INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 6.078
(Volume 6, Issue 3)
Available online at: www.ijariit.com

BIM-understanding, its drivers and challenges in the Indian Construction Industry

Nadim Akhtar
n.akhtar05@gmail.com
School of Planning and Architecture, Vijayawada, Andhra Pradesh

ABSTRACT

With the rapid rise in AECO (Architecture, Engineering, Construction, Operation & Maintenance) industry, there was a need to reinvent the conventional construction practice and project delivery system. The digitization of data resulted in the formation of Building Information and Modelling (BIM) which revolutionized the AEC industry. BIM offers the integrated ability of properties, materials, life-cycle and other data with added facilities of interoperability, facility management, construction management, risk management and leadership in energy and environmental design. Since 2000 BIM is considered to be a major breakthrough in the construction industries which not only delivers the projects but also tackles the operation and maintenance of the delivered project. BIM provides the 7D environment i.e. (x.y, z) axis, time, cost, sustainability and facility management, further research is being going on to achieve nD environment. This research aims at the growth drivers and the challenges faced for adoption of BIM in Indian construction projects through questionnaire survey for different user and discuss the risk, challenges, reason and interest in adoption of BIM for Indian Construction Industry. The discoveries and proposals of this research could be utilized by organizations to help survey their current BIM appropriation and distinguish if and how BIM ought to be embraced.

Keywords— *BIM, nD, Conventional - Construction, Interoperability*

1. INTRODUCTION

At present BIM is seen as a software tool that test, analyze and improve our design resulting in increase in Building performance were as in conventional construction practice, we cannot analyze until it's built. BIM is used for designing, optimizing and visualizing a building and its performance both in terms of graphical representation and quantity.

As BIM has started very late in our country, the application is not proper, the regulation and data storage is not yet developed, moreover the policies and laws has not yet established. No single person or company to support its back-end and technical glitch. As in this technological and information sharing era, it is totally dependent on data an cloud computing to enable proper centralized storage for smooth functioning and real-time updating in the construction field as well as in the virtual design.

1.1 The technical definition of BIM

BIM is mostly defined as a term for different activities and properties of Computer Aided Design which represents the different building elements and facilities in terms of 2D & 3D form along with time, quantitative and qualitative assessment. "Building Information Modeling (BIM) is a process that begins with the creation of an intelligent 3D model and enables document management, coordination and simulation during the entire life-cycle of a project (plan, design, build, operation and maintenance)"by Autodesk®.3D model helps in predicting future observations, help to control future events and explain the past observation. BIM is the concept of centralized model with multiple uses which includes the geometry, the physical property, and the type of spaces in the building and the schedule of operation of each part of the Building.

1.2 Generalized Definition

BIM can be said as portal and software service which is supported by data storage and visualization technology of back-end database with the ability of project management, life cycle costing and operation and maintenance of the project.

1.3 The conventional construction practices

It is a process of building construction which uses the conventional tools like plywood, formwork, steel reinforcement and it is cast in situ. In conventional construction practice the building is rarely visualized nor its performance its analyzed.

2. METHODOLOGY

2.1 Literature Review

Literature review was carried out to know and understand the issues regarding the implementation and challenges faced during the adoption of BIM in Indian Construction industry. The main aim of the review was to find out the growth driver and challenges in adopting BIM in the Indian Construction Industry.

2.2 Questionnaire Survey

The research was carried out through questionnaire survey for different users and the result of the survey could be considered significant if the response rate is not lower than 30%. Questionnaire Survey consist of 4 parts:

2.2.1 General Details: This includes the demographic profile like respondent's Name, Designation, Organization, and Educational Qualification.

2.2.2 BIM awareness level: his includes 2 questions, assessment of BIM knowledge and working experience.

2.2.3 Growth Drivers: This includes the factor which result(s) in increase in the usage of BIM in Indian Construction Industry.

2.2.4 Challenges and Barriers in the adoption of BIM: This includes at what extent the challenges and barriers hinder in the adoption of BIM in Indian Construction Industry.

The growth drivers, challenges and barriers is assessed on a 5 point Likert scale provided by the respondent. The Relative Importance Index (RII) method is used to determine the challenges and factors in adoption of BIM in Indian Construction market.

