

# **Investigating the Barriers of Building Information Modelling (BIM) Implementation in the Higher Education in Morocco**

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## **Abstract**

The implementation of Building Information Modelling (BIM) has significantly increased in the last few years in Morocco. However, it has been noticed from the literature that construction companies in Morocco face barriers which limit the full implementation of this technology. One of these barriers has been identified to be the lack of BIM courses within the higher education system, since is essential for AEC students to get a clear and deep understanding of this process and technology in order to meet the industry's requirements. Currently, there is an increasing request to embrace BIM within the educational system in Morocco either for undergraduate and postgraduate courses in order to supply students with the required knowledge and skills to be able to work within a BIM environment. Therefore, the aim of this research is to explore the status of BIM in the Moroccan higher education and to identify the main barriers which limit its implementation in the Moroccan higher education. To achieve the aim of this research, a mixed method approach has been adopted. Furthermore, the researchers highlights some recommendations which will aid the implementation of BIM within the higher education system in Morocco.

## **Keywords**

Building information modelling (BIM), Architecture, Engineering and Construction (AEC), Moroccan higher education, barriers, Mix method.

## 1. Introduction

Recently, BIM had been gaining more attention from educational institution. Indeed, several universities started implementing BIM in the pedagogical curriculum in order to respond to the need of construction sector for skilled professionals. Taylor et al. (2008) clarified that certain strategies must be prospected at the educational institution in order to obtain skilled students able to adapt to the new transition in the construction industry. Joannides et al. (2012) confirmed that several Construction Management courses have integrated BIM technology in their education system to prepare future engineers with the needed abilities in the construction sector.

However, the incorporation of BIM in the educational courses is not perfect yet. Several studies have revealed that the pedagogical teaching of BIM in the educational institutes is still delicate even though the recognition of the benefits offered by implementing BIM and its potential in changing the whole methodology within the construction industry (Casey 2008; Johnson and Gunderson 2009; Wang and Leite 2014).

The National Building Specification report published in 2015 demonstrate that BIM teaching has been implemented at different stages around the world. Certain countries have positively merged their technology in their educational systems although other countries are still struggling with it or they are in the early stages of the implementation.

Within the context of the Moroccan higher education, BIM integration within the education system still in its early stages when compared to other countries, as the United States and the United Kingdom. Therefore, the aim of this paper is to explore the status of BIM in the Moroccan higher education and to identify the main barriers which limit its implementation in the Moroccan higher education

### 1.1 Overview of BIM in International Universities

In the UK, a research conducted by McGough (2013) showed that the UK government has mandated the obligatory use of BIM in all public projects from 2016. This initiative by the government to motivate the UK construction industry to embrace this technology has encouraged many British universities to integrate BIM within their courses. Indeed, several universities are proposing BIM courses in their AEC faculties such as Westminster University, Salford University, Liverpool and Coventry University.

In the US, a research study conducted by Sacks and Pikas (2013), showed that at the beginning only a small amount of universities have incorporated BIM courses and modules into their AEC programs. The main reason behind that, is the lack of awareness within the universities of the real need of the industry regarding BIM and what are the skills and knowledge required by fresh graduate engineers to be able to work within a BIM environment. However, a most recent study shows that several American universities succeeded in the integration of BIM in their curriculum such as Arizona State University, University of Texas at San Antonio, California State University (Yilei Huang, 2018).

### 1.2 BIM in Moroccan Higher Educational System

Many research demonstrate a noteworthy increase in the use of BIM tools all the world. Universities around the globe are changing over their educational program to meet this change. (Ibrahim and Okeil 2011). Graduates with BIM foundation and knowledge are more favored than those with just CAD capacities. Currently, universities in Morocco still in the early stage of BIM implementation, since the industry is not fully aware of BIM and there is no mandatory use of this technology. However, due to the substantial expansion of BIM usage around the world, it seems that the Morocco higher education need to be prepared in order to integrate this technology in their curriculum. This integration will result in supplying fresh graduates with the right skills and knowledge in order to meet the market's expectations and be able to work in a BIM environment.

