilities. BIM application isn't about the effectiveness of the methodology or software applications only, but it's about changing the mechanism of thinking prevailing about projects modeling and building, and the way the elements of the building are defined with their information [7]. The notable lack of know-how to manage the hindrances for the implementation BIM is the major reason for the modest use of BIM in the AEC industry in MENA area [14]. Unfortunately, decision makers in Syrian companies do not realize the importance of BIM, and allocate very low budget to train employees, not to mention their fear of the high cost related to BIM adoption [1].

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

BIM application requires participants to have adequate knowledge to apply it, in addition to adequate level of using technology and their readiness for development. When Engineering syndicate and companies were visited, it was noted that elderly engineers aren't mentally ready to move to a new technology. Therefore, there should be a tendency towards training fresh graduates and university students, which saves time in the future [7].

According to [1] There are different economic, technical, organizational, legal, and human challenges to apply BIM; there is a lack of demanding BIM, the strong internet connection the BIM servers require, the week cooperation among departments, the lack of experience and qualified experts, and [11] the resistance against change, especially by the aged individuals.

[14] Sees that The main barriers can be summered as getting seniors to adopt the new methods, changing the organization of staff to suit particular skills, cost of implementation (software and training), lack of senior management support, scale of culture change required, lack of supply chain buy-in, staff resistance and ICT literacy and legal uncertainties.

According to [16] The questionnaire respondents and interviewees ordered the main external factors influencing the BIM implementations as; (1) Providing guidance on using BIM; (2) Government support and pressure for the implementation of BIM; (3) Providing education at university level; (4) Developing BIM and data exchange standards, rules and regulations; (5) Perceived benefits from BIM to client; (6) Collaboration with universities (research collaboration and curriculum designed for students); (7) Increased demand for BIM by other project parties; (8) Client pressure and demanding for the application of BIM in their projects; (9) Clients provide pilot project for BIM; (10) Contractual arrangements; (11) Promotion and awareness of BIM; (12) Competitive pressure; (13) Availability of appropriate software and hardware. This result is the same as the literature, but factors are ordered differently.

Also, [12] concluded that the top barriers deterring BIM implementation are: (1) There is low level of BIM awareness about BIM in the AEC industry, (2) lack of top management support, (3) lack of government demand for BIM, (4) resistance to change, (5) Lack of BIM technical experts and (6) time and cost required for switching to BIM. For appropriate implementation of BIM, lessons learned from earlier BIM users such as UK, USA, Australia, and New Zealand must be taken into consideration to learn from their pitfalls.

Moreover, [15] defined the main obstacles to applying BIM as follows: 1) The market is not ready, 2) the clients do not demand BIM , 3) Training Costs and the learning curve are too high, 4) The difficulty of having everyone on board to make BIM effort worthwhile, 5) Too many legal barriers exit and they are too costly to overcome, 6) Issues of model ownership and management will be too demanding on owner resources, 7) Designers or Architectural Engineering firms do not usually prove empirically the benefits of BIM to customer, 8) Construction Insurance companies do not have BIM projects risk specific policies, 9) Technology risk and barriers technology is ready for singlediscipline design but not integrated design, 10) BIM is not having a full support of upper management or decision makers.

2.7 The importance of engineering training in Building Information Modeling

A survey has been created to measure the engineers' technical and professional skills, and to define the role of educational bodies in qualifying engineers to use BIM. Only a sample of the work would be presented in this article, and the work is ongoing on all Syrian governorate with more expanded surveys and diversified questions.

3. Research Methodology and Data Collection:

The data collection and analysis process was carried out by conducting a survey that contains multiple related and consecutive questions which could help obtaining indications and semantics about the engineering training process status in training centers and institutes, academically and technically, and its role in spreading the BIM knowledge and awareness. The survey included 28 engineers and 9 bodies in Damascus, while 38 engineers participated in Homs. Engineers are registered in the engineering syndicates and unions . The sample was divided into 3 parts in Damascus; training centres (Management), trainees, and trainers. And in Homs there was 2 parts; trainees, and Engineering Syndicate. This sample is a small one, but work is ongoing in all the Syrian governorates on greater segments to analyze the whole situation of the engineering training in Syria.

The questionnaire depended on 2 ways of data collecting; interview questions, and handout-Multiple-Choice questions. Data has been collected and analyzed in order to get a primary image of the current engineering situation in the Syrian syndicates and institutes that are participating in providing training for engineers.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

4. Results analysis:

4.1 Damascus

4.1.1 Management

The main purpose of this set of questions is to classify and evaluate the performance of private centers in Damascus, that provide training courses for engineering programs in general, and BIM tools and platforms and in particular. The questionnaire was applied on a group of nine of the most important engineering institutes and organizations in Damascus.

Al-Hadara Institute	Ampeng Syria	New Horizons
Harvest Institute	Al-Yeser Co.	Golden Age
Axes	Ousos Institute	Tip Top

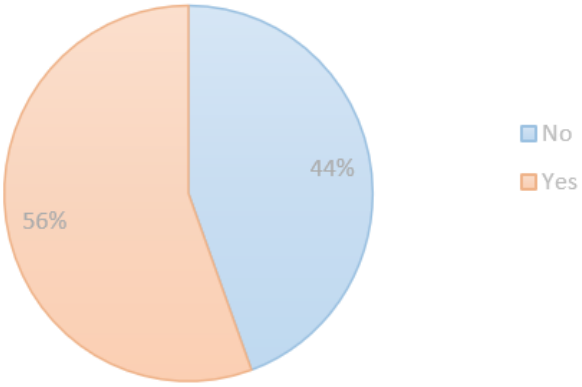

Figure 1: BIM familiarity among engineers

Up to 44% of institutes and centers managers, which is a high percentage, do not even know the meaning of BIM yet, considering that the rest of 56% of the respondents understand the term BIM, but do not necessarily adopt or implement it within their centers or institutes. Therefore, Management departments should know about BIM and then accept it to provide training courses regularly for its platforms and tools.

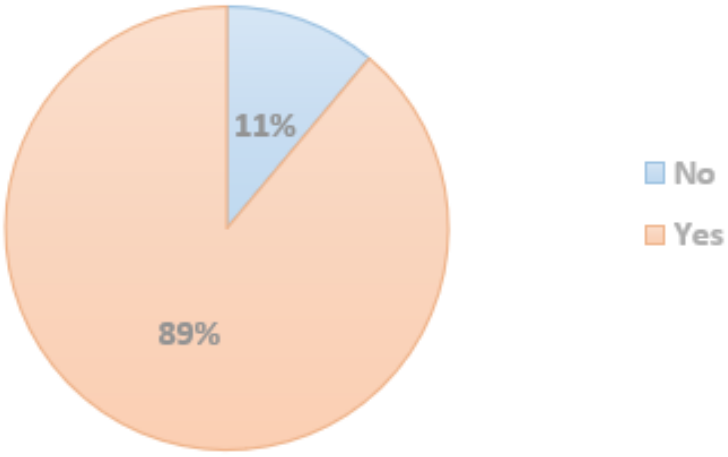

Figure 2: Institutes that started the digital transformation plan

89% of these private centers have already started a plan for digital transformation, and there are still 11% of the centers that have not started yet, noting that most of these centers that have already started implementing digital transformation are partially transformed.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