The Relative importance index (RII) :

$$R.I.I = \sum \frac{W}{(AXN)} \quad (0 \le index \le 1) \text{ ----------(i)}$$

Where:

W = Weightage given to each factor in the range of 1to 5.
1 = Not Significant.
2 = Little Significant.
3 = Moderately Significant.
4 = Greatly Significant.
5 = Extremely significant.
A = highest weight (i.e. 5 in this case), and
N = total number of respondents (i.e. in this case).

2.3 Survey Population Selection criteria and Calculation of Sample size

Being unable to find the exact number of targeted populations, help of the industrial experts of BIM was taken and was to decide a range of total targeted population, which came out to be 80000-100000.For more accuracy the LinkedIn was checked who stated themselves as BIM user or their skill as BIM. At the time of research 140000 claimed BIM as their working skills. Thus, average was considered

$$\frac{(80000+140000)}{2} \equiv 110000 \text{ ----------(ii)}$$

So, the targeted research population was 110000.

To decide the sample size different statistical tool like Solvins Formula is used:

$$n = \frac{N}{N(C^2)} \text{ ----------(iii)}$$

Where
N= Total population, taken as 110000 (from equation ii).
C= margin of error

The margin of error "C "= 1-P, where P is the level of confidence of research. For this research, keeping the diversity of population in mind, the researcher interpreted level of confidence to be 91%. When the researcher say that the level of confidence is 91%, then he means that the sample will reflect the entire population.

$$C = 1 - \left(\frac{P}{100}\right)$$
$$= 1 - \left(\frac{91}{100}\right) = 0.09 \text{ ----------(iv)}$$

n=Sample size.

Solving equation (iii) with give data

$$n = \frac{110000}{110000(0.09)^2}$$
$$= 123.3 \approx 124. \text{ ----------(v)}$$

2.3 Data Analysis

It involves analyzing the data collected from questionnaire survey. Graphical representation, charts, graphs and is used with written and descriptive explanation for better understanding of the results.

2.4 Limitation

The limitation in this study are as follows

a) It is limited to the Construction industry prevailing in India only.
b) The quantitative data of the study is obtained from the survey and it's limited to the no. of respondents taking part in the survey.

3. BUILDING INFORMATION MODELLING (BIM)

In India BIM is generally seen as a tool which can generate and create 3D but reality is far more different. BIM is a tool which helps in generation of 3D along with its property for e.g. in CAD two parallel lines hatched with ANS 132 denotes a wall but when a wall is created in BIM it has its own properties with material specification and types of construction opted to construct that wall and also specifies where it is being constructed.

Fig. 1: Plan of a wall of 3000 mm with a thickness of 230mm.

Figure 1, CAD representation of the wall of 3000 mm with a thickness of 230 mm, hatched by ANS -132.This does not specify the height, specification as well as the property of the wall neither it represents the material of the wall.

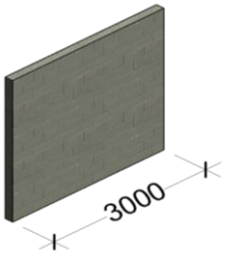


Fig. 2: 3D view of Wall created in BIM platform (Revit) of 3000 mm with thickness of 230 mm

Figure 2, BIM representation of the wall with dimension of (3000X3000X230) mm. This specifies the length width and height of the wall as well the property, specification and the graphical representation of the material.

The BIM platform centralized the information of a particular object and link it with and among the associated objects. The BIM platform provides cloud-based service with the addition service of time-lapse as well as quantification with clash

detection. Table I. Shows the efficiency of CAD and BIM in different phases of a particular project.

Table 1: Efficiency of CAD and BIM in different phases of a particular project

Sl. no	Task	CAD (Hours)	BIM (Hours)	Hours Saved	Time Savings
1	Schematic	190	90	100	53%
2	Design Development	436	220	216	50%
3	Construction Documents	1023	815	208	20%
4	Checking & Coordination	175	16	159	91%
	TOTAL	**1824**	**1141**	**683**	

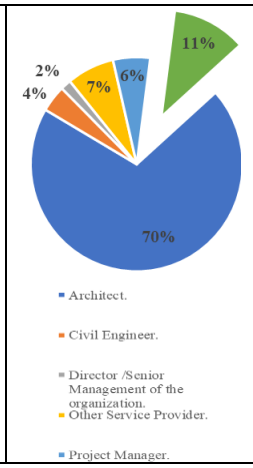
4. ANALYSIS OF RESPONSES

The questionnaire and survey were controlled and administered personally and distributed electronically and appropriately among the different BIM user in India. A list of students, companies and BIM skilled (taken from LinkedIn) was obtained and a total of 325 questionnaire distributed, a total of 132 response were received back making a response rate of 40.6%. The responses of 8 respondents were completely excluded. Out of which 3 have multiple responses, 2 have expressed that they have a low or very low understanding about BIM and 3 were students of first year of Bachelor of Technology (B.Tech)/Bachelor of Architecture (B.Arch).Thus a total of 124 responses were utilized which makes up the sample size stated above in equation (v) for the analysis of the questionnaire results.