Despite the numerous available research and data regarding the integration of BIM in higher educational system, seems there is no clear strategy to accomplish that (Woo 2006). Therefore, at the end of this research some

recommendations obtained from professionals in Moroccan universities will be highlighted, regarding how BIM can be integrated effectively within the higher education system.

## **2. Research Methodology**

The research methodology adopted in this research is a mix method approach. This research design was chosen to identify and detect the barriers of BIM implementation in the Moroccan higher education then get the opinion and professionals point of view about how BIM can be embraced by Moroccan universities. Regarding the qualitative part, the interview questions were divided into three main sections. The first section was a group of general questions about the participant, the second section was a group of specific and detailed questions related to the research topic and the final section was a question to sum up all the important points said during the interview. The interviews have been conducted through Skype due to the limited time of the participants and each interview took approximately 25 minutes. On the other hand, a questionnaire has been distributed to more than 20 professionals in the Moroccan higher education from public and private sectors in order to get their opinion on the research topic. The questionnaire was based on fourteen closed ended-questions connected to the aim of this research which has been created using Bristol Online Survey. The questionnaire has been divided into three parts, the first part is a group of general and personal questions about the participant, followed by a second part with questions evaluating the status of BIM in the Moroccan higher education. The last part of the questionnaire aimed to investigate the potential barriers faced when integrating BIM in the Moroccan higher education.

## **3. Analysis and Discussion**

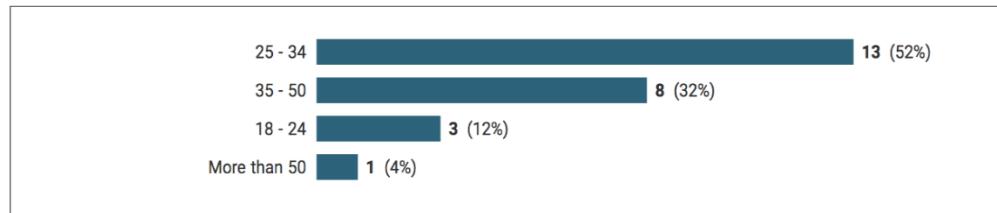
### **3.1 Questionnaire Responses Analysis and Discussion:**

The questionnaire responses were collected from 25 respondents and were statistically analyzed using frequency distribution analysis and their results are provided in the figures 4.1 to 4.14 given below along with discussion respectively.

#### **Participants' information:**

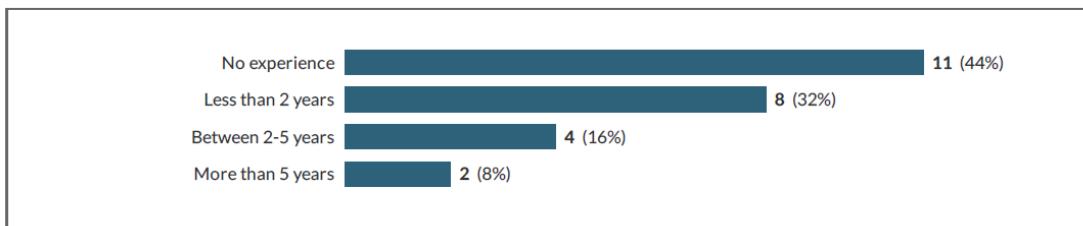
In question one the respondents were asked to select their age group as shown in the following chart. The bar chart indicates that 52% of the respondents selected 25 to 34 years' age group, while 32% selected 35 to 50 years' age group, whereas 12% selected 18 to 24 years age group, and only 1% selected more than 50 years age group. It means the majority of the participants was between 25 to 34 years age group and were young adults.