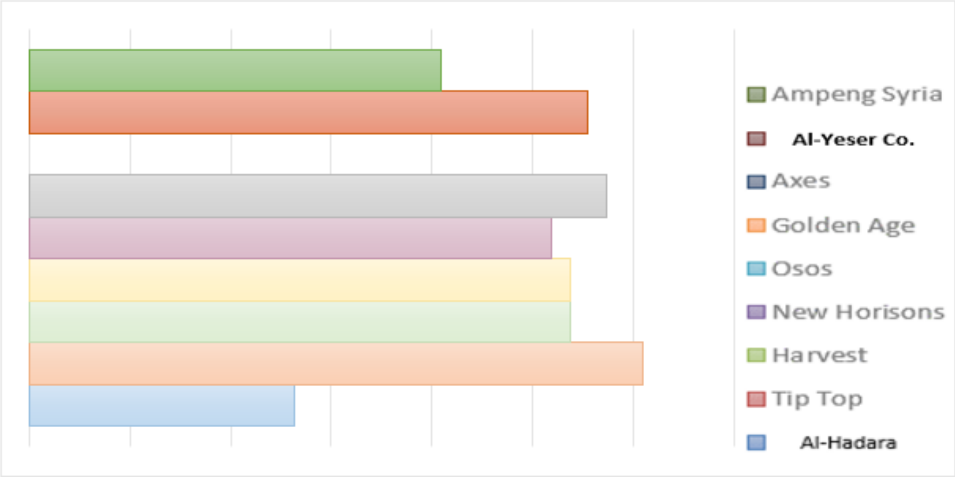

Figure 3: Digital Transformation plan start year

The answers about starting to implement the digital transformation were various. Al-Hadara Institute was the first private training center in Damascus to implement a transformation plan in 2002, while other centers started their transformation plans between 2010 and 2021, there is still one of the centers (Axes) hasn't started a transformation plan of its own, this raises the question about the huge amount of time and effort that required for a full digital transformation in order to adopt and implement BIM in these private centers.

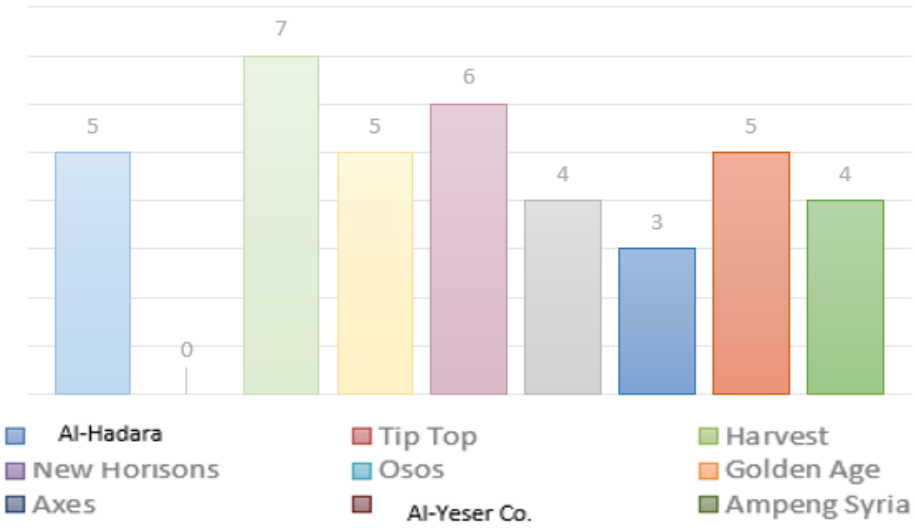

Figure 4: number of functional departments and centres

The number of functional departments varies from one center to another. Harvest Institute tops the list for containing the largest number of departments, other centers have between 3 – 6 departments, and Tip Top does not have any. Knowing that only few of the previous centers have a technological development department, which is responsible for managing and providing training courses, and it should be interested and working on BIM adoption in the center.

4.1.2 Trainees

The purpose of these questions was to understand the background and bases of thetrainees, and their knowledge and awareness of BIM.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

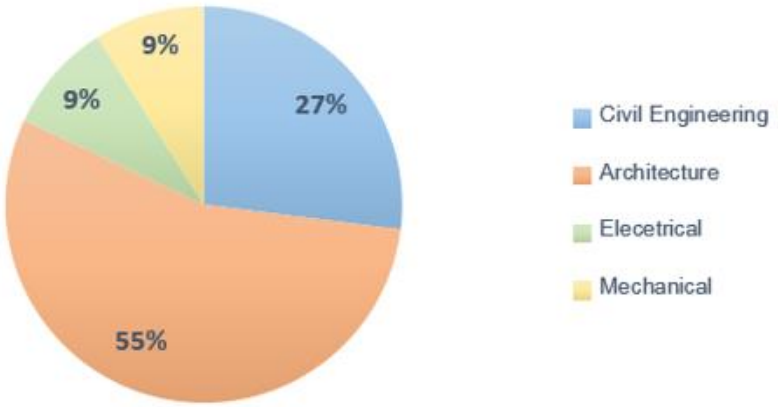

Figure 5: Respondents' engineering major

Most of the respondents were majored in architecture, which accounts for 55% of the total participants, mainly because architects are directly involved in BIM implementation and coordination with clients, owners and contractors, while 27% of the respondents are civil engineers, Finally, the smallest group of responses was from Mechanical & Electrical Engineers, accounting for 9% each. Civil, mechanical and electrical engineers need to increase their knowledge and about the BIM and its importance in their majors, by learning more about its tools and platforms and their benefits.

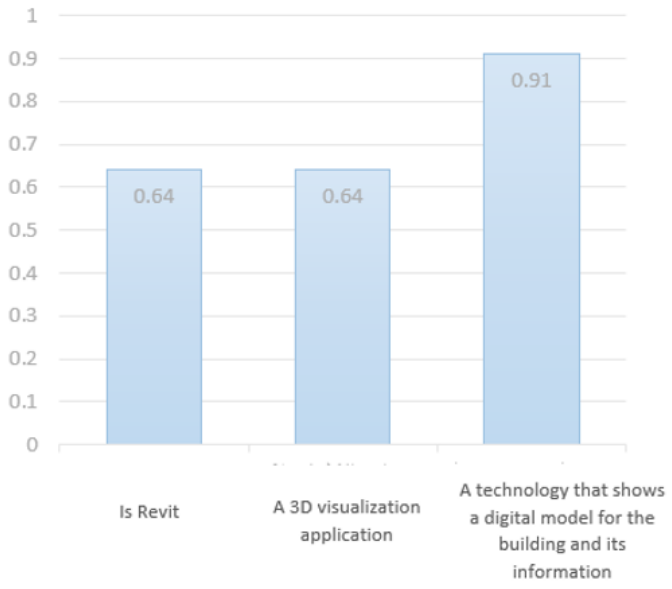

Figure 6: statistical chart of respondents' understanding of BIM

Half of the participants mistakenly think that BIM is "Revit program" only, or that it is limited to a 3D visualization software, which shows the necessity to increase awareness and knowledge about BIM in Syria, in order to reach the required understanding of BIM and implement it correctly.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