4.1 Demographic profile

Table 2: Role in the industry

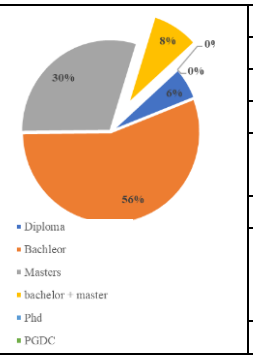
Role



Designation	Frequency
Architects	87
Civil Engineers	5
Director /Senior Management	2
Other Service Provider	9
Project Manager	7
Student /Intern	14
Total	124

Table 3: Educational Qualification

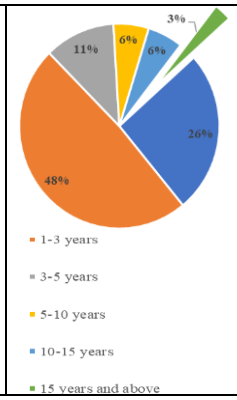
Educational Qualification



Qualification	Frequency
Diploma	7
Bachelors	69
Masters	37
Bachelors + Masters	11
Ph.D.	0
Post Graduate Diploma Courses	0
Total	124

Table 4: Work Experience

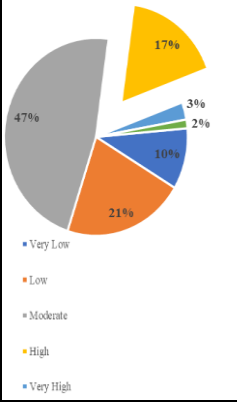
Work Experience



Years	Frequency
Fresher	32
1-3 Years	60
3-5 Years	14
5-10 Years	7
10-15 Years	7
15+ Years	4
Total	**124**

Table 5: BIM Awareness level

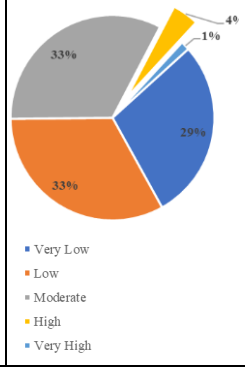
BIM Awareness level



Awareness Level	Frequency
Very Low	12
Low	27
Moderate	58
High	21
Very High	7
BIM coder	2
Total	**124**

Table 6: BIM Experience Level

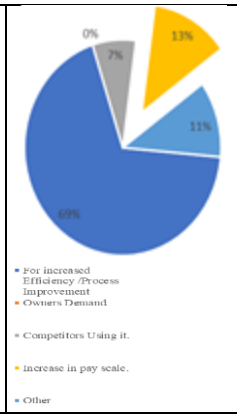
BIM Experience level



Experience Level	Frequency
Very Low	35
Low	41
Moderate	41
High	5
Very High	2
Total	**124**

Table 7. Cause for starting BIM

Cause for Starting BIM



Cause	Frequency
For increased Efficiency /Process Improvement	85
Owners Demand	0
Competitor Using it	9
Increase in pay scale	16
Other	14
Total	**124**

4.2 Growth drivers for BIM in Indian Construction Industry

Table 8: Growth Drivers for BIM in Indian Construction Industry with RII and Rank

Sl.no	Drivers	R.I.I	Rank
1	BIM Software availability and affordability.	**0.68**	**2**
2	Clients' interest in the use of BIM in their projects.	**0.56**	**7**
3	Availability of trained professionals to handle the tools.	**0.62**	**6**
4	Proof of cost savings by its adoption.	**0.79**	**1**
5	Cultural change among industry stakeholders.	**0.66**	**3**
6	Government support through legislation.	**0.53**	**8**
7	Collaborative Procurement methods.	**0.63**	**5**
8	Single person or company to support its back-end data and technical glitch. (One -point problem solving)	**0.65**	**4**