1 What is your age?



**Figure 1: Age of participants**

2 How many years experience do you have with BIM?

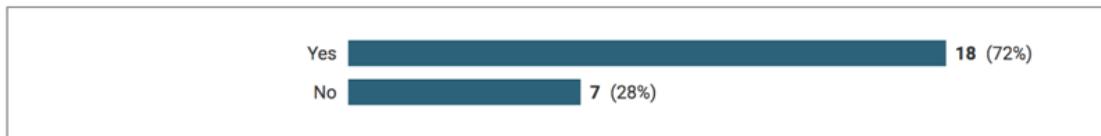


**Figure 2: Experience with BIM**

In question two the respondents were asked to select the years of experience they have with BIM. The results given below in figure (2) indicates that 44% of the respondents selected no experience, while 32% selected less than 2 years' experience, whereas 16% selected between 2-5 years' experience, and just 8% selected more than 5 years' experience. This shows that the majority of the respondents had no experience of working in BIM, while around 56% of the respondents had up to 5 years of experience of working in BIM.

Awareness of Moroccan universities about BIM:

3 Is your university aware of what building information Modelling (BIM) is?

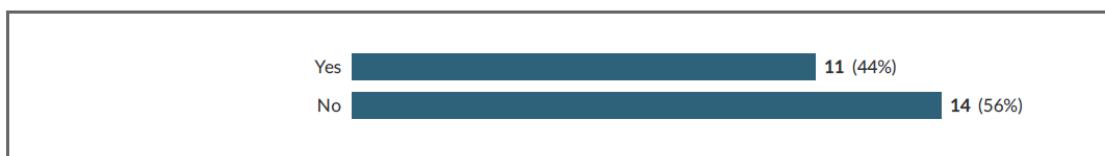


**Figure 3: Awareness about BIM in Moroccan Universities**

In question three the respondents were asked if their university was aware of what Building Information Modelling (BIM) is. It was found based on the following results that 72% of the respondents answered yes, while remaining 28% answered no, this shows that the majority of the respondents' universities were aware of what BIM was.

Status of BIM in Moroccan courses:

4 In your university, do you teach or at least discuss about BIM?

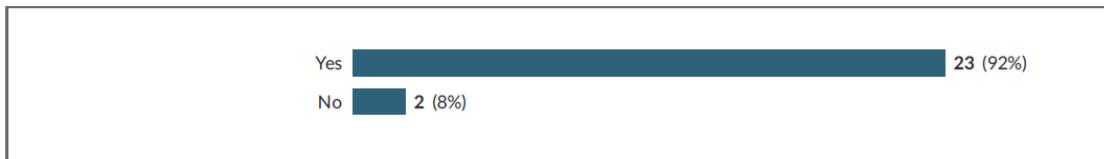


**Figure 4: Status of BIM in Moroccan courses**

In question four when respondents were asked if they teach or at least discuss about BIM in their university, 56% of the respondents answered no, while 44% answered yes. This shows that the majority of the respondents were not teaching or discussing about BIM in their university.

Acceptance of BIM in the Moroccan higher education:

- 5 If no, would you be okay to try and accept this new process?

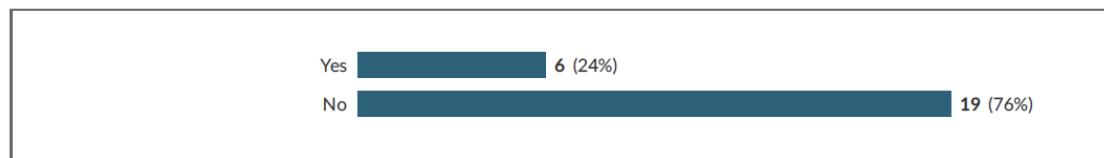


**Figure 5: Acceptance of BIM in the Moroccan higher education**

Those respondents which have answered no were further asked if they would be okay to try and accept this new process. The 92% of the respondents answered yes and so the majority of them were ok to try and accept this new process of BIM.

BIM workshops:

- 6 Did you try to organize BIM workshop in the university?