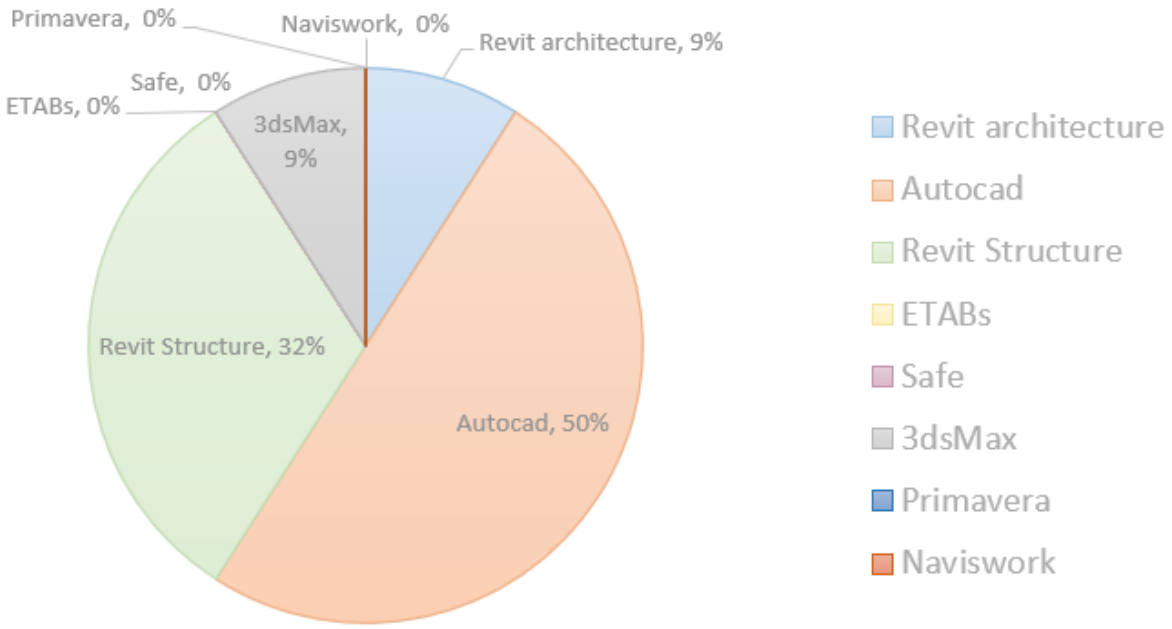

Figure 7: Courses that trainees took

The purpose of this question was to review programs for which participants are interested in practicing and learning, the result received from the questionnaire shows that exactly half of the respondents have taken only AutoCAD courses, while 32% have taken Revit Structure courses.

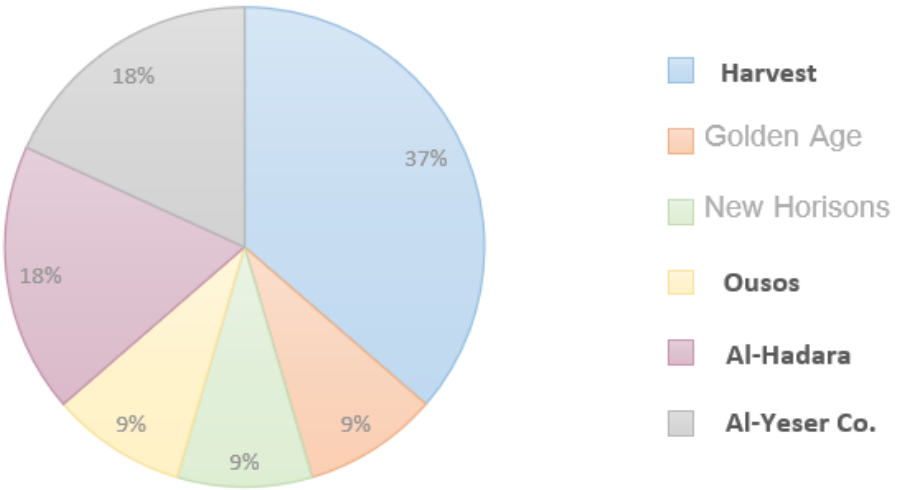

Figure 8: The centers where the trainees took the previous courses

The questionnaire was shared within nine institutes and centers that provide engineering training courses on a regular basis, Harvest Institute had the biggest share of the respondents' answers, as the most widespread institute in organizing courses of engineering software in Damascus, with 37% of the total answers.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

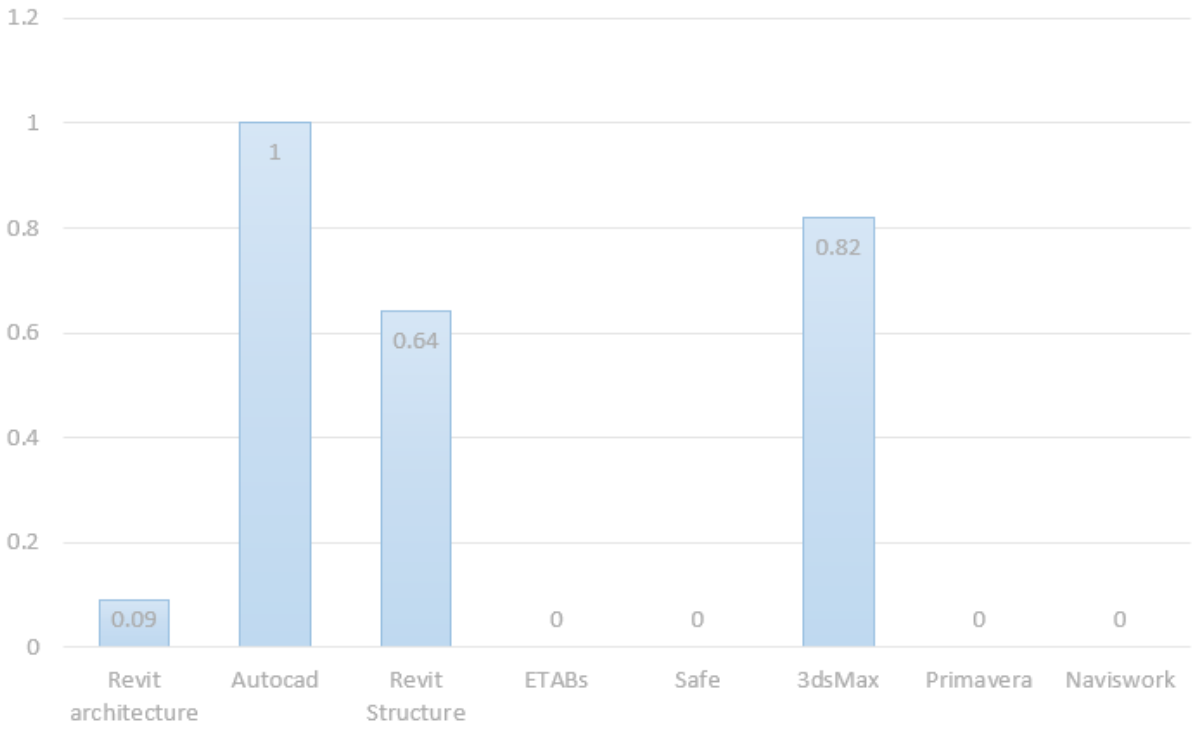

Figure 9: Mostly used engineering software by respondents

Although there are about 62% of the participants are using (Revit Structure) but still most of them are still using CAD system and 3Ds max beside using Revit (Architecture and Structure), and none of the respondents use (Naviswork), (Primavera), (Safe) or (ETABs), although part of the respondents have attended for their training courses, due to the lack of knowledge of BIM and its importance in their fields, what brings us back again to the need of increasing the BIM platforms and tools training courses in the centers and institutes in Syria, in order for the users to understand that they can fully depend on BIM platforms to reach the IDP (Integrated Delivery Project).

4.1.3 Trainers

In this section of the questionnaire, these questions were asked for the trainers to evaluate the attendance and understanding of the training courses they have provided.