From the Table 8,we can conclude that , the most important drivers of the BIM in Indian construction industry is found out to be "the proof of cost saving by its adoption with Relative importance index (RII) of 0.79, then "BIM Software availability and affordability" with RII of 0.68, "Cultural change among industry stakeholders." with RII of 0.66, "Single person or company to support its back-end data and technical glitch. (One -point problem solving)" with RII of 0.65, "Collaborative Procurement methods." with RII of 0.63," Availability of trained professionals to handle the tools." with RII of 0.62, "Clients' interest in the use of BIM in their projects.' with RII of 0.56 and "Government support through legislation." with RII of 0.53 having the least need for the growth driver of BIM in India. This shows the respondents on the whole accentuated the issues of instruction and preparing, programming accessibility and empowering condition, with customers who have enthusiasm for the utilization of BIM on their activities as the most significant components that will help the selection of BIM innovation in India.

4.3 Challenges or Barriers in the adoption of BIM in Indian Construction Industry

Table 9: Challenges or Barriers in the adoption of BIM in Indian Construction Industry with RII and Rank

Sl.no	Barriers	RII	Rank
1	High-Cost of training /software.	0.69	3
2	Poor Internet Connectivity	0.58	10
3	Frequent Power Failure	0.53	12
4	Social and Habitual Resistance to Change	0.67	4
5	Legal and Contractual Constraints	0.57	11
6	Lack of Enabling Environment (Government policies and legislations)	0.62	7
7	Lack of Trained Professionals to handle the tools	0.70	2
8	Clients not requesting the use of BIM on projects	0.66	5
9	Lack of Standards to Guide Implementation	0.65	6
10	Lack of Awareness of the technology among industry stakeholders.	0.73	1
11	No proof of financial benefits	0.60	9
12	Lack of data (cloud) storage.	0.61	8

From Table 9 , we can conclude that "Lack of Awareness of the technology among industry stakeholders." is the most challenging task for the implementation of BIM in Indian Construction Industry with a RII of 0.73, followed by "Lack of Trained Professionals to handle the tools" with an RII of 0.70 and "High-Cost of training /software." with an RII of 0.69 ," Social and Habitual Resistance to Change" with an RII of 0.67 ," Clients not requesting the use of BIM on projects" with an RII of 0.66, "Lack of Standards to Guide Implementation" with an RII of 0.65," Lack of Enabling Environment (Government policies and legislation)" with an RII of 0.62," Lack of data (cloud) storage." with an RII of 0.61," No proof of financial benefits" with an RII of 0.60, "Poor Internet Connectivity" with an RII of 0.58 ," Legal and Contractual Constraints" with an RII of 0.57," Frequent Power Failure" with an RII of 0.53.

4.4 Reason for the adoption of BIM in India

In the questionnaire survey, the main reasons were listed and the respondents were asked for their consent on the 5 reasons for adopting BIM. They are as follows

- The adoption of BIM in architecture will increase societal value for Architects and Engineers.
- Adopting BIM workflow will lead to better architectural works.
- Adopting BIM leads to greater efficiency.
- 2D is inefficient to true BIM workflow in the working drawing phase than 2D CAD.
- BIM is too complex and should make it simpler.

Table 10: Reason for adoption of BIM with RII and Rank

	Consent	The adoption of BIM in architecture will increase societal value for Architects and Engineers	Adopting BIM workflow will lead to better architectural works.	Adopting BIM leads to greater efficiency.	2D is inefficient to true BIM workflow in the working drawing phase than 2D CAD.	BIM is too complex and should make it simpler.
1	Strongly Disagree	0%	2%	0%	0%	0%
2	Disagree	0%	0%	0%	0%	23%
3	Neutral	14%	16%	2%	39%	35%
4	Agree	56%	43%	48%	49%	34%
5	Strongly Agree	30%	39%	51%	12%	8%
Relative importance index (RII) and Rank						
RII		**0.76**	**0.82**	**0.88**	**0.68**	**0.65**
RANK		3	2	1	4	5