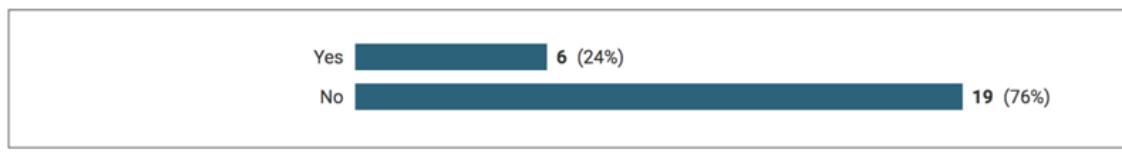


**Figure 6: BIM workshops**

In subsequent question the respondents were asked, did you try to organize BIM workshop in the university, 24% of the respondents answered no, while 76% answered yes. This shows that the majority of the respondents did try to organize BIM workshop in the university.

Teaching BIM in universities:

- 7 Do you have a skilled staff to teach BIM in your university?

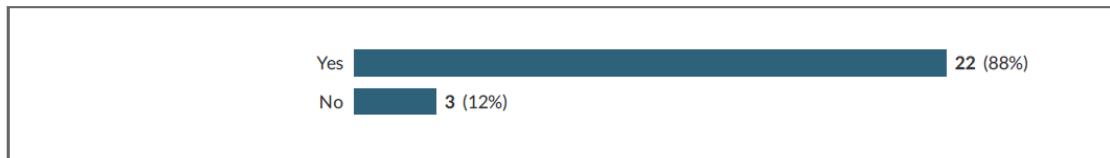


**Figure 7: Skilled staff to teach BIM in Moroccan universities**

In next question the respondents were asked if they had a skilled staff to teach BIM in their university, 24% of the respondents answered no, while 76% answered yes. This shows that the majority of the respondents had a skilled staff to teach BIM in their university.

Interested students about BIM:

- 8 Do you get students asking and interested about BIM?

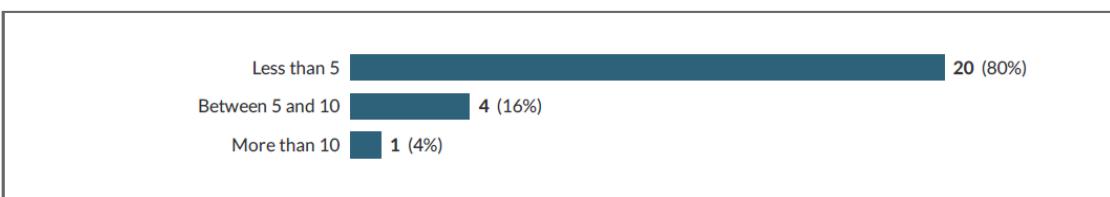


**Figure 8: Interested students about BIM**

Afterwards in question eight, the respondents were enquired if they get students asking and interested about BIM, 88% of the respondents answered yes, while 12% answered no. Therefore, it was evident the majority of the respondents get students asking and interested about BIM.

Researchers about BIM in Moroccan universities:

- 9 Do you have any research student in the faculty researching about BIM?

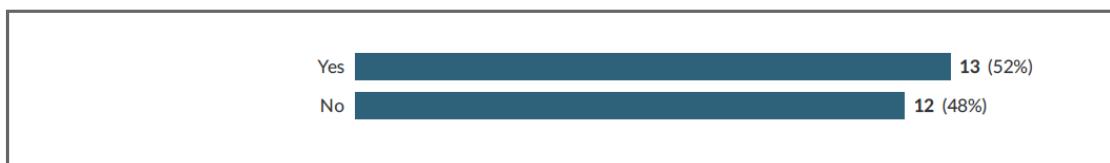


**Figure 9: Researchers about BIM in Moroccan universities**

When the respondents were asked, do you have any research student in the faculty researching about BIM, 80% of the respondents selected less than 5, 16% selected between 5 and 10, and 4% selected more than 10. This shows majority of the respondents had less than 5 research students in the faculty researching about BIM.