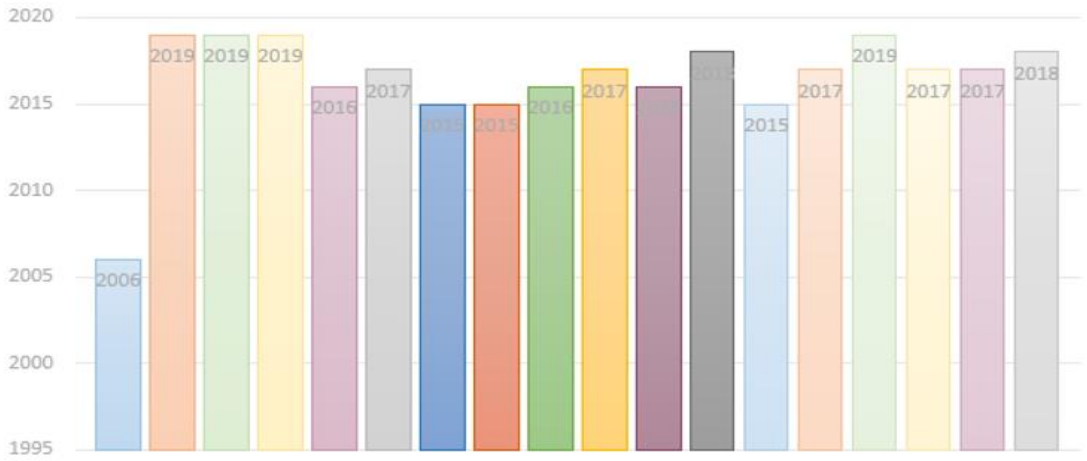

Figure 10: timeline of training courses provided by institutes

Trainers have started their courses in the centers mostly between 2015 – 2019, only one of them has started since 2006, there's a clear need for BIM adoption by the trainers first and providing more training courses with

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

to reach the required level of knowledge and increase awareness that attending training courses for BIM tools and platforms is the first step to qualify the trainees and prepare them to deal with BIM technologies.

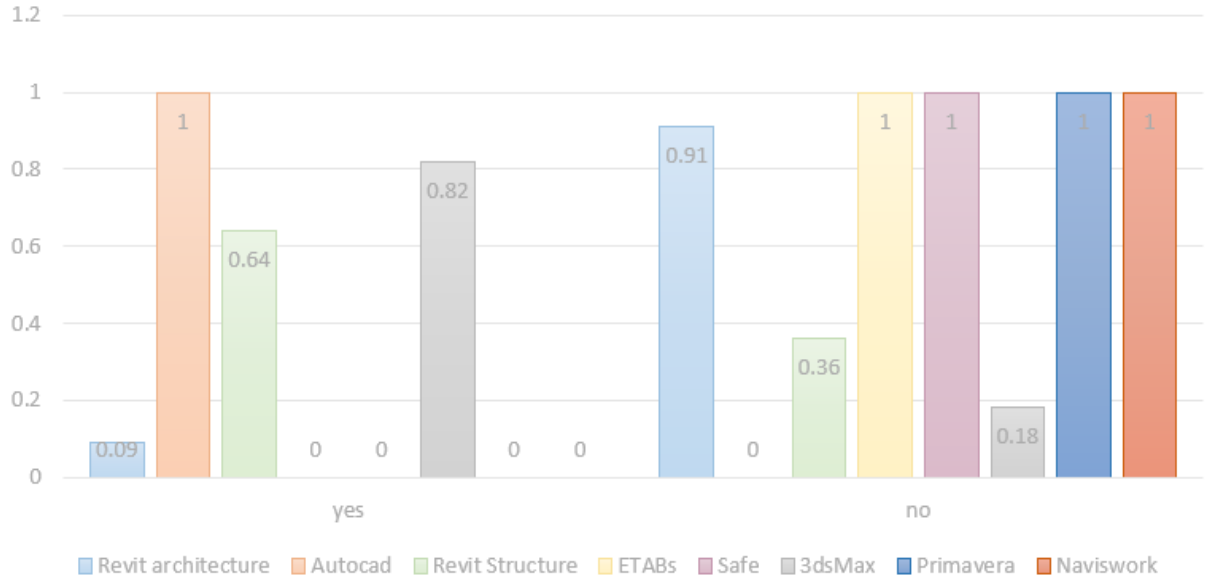

Figure 11: List of BIM software applications that engineers have knowledge about

This question was asked to understand the trainers' background and their knowledge and familiarity with BIM tools and platforms, in order to provide the right courses and In order to provide appropriate training courses and follow-up more on the rapid developments in BIM technologies, as shown in the chart above, although there were part of the trainers have a basic knowledge of BIM platforms, they have claimed that it was difficult to transfer their knowledge through the courses and it is needed to provide more courses with clear and thoughtful curricula.

4.2 Homs

4.2.1 Trainees

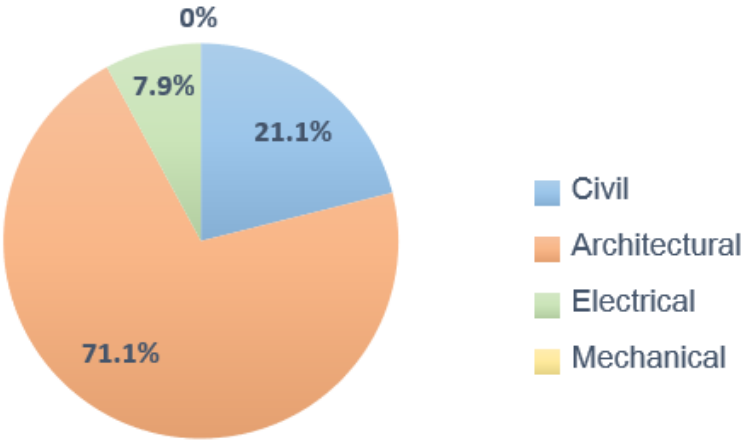

Figure 12: Respondents' engineering major

As seen in Damascus, and for the same reasons, the majority of respondents were architects. The same applies for civil, electrical, and mechanical engineers. This leads us to the conclusion that engineers hold the same technical and professional background regarding new technology and methodologies.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

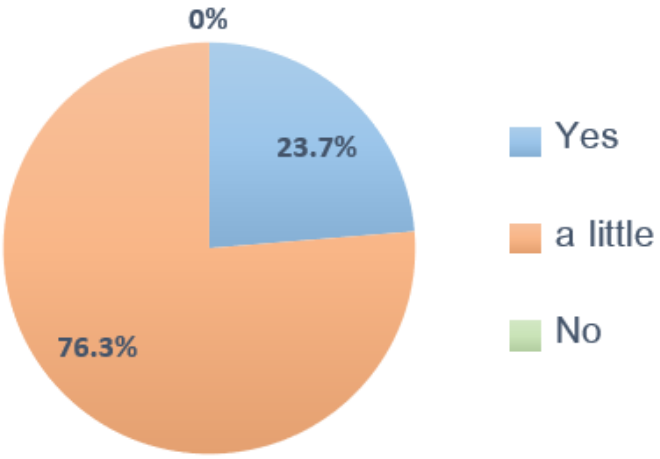

Figure 13: Respondents' knowledge about digital modeling

Most of the respondents have basic knowledge about digital modelling, constituting 76.3% of the total respondents. But this percentage actually represents who only know a little bit about the terms that are used in digital modelling and its software applications, not who really practiced digital modelling on real-life projects. And the other 23.7% were respondents who at least practiced digital modelling in one project. Training on digital modelling would be one of the most important issues to closely link it with the professional aspect to get the best results that save time, money, and effort.