The results depicts that "Adopting BIM leads to greater efficiency." is the main reason for the adoption of BIM technology in India with RII of 0.88 as 51% strongly agreed ,48% agree and 2 % of the sample size is neutral about it which lead it to Rank 1."Adopting BIM workflow will lead to better architectural works." with RII of 0.82 as 39% strongly agree, 43 % agree and 16% is neutral which makes it at Rank 2. "The adoption of BIM in architecture will increase societal value for Architects and Engineers" with RII of 0.76 as 30% strongly agree, 56% agree and 14% is neutral which makes it at rank 3. "2D is inefficient to true BIM workflow in the working drawing

phase than 2D CAD." with RII of 0.68 as 12% strongly agree, 49% agree and 39% is neutral which makes it at Rank 4."BIM is too complex and should make it simpler." with RII of 0.65 as 8% strongly agree, 34 % agree, 35 % is neutral and 23% disagree which makes it at Rank 5

4.5 Interest in adoption of BIM in Indian Construction Industry

In the questionnaire survey, two questions were asked on the interest of the user or stakeholder for the adoption of BIM in near future in their firms, offices or project.

The Table 11, illustrates that the 79% of the sample size is interested in using BIM and 65% would like to adopt BIM for better pay scale in AECO industry.

Table 11: Interest in adoption of BIM in Indian Construction Industry with RII and Rank

		Interested in adopting BIM workflow	Adopting BIM in Architecture, Engineering, and Construction & Operation (AECO) field leads to better pay
1	No	0%	0%
2	Maybe	21%	35%
3	Yes	79%	65%
Relative importance index (RII) and Rank			
RII		**0.9**	**0.88**
Rank		1	2

5. CONCLUSION

The responses from the questionnaire survey help us achieve the perception of Indian Construction Industry on the growth drivers of BIM efficiency ,growth drivers ,challenges and barriers in the adoption of BIM, reason for adoption and interest in BIM .The relative importance index revels that the main factor for the growth of BIM are "Proof of cost savings by its adoption.(RII-0.79 and Rank 1) and BIM Software availability and affordability (RII – 0.68 and Rank 2) ", the potential challenges to be faced for BIM adoption in Indian Construction Industry are Lack of Awareness of the technology among industry stakeholders.(RII -0.73,Rank 1) and Lack of Trained Professionals to handle the tools (RII-0.70,Rank 2).The reason for adoption of BIM came out to be "Adopting BIM leads to greater efficiency(RII-0.88,Rank 1) and Adopting BIM workflow will lead to better architectural works (RII-0.82, Rank-2) and interest rate shows that 79% are interested in adopting the BIM workflow which will lead to their better pay scale.

The results not only focused on the factors but also state about the perception of BIM acceptance by the owners, architects, engineers, builders and other trade of Indian Construction Industry. The study investigates the BIM possibilities when utilized in the field to more readily convey and incorporate development data across various exchanges, taking into consideration proficient work forms & better choices.

6. FUTURE RECOMMENDATION

Within a reasonable time-frame almost certainly, an enormous extent of the development industry will be 'BIM mindful' and 'BIM skillful' rather than 'BIM expert'. The limit for ability right now is high also, and probably going to increment with time. It is foreseen that an incorporated plan procedure joined with productive commitment with partners will be the way to reasonable and sustainable design.

7. REFERENCES

[1] Aibinu, A. A., and Jagboro, G. O. (2002). The Effect of Construction Delays on Project Delivery in Nigerian Construction Industry. International Journal of Project Management, 20, 593-599.

[2] Ameh, O.J., and Osegbo, E.E. (2011) Study of relationship between time overrun and productivity on construction sites, International Journal of Construction Supply Chain Management 1 (1). Pp 56-67.

[3] Ayarici, Y., Khosrowshahi, F, Ponting, A.M, and Mihindu, S. (2009) Towards Implementation of Building Information Modelling in the Construction Industry. Fifth International Conference on Construction in the 21st Century.

[4] (CITC-V) "Collaboration and Integration in Engineering, Management and Technology" May 20-22, 2009, Istanbul, Turkey

[5] Azhar, S (2011). Building Information Modelling: Trends, Benefits, Risks and Challenges for the AEC Industry. Journal of Leadership and Management in Engineering. 2011/11. 241-252.

[6] Koc S. & Skaik S., ―Disputes Resolution: Can Bim Help Overcome Barriers?‖, Heriot Watt University, Dubai, 2014.

[7] Gibbs D. et al., ―BIM and construction contracts – CPC 2013's approach‖, Proceedings of the Institution of Civil Engineers, United Kingdom, 2015 .

[8] H. Yan and P. Demian. "Benefits and barriers of Building Information Modeling". 12th International Conference on Computing in Civil and Building Engineering, Beijing (2008).