Acceptance of BIM process in educational institutions:

- 10 Do you think that Morocco is ready to adopt this process in the educational institution?



**Figure 10: BIM acceptance in educational institutions**

Subsequently the respondents were asked, do you think that Morocco is ready to adopt this process in the educational institution. It was evident that 52% of the respondents selected yes, while 48% selected no. Therefore, around half of the respondents were of the opinion that Morocco is ready to adopt this process in the educational institution.

Consciousness about BIM integration in universities:

- 11 How important do you think is BIM implementation in the education in Morocco?

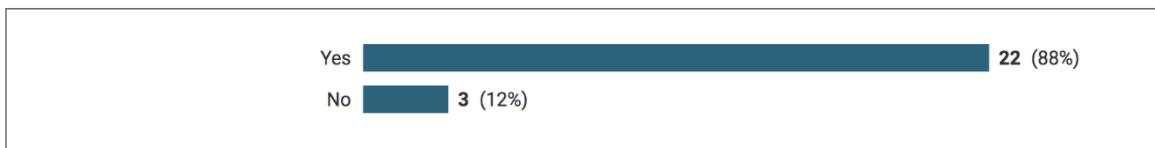


**Figure 11: Consciousness about BIM integration in universities**

In next question the respondents were asked about the importance of BIM implementation in the education in Morocco, 40% of the respondents selected very important, while 56% selected important, however only 4% stated not important. In view of majority of the respondents, BIM implementation in the education in Morocco is either important or very important.

National development of BIM in Morocco:

12 Are you aware of the national development BIM in Morocco?



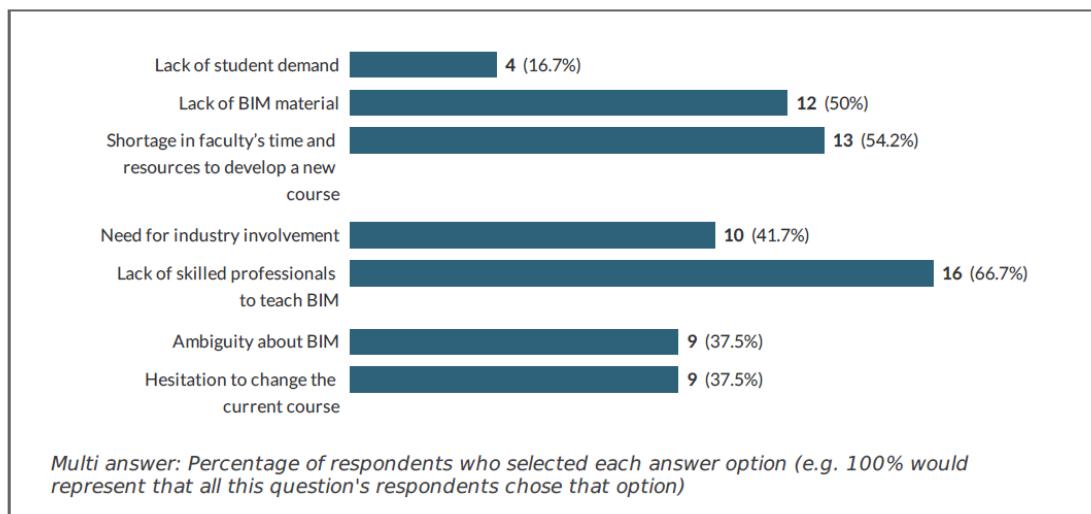
**Figure 12: National development of BIM in Morocco**

When the respondents were asked, are you aware of the national development BIM in Morocco, 88% of the respondents selected yes, while 12% selected no. This shows the majority of the respondents were aware of the national development BIM in Morocco.

Barriers of BIM implementation:

Afterwards the respondents were asked to select the main barriers of BIM implementation in the higher education in Morocco. In view of majority of the respondents; lack of BIM material, shortage in faculty's time and resources to develop a new course, and lack of skilled professionals to teach BIM were the main barriers which prevent, BIM implementation in the higher education in Morocco.