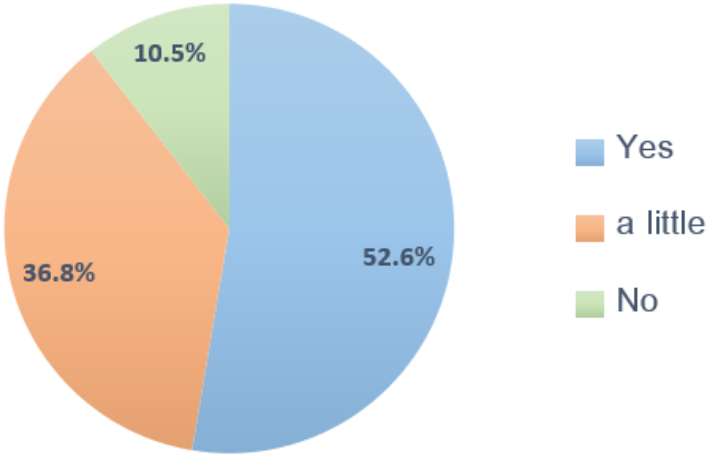

Figure 14: Respondents' knowledge of BIM

Although 52.6% of respondents answered "Yes," but this knowledge is, in many cases, only related to the basics of BIM and the basic terms used in BIM and not the whole process. Still, there's a percentage of 10.5% who don't know anything about BIM. Nowadays, an engineer without the basic knowledge about the latest technologies would absolutely miss his/ her chances in the labour market. Educational bodies should care more about including new technologies in their curricula.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

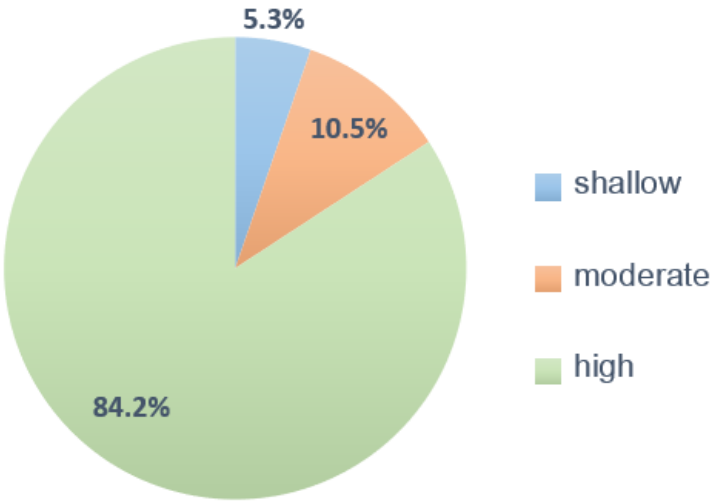

Figure 15: Digital modelling influence on engineers' work

Digital modelling had a great impact on engineering works according to the respondents. Now this is basically reasonable because of the benefits that digital modelling provides, and this percentage should significantly increase with the BIM adoption in the near future. The other two percentages represent users who didn't adopt the digital modelling as a central process, but only used some models without taking advantage of all the benefits.

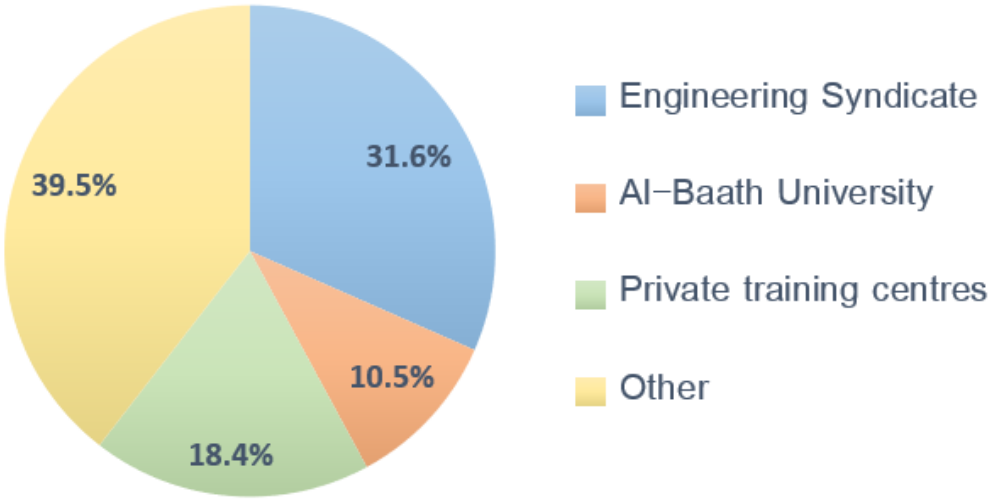

Figure 16: Distribution of training centres that provided courses

Engineering syndicate was the leading body that taught BIM courses. "Other" here refer to the self-training, internet websites, and other resources. The university should increase the frequency and number of courses that should contribute to adopting BIM.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

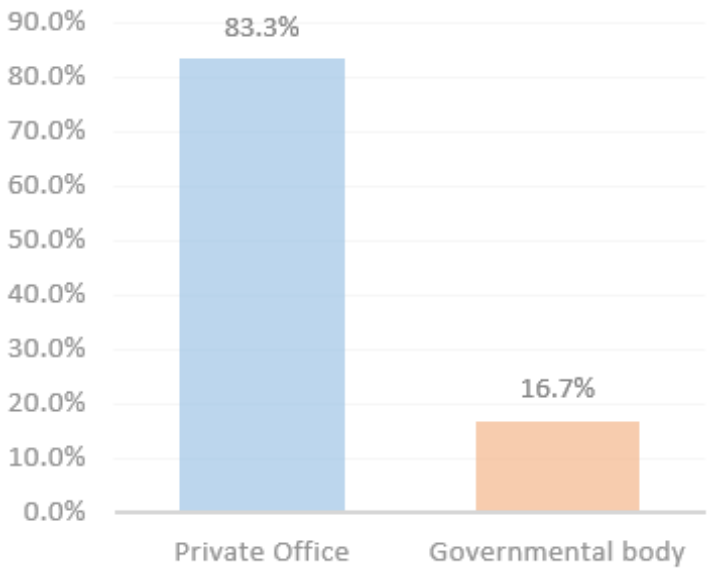

Figure 17: place of work

83.3% of the participants are working in private engineering offices, they claimed that BIM use into their offices is still shallow, and the managers are finding it difficult to change their current work assets into a different system, the other 16.7% participants, that working in a governmental jobs, also pointed to a lack of knowledge, delays, resistance to change and wasting of time and resources into their work place.