[9] Khemlani, L. "Top Criteria for BIM Solutions", AECbytes, October issue [WWW document] URL http://www.aecbytes.com, November 22,2007).

[10] Holzer Dominic; Royal Melbourne Institute of Technology, "ARE YOU TALKING TO ME? WHY BIM ALONE IS NOT THE ANSWER", Association of Architecture Schools Australasia Conference 2007, URL http:// hdl.handle.net/2100/476, (October 5, 2007).

[11] Aguila, G., M., De Castro, E., Dotong, C., I., & Laguador, J., M. (2016). Employability of Computer Engineering Graduates from 2013 to 2015 in one Private Higher Education Institution in the Philippines. Asia Pacific Journal of Education, Arts and Sciences. Vol 3, 48-54.

[12] Ahmad Latiffi, A., Brahim, J., & Fathi, M., S. (2014). The Development of Building Information Modelling (BIM) Definition. Applied Mechanics and Materials, Vol 567, 625-630.

[13] Takim, R.,Harris, M. & Nawawi, A., H. (2013). Building Information Modeling (BIM): A new paradigm for quality of life within Architectural, Engineering and Construction (AEC) industry. Proceeding from: AMER International Conference on Quality of Life, 6-8 April 2013.

[14] Travaglini, A., Radujkovic, M., & Mancini, M. (2014). Building Information Modelling (BIM) and Project Management: a Stakeholders Perspective. An International Journal of Organization, Technology and Management in Construction, 1058-1065.

[15] Zahrizan, Z., Mohamed Ali, N., Haron, A., T., Marshall-Ponting, A., J., & Abd Hamid, Z. (2013).

Exploring the Adoption of Building Information. International Journal of Research in Engineering and Technology, Vol 02, 8, 384-395.

[16] Bañuelos Blanco, F., G., Chen, H. (2014). The Implementation of Building Information Modelling in the United Kingdom by the Transport Industry. Proceeding from: The 9th International Conference on Traffic & Transportation Studies (ICTTS'2014).

[17] Bryde, D., Broquetas, M., Volm, J., M. (2012). The project benefits of Building Information Modelling (BIM). International Journal of Project Management, 971–980.

[18] Cao, D., Wang, G., Li, H., Skitmore, M., Huang, T., Zhang, W. (2014). Practices and Effectiveness of Building Information Modelling in Construction Projects in China. Automation in Construction, 49, 113-122.

[19] CIDB, (2017). Construction Industry Review, Construction Industry Development Board Malaysia. Kuala Lumpur, Malaysia. Creswell, J. (2003). Research design: Qualitative, quantitative and mixed methods

[20] Davison, C., & Argyriou, E. (2016). Gender Preferences in Technology Adoption: An Empirical Investigation of Technology Trends in Higher Education. International Journal of Gender, Science and Technology, Vol 8, No 3.

[21] Doumbouya, L., Gao, G., Guan, C. (2016). Adoption of the Building Information Modeling (BIM) for Construction Project Effectiveness: The Review of BIM Benefits. American Journal of Civil Engineering and Architecture, Vol. 4, 3, 74-79. Available online at http://pubs.sciepub.com/ajcea/4/3/1

[22] Eastman, C., Teicholz, P., Sacks, R. & Liston, K. (2008). BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Constructions. 1st ed. New Jersey: John Wiley & Son Inc.

[23] Gerges, M., Austin, S., Mayouf M., Ahiakwo, O., Jaeger, M., Saad, A., & Gohary, T., E. (2017). An Investigation into the Implementation of Building Information Modelling in the Middle East. Journal of Information Technology in Construction, Vol 22, 1-15, http://www.itcon.org/2017/1.

[24] R. Sebastian, W. Haak, E. Vos, BIM application for integrated design and engineering in small-scale housing development: a pilot project in The Netherlands, International symposium IBW096 future trends in architectural management, 2009, pp. 2-3.

[25] S. Sepasgozara, S. Davisb, Modelling the Construction Technology Implementation Framework: An Empirical Study, America 30 (33) (2015) 63.

[26] M. Sexton, P. Barrett, Appropriate innovation in small construction firms, Construction Management and Economics 21 (6) (2003) 623-633.

BIBLIOGRAPHY

Nadim Akhtar
School of Planning and Architecture, Vijayawada, Andhra Pradesh