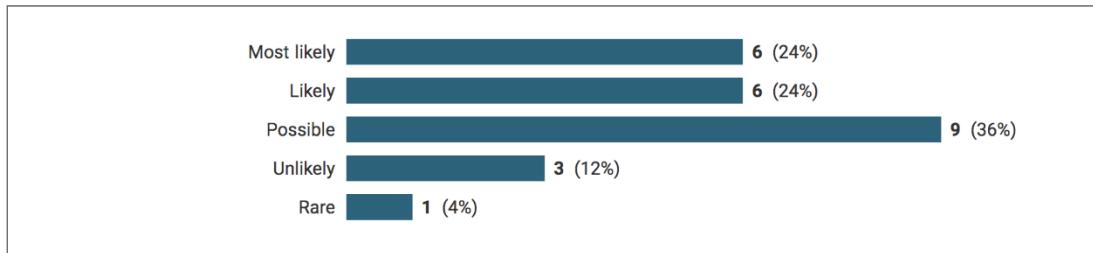
13 What are the main barriers of BIM implementation in the higher education in Morocco? (You can choose multiple answer)



**Figure 13: Barriers of BIM implementation in the Moroccan higher education**

Adoption of BIM in Moroccan higher education in the future:

14 Do you think that the universities will adopt BIM course in the higher education in Morocco?



**Figure 14: Adoption of BIM in Moroccan higher education in the future**

In the last question the respondents were asked, do you think that the universities will adopt BIM course in the higher education in Morocco, 24% of the respondents selected most likely, while 24% selected likely, 36% selected possible, however 12% selected unlikely, and 4% selected rare. This means the majority of the respondents had positive opinion regarding the possibility that universities will adopt BIM course in the higher education in Morocco.

### 1.1 Qualitative Analysis of Interviews and Discussion:

Three interviews were conducted to perform qualitative research, where first interviewee was conducted with a Senior lecturer who had 30 years of work experience, while the second interviewee was conducted with a lecturer who had 15 years of work experience, and the third interview was conducted with a researcher who had 6 years of work experience. The interviewees were asked seven questions related to BIM and their responses were analyzed using content analysis.

When the interviewees were asked, how often they received questions about BIM. In reply the first interviewee answered ‘almost always’, while the second and the third interviewees answered ‘Frequently’. This shows that lecturers and researchers at the Moroccan universities frequently received questions about BIM.

When the interviewees were asked, have you used BIM on any workshop or lectures, the first and the third interviewees answered ‘yes’ that they used BIM on any workshop or lectures so that the students can have a general idea about BIM. However, the second interviewee answered ‘no’ that he did not use BIM on any workshop or lectures because in his opinion BIM is not developed yet in Morocco so there is no need to get students confused about a process which is not yet implemented in Moroccan firms.

Subsequently the interviewees were asked if Moroccan higher education is ready to accept the implementation of BIM within universities. Based on their answers it was identified that the demand for BIM course is increasing but unfortunately not enough to open a new course. Moreover, in the Moroccan universities there is a huge shortage of lecturers with BIM skills and knowledge, existing staff member are not able to teach this process effectively and the BIM software and material is too expensive and not accessible to all universities.

Afterwards when the interviewees were asked if they had received any external requests for BIM’s course and from whom, all of them answered ‘yes’. Based on the content analysis of their answers it was identified that they received external requests for BIM’s course from engineers working on new projects using BIM in Moroccan and students.

Moreover, the interviewees were asked which strategy they think is more suitable and easier to use to BIM course in the higher education in Morocco. They suggested to; open a new course for BIM, or offer a stand-alone course or integrate the BIM content in an AEC course as a part of the course.

When the interviewees were asked about the internal/external barriers to the BIM course implementation in the Moroccan universities they suggested the following barriers; lecturers’ unwillingness to change traditional working practices, high cost of training for BIM, too much time is needed for learning BIM software, lack of expertise among the lecturers, legal barriers for starting new course for BIM, it is not considered important, lack of BIM textbooks and other educational resources (such as no French books are available), and no room for new courses in existing curriculum.