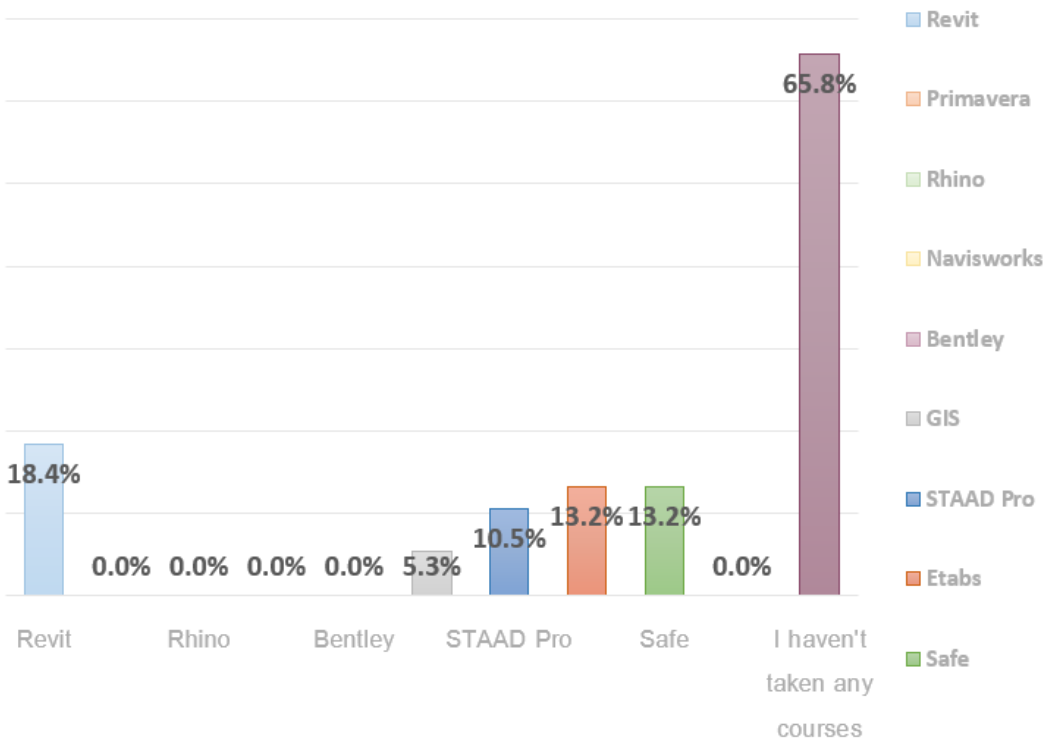

Figure 18: percentage of courses that has been taken in the engineering syndicate

The majority of respondents didn't take any courses in the engineering syndicate, with a percentage of 65.8% of the respondents. This is a very disappointing percentage for only a small sample. The engineering syndicate should advertise in a better way and help engineers get more involved in training and practice.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

4.2.2 Engineering Syndicate

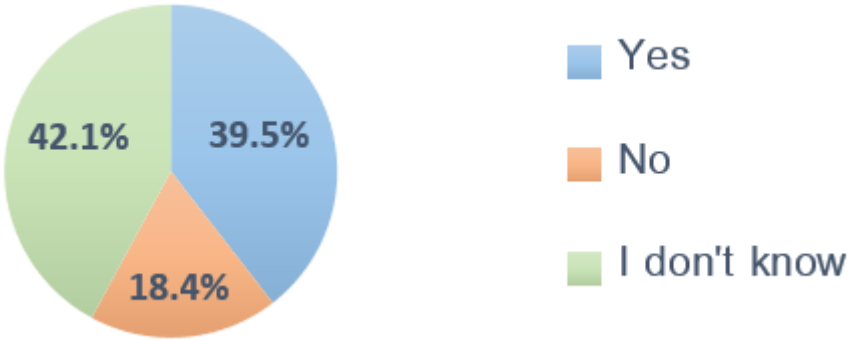

Figure 19: Have training courses been provided by the Engineering Syndicate?

According to the previous chart, only 39.5% of the respondents have heard about the training courses that take place in the syndicate, which considered a low percentage, and it clarifies a lack of awareness therefore attendance of these courses. In order to achieve the required benefits of the training courses, this shows the need to announce more widely about these courses.

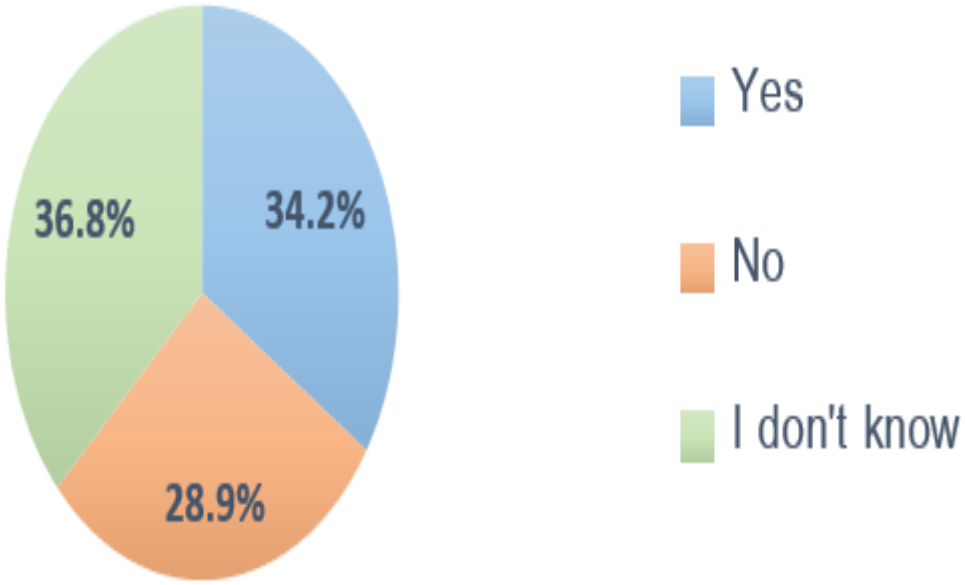

Figure.20: The availability of clear curricula for the provided courses that trainees can depend on

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

34.2% of the respondents thought that curriculum was sufficient and clear, other participants indicates that it was not clear enough, while 36.8% of the respondents answered "I don't know" which shows that they did not have enough knowledge to assess and evaluate the course, This raises the question about the nature of the curriculum and its role in increasing knowledge and understanding of BIM in Homs.

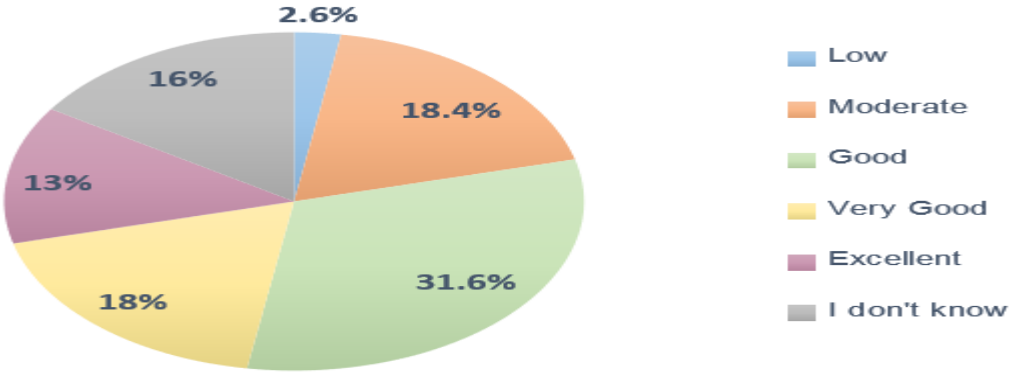

Figure 21: Trainer's ability to strike a balance between software information and its applicability

According to the previous chart, most of respondents agreed on the good performance by the trainer, about 18.4% found the trainer's ability to balance is moderate, 2.6% found it low, and about 16% of the respondents did not know to evaluate the trainer's performance. This indicates an urgent need to qualify the trainers at first, by providing courses that helps increasing their knowledge and familiarity with BIM technologies in order to transfer it through the courses in the syndicate.

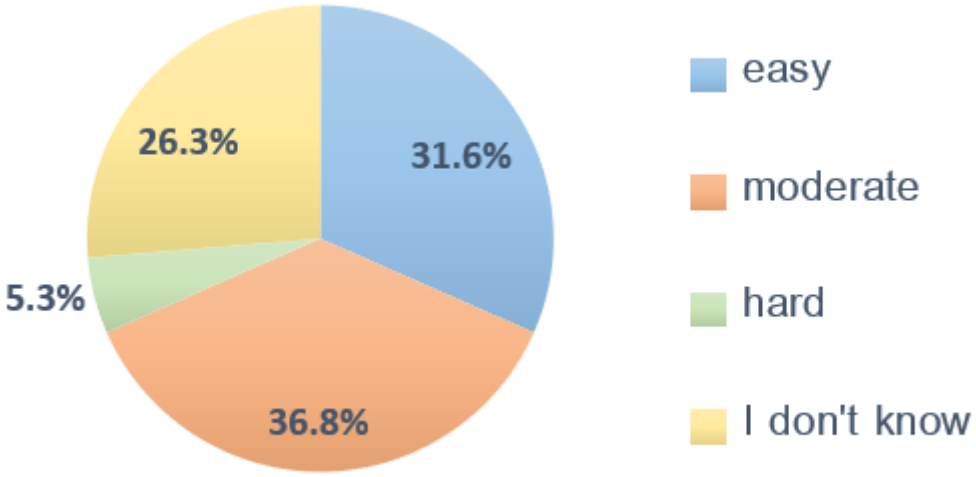

Figure 22: Access to educational material for the courses that were attended

This question was for the trainers about the possibility of reaching out to the required information and materials for their courses, 31.6% of the respondents found the materials accessible, 36.8% claimed it was moderately hard to access to these files, while 5.3% others found it difficult to access to these files and materials, the rest of respondents which counts for 26.3% did not know about the accessibility of these educational materials. The results of the previous chart explain the importance of providing access and ability to obtain the required educational materials.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

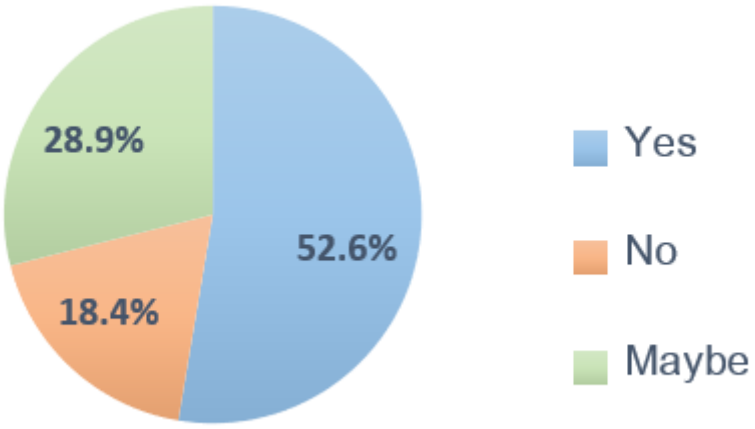

Figure 23: The tendency towards obligating engineering offices to start using BIM instead of AutoCAD

52.6% of the respondents thought it is necessary to begin implementing and adopting BIM, and then obligating engineering offices and companies to use BIM instead of CAD systems. The ability to change the current mentality and start implementing more development one is a good indicator, However, what is really needed in Syria generally and Homs particularly, is increasing the knowledge and awareness about BIM advantages, because as it has been cleared above, there are still 18.4% of total respondents still encouraging to keep using CAD systems in Syria.

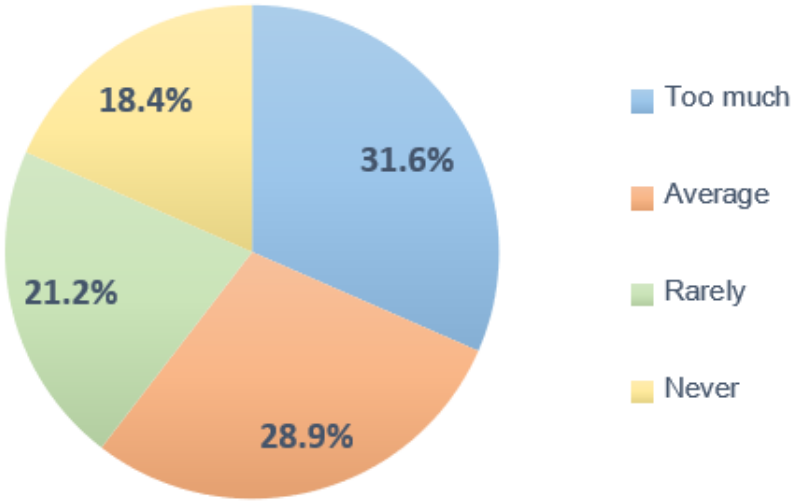

Figure 24: Engineers' usage of BIM in engineering studies

31.6% answered that they use BIM tools and platforms in their engineering work, 28.9% partly depend on BIM, 21.2% rarely use any of BIM tools and platforms, and 18.4% do not use it at all. The results reflect the lack of knowledge and awareness of BIM benefits and advantages, noting that even the respondents that claimed they use BIM technologies a lot, they have worked on 2-3 projects using Revit, here lies the huge misunderstanding about BIM adoption, none of the respondents has actually worked on a model fully depending on BIM environment.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

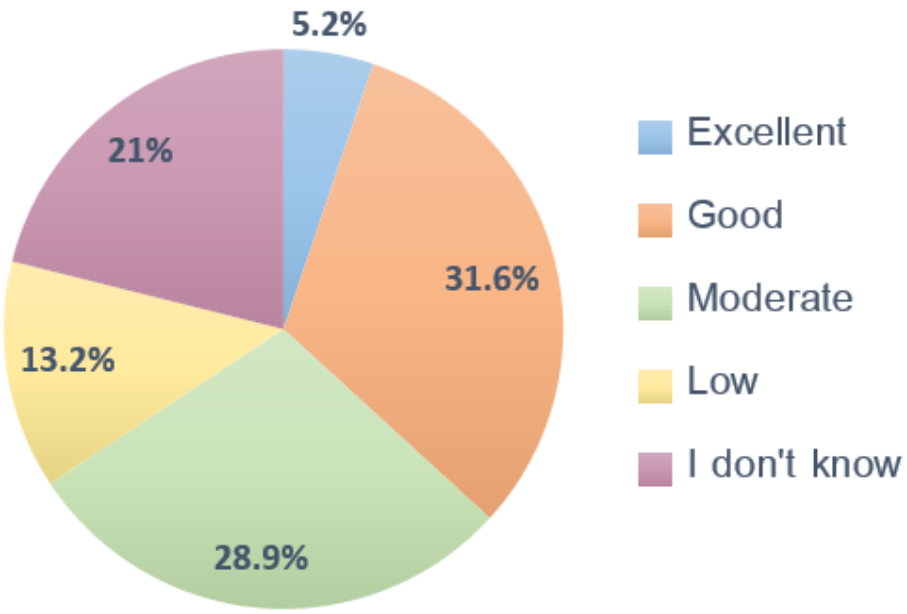

Figure 25: The quality of logistical requirements for the courses

There ware various opinions about the logistic evaluations from the trainees, 5.2% thought it was excellent, 31.6% answered "Good", while 28.9% found it moderate. Although there was about 65% of the respondents found the requirements acceptable, other respondents detected a weakness in the training process, and about 21% did not know whether the requirements are suitable or not. Logistical Requirements are the main structure of the training courses, there's a clear need to understand each software in order to prepare a training process that is enough to qualify the trainees into the convenient environment.