Lastly the interviewees were asked how the barriers in BIM implementation can be overcome to successfully implement BIM in the Moroccan higher education. Based on the content analysis of their answers the following measures can be taken to successfully implement BIM in the Moroccan higher education; a policy-level change, realizing the value from facilitating the construction process, national level awareness/purchasing software and

technology, training lecturers on new software and technology/overcoming the resistance to change, and getting people to understand the potential and the value of BIM over traditional methods.

#### **4. Conclusion and Recommendations**

The aim of this paper was to explore the current situation of BIM within the higher education system in Morocco. From the data collected using a mix method approach, it has emerged that the status of BIM in Morocco universities is at the very early stage. This has been justified by the participants by claiming that BIM is not required to be used in Moroccan construction firms, therefore there is no need to confuse students with an advanced technology such as BIM. Moreover, other limitations emerged from the data collection, such as lack of BIM materials, lack of experience among lecturers and high cost of training for BIM.

On the other hand, the participants have proposed few recommendations to overcome these barriers and will help in the integration of BIM in Moroccan universities. One of the recommendations were based on mandating an obligatory use of BIM, as in the UK, which will consequently lead the industry and universities to embrace this technology. In addition, they have recommended training lecturers on new software and technology despite its high cost, since the availability of a BIM course will bring the attention of a higher number of students which will lead to a higher return on investment. Finally, the participants emphasized on the important role of the government in spreading BIM awareness between organizations and universities, as well as providing materials and textbooks in both Arabic and French, since these are the two official languages in Morocco.

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## **Biography**

**Dr Abdussalam Shibani** is an Assistant Professor, and course director of Master of Construction Management with BIM in the School of Energy, Construction and Environment at Coventry University. Dr Shibani has achieved his master and PhD degree from Coventry University. In addition, he pursued his work as a Post-Doctoral Research fellow at the same university. Dr Shibani has extensive publications in both high quality journals and conferences. His research interest is based on various topics as Building Information Modelling (BIM), Total Quality Management (TQM), Supply chain management, Construction productivity and performance and Six Sigma implementation within the construction context. Alongside his interest in research, he is accepting PhD research students and currently he is supervising three students whose research is based on BIM.

**Khaled Abu Awwad** is a Ph.D. student in Civil Engineering, Architecture, and Building at Coventry University. The focus of his research is to investigate the implementation of Building Information Modeling Level 2 in Small and Medium Enterprises in the UK construction Industry. After completing his Bachelor's Degree (B.E.) in Civil Engineering, he moved on to concentrate in Construction Management and received his Master's Degree (MSc.) in Construction Management from Coventry University in 2016. The experienced he gained while working as a Civil Site Engineer, helped him initiate his academic career as a part-time lecturer in Project Management at Coventry University, where he is currently involved in many research areas, such as Building Information Modelling, Six Sigma implementation and Sustainable Development in construction.

**Michel Ghostin** is a Ph.D. student in Civil Engineering, Architecture, and Building at Coventry University. The focus of his research is to investigate the implementation of Building Information Modeling and evaluate its impact on Sustainable Development in the construction industry. After completing his Bachelor's Degree (B.E.) in Civil Engineering, he moved on to specialize in Construction Management and received his Master's Degree (MSc.) in Construction Management from Coventry University where he began his research in Building Information Modeling and Construction Technology. The experienced he gained while working as a Civil Site Engineer, helped him initiate his academic career as a part-time lecturer in Project Management at Coventry University, where he is currently involved in several research areas, focusing on Construction Management and Technology, mainly Building Information Modeling and Sustainable Development.

Kalim is an economist, specializing in Development Economics and International Economics. His work, which combines elements of international and development economics, economic policy, economic history and political economy, often challenges prevailing orthodoxy about which policies promote overall development in less developed countries.