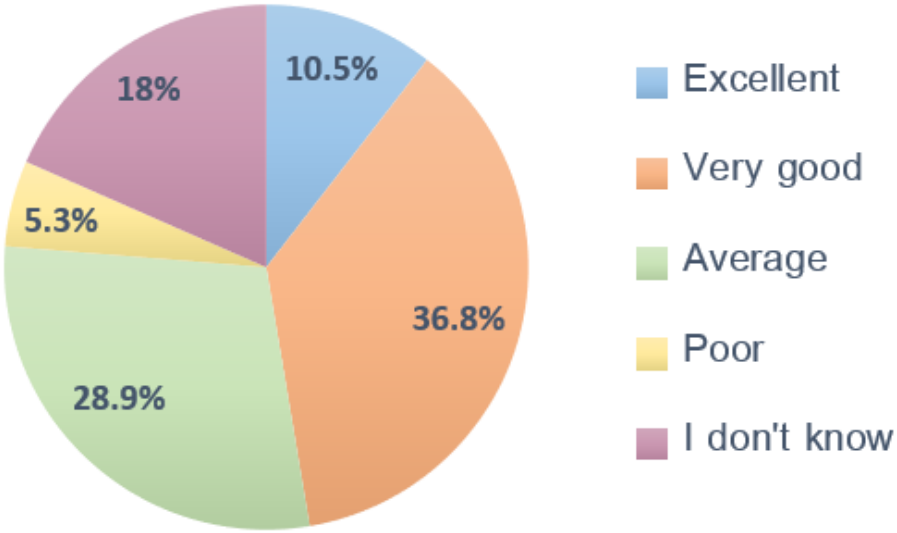

Figure.26: The benefit received from training courses for engineers

The purpose of the previous chart was to evaluate the training courses which was provided by Homs Engineering Syndicate. Given that the trainees have completed and evaluated those courses, they were asked to rate the benefits they achieved from their attendance, in order to evaluate and improve the performance and results. Nearly half of the respondents found the results convenient, while others did not get the required benefits out of it. Some others which counts for 18%, did not know to evaluate their achievements level, which is uncommon, therefore clarifies a deficiency and lack of organization into the training process, calls for reconsideration.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

5. Conclusions and suggestions

The continuous follow-up in the governorates (Homs and Damascus) show that the labor market requires engineers to not only have the basic occupational knowledge, but also the knowledge of how work goes in work field and the ability to manage projects whether in the design or construction phase. Fresh graduates don't have such qualifications. Not only this, they also lack the basic engineering knowledge., and this is due to the poor educational level at the universities. All this led to the need of having training bodies that qualify engineers, which can meet the fresh graduates' needs and help them start their career correctly.

To develop training centers and provide them with the suitable courses that engineers can benefit from, the following suggestions should be considered:

1- Adopting digital transformation for the practical courses and link the new technologies in accordance with BIM to the reality of engineering work.
2- Preparing training materials as PDF and PowerPoint files.
3- Field visits that are related to the study subjects.
4- Developing the mechanism of engineering training using the revers transmission of the material, and that is by presenting images and videos, then transform them into engineering problems and issues.
5- Cooperation awareness raising [1].
6- Including BIM in university curricula [1].
7- There should be defined standards to adopt training in the right way, where there are more than 70 BIM codes around the world [1].

References

1- Ahmed, S., Dlask, P., Shaban, M. & Selim, O., 2018. The possibility of Applying BIM in Syrian Building Projects. *Engineering for Rural Development. Jelgava.*.
2- Ahmed, S., 2018. Innovation of building processes in Syria by using BIM, DOCTORAL THESIS. *CZECH TECHNICAL UNIVERSITY IN PRAGUE.*
3- Ahmed, S., 2018. PROBLEMS OF TECHNICAL EDUCATION AND LACK OF STUDENTS AT CZECH TECHNICAL UNIVERSITIES. Czech Technical University in Prague, Czech Republic.. *Jelgava.*
4- Ahmed, S. & Dlask, P., 2018. The Gradual Transition to BIM in Syrian Companies. *Creative Construction Conference 2018, CCC 2018, 30 June - 3 July 2018, Ljubljana, Slovenia.*
5- Ahmed, S., Dlask, P. & Hasan, B., 2014. Deviation in the cost of projects. *Construction Macroeconomics Conference.*
6- Ahmed, S., Dlask, P., Selim, O. & Elhendawi, A., December- 2018. BIM Performance Improvement Framework for Syrian AEC Companies. *International Journal of BIM and Engineering Science*, 1(1).
7- Ahmed, S. & Sleim, O., 2018. *Way to BIM.* 1st ed. Damscus: SPR Agency, and Syrian International Academy for Training and Development.
8- Gerges, M., Austin, S., Mayouf, M., Ahiakwo, O., Jaeger, M., Saad, A., Gohary, T.E, 2017. An investigation into the implementation of Building Information Modeling in the Middle East. *ITcon*, Volume 22, pp. 1-15.
9- Mia, R., 2016. Performance Management for Syrian Construction Projects. *International Journal of Construction Engineering and Management.* DOI: 10.5923/j.ijcem.20160503.01.
10- Gregory, A., Herrmann, M. M., Miller, B. & Moss, J., 2014. Integrated Practice and Architecture Education: The Evolution of a Pedagogy.. *ARCC Conference Repository.*
11- Ahmed, S., Dlaska, P., Hassan, B. & Beshara, M., 2017. Pre-Cast Concrete, a Key Option for the Reconstruction Phase after War. Procedia Engineering. DOI: 10.1016/j.proeng.2017.08.074.
12- Elhendawi, A., Omar, H., Elbeltagi, E. and Smith, A., 2019. Practical approach for paving the way to motivate BIM non-users to adopt BIM. International Journal of BIM and Engineering Science, 2(2).
13- Evans, M., Farrell, P., Elbeltagi, E., Mashali, A. and Elhendawi, A., 2020. Influence of partnering agreements associated with BIM adoption on stakeholder's behaviour in construction mega-projects. International Journal of BIM and Engineering Science, 3(1).
14- Elhendawi, A.I.N., 2018. Methodology for BIM Implementation in KSA in AEC Industry. Master of Science MSc in Construction Project Management), Edinburgh Napier University, UK.
15- Shaban, M.H. and Elhendawi, A., 2018. Building Information Modeling in Syria: Obstacles and Requirements for Implementation. International Journal of BIM and Engineering Science, 1(1).
16- Elhendawi, A., Smith, A. and Elbeltagi, E., 2019. Methodology for BIM implementation in the Kingdom of Saudi Arabia. International Journal of BIM and Engineering Science, 2(1).

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022

17- Elgendi, A.F., Elhendawi, A., Youssef, W.M.M. and Darwish, A.S., 2021. The Vulnerability of the Construction Ergonomics to Covid-19 and Its Probability Impact in Combating the Virus. International Journal of BIM and Engineering Science, 4(1).
18- Specification, N. B., 2014. NBS National BIM Report, UK: NBS.

Doi: https://doi.org/10.54216/IJBES.050103
Received: January 08, 2022 Accepted: May 18, 2022