

Building Information Modelling (Bim) Usage on Professionals Interface at Design Stage of Construction Projects in Lagos State, Nigeria.

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Abstract: The study was carried out to investigate the impact of BIM usage on professional's interface at design stage of construction projects in Lagos State, Nigeria. The study was conducted using structured questionnaire. The population engaged in the study were construction professionals who had utilised BIM at all levels to address interface problems at design stage of construction projects in Lagos State. Two hundred and sixty (260) copies of completed questionnaire were obtained using snowball sampling method for selection of respondents. Data were analysed using factor analysis and structural equation modelling. Findings revealed the impact of BIM usage on professional's interface at the design stage are; producing tools for reporting task completion, quality value and mistakes of the design team, automatic low-level of amendments whenever modification occurs in design, improve design quality, reduce the risk of errors in design documents, saves design time and cost, improve visualisation of design for better understanding, it gives room for interoperability, enhances earlier collaboration of different designs by means of integrated project delivery and less printing and distribution of drawings.

Keywords: BIM, Interface, Interface Issues, Construction Professionals, Design.

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I. INTRODUCTION

Building Information Modelling (BIM) is the formation of a digital parametric model that depicts the physical and purposeful description of a structure in complete detail and provides a sharing platform of knowledge which can be utilised to take dependable decisions during the planning, development process and even by client, throughout the lifecycle of structure (Holness, 2008; Eastman, Teicholz, Sacks and Liston, 2011). The idea of BIM is to develop a structure practically, before building it in a real sense, so as to work out problems, recreate and break down the potential effects (Smith and Tardif, 2009). BIM has improved the designs, production, and activity of a wide range of building projects across the globe, from the traditional means of building structures to the utmost exciting projects (Seaman, 2006). The usage of BIM in construction industry ensures design sustainability, enhanced collaboration between project stakeholders, quality of work is controlled and reduced risk (Cooperative Research Centre, 2007).

Shokri (2012) described interface as the point of meeting between partners, stakeholders, equipment, industry, systems, production elements and people. Interface take place when a project activity is separated into different numerous sub-project activities embraced by various firms. These interfaces can be soft (i.e., delicate) or hard, and external (outer) or internal (inner). Data substitutes between professional members e.g., plan

requirements, approval requirements, or utility requirements among construction teams or a delivery team and external members are illustrations of soft interface deliverables. Hard interface interoperated physical links between two or more elements or framework, for example, basic structural steel connections, pipe terminations, or link association. Interface problems occur as a result of inadequate integration among the architect, services engineers, civil engineers, and the contractors (Dim, Basili, and Okoro, 2015). Some of these interface issues are insufficient detailed plans, rework, trade clashes, design mistakes, part discrepancy, system performance flaws, coordination problems, construction conflicts, lack of teamwork, inadequate trust, and insufficient communication which may lead to low productivity, poor quality, waste, delays, poor relationship, claims, and cost overruns (Fu Chi, Yen-Chi, and Yu-Cheng, 2010; Sugumaran and Lavanya, 2013).

Project teams need to adjust their work procedures to the new collaborative and integrated methods of working that require BIM based software. Along these lines, BIM is accepted to be a fundamental device in construction industry, to handle, distribute as well as exchanging data among project participants (Arayici, Koskela, Coates, O'Reilly, Usher and Kagioglou, 2011). The optimisation of BIM provides collaborative platform to construction by integrating the numerous construction professionals to build a structure in a virtual and visual environment. BIM goes beyond making a relational database; this implies there is interconnection of all the designs in BIM that is, when there are alterations of objects in BIM device, all other concern spot and objects in the designs will be automatically updated. Take for instance, erasing a wall design on BIM software, the openings on that same wall will be erased automatically, and all information on project terms, cost, and programme will be immediately updated (Haron, Marshall-Ponting and Aouad, 2009). There is a need for BIM adoption due to design difficulty and modern technique of production process. BIM usage has become an imperative technology to lessen errors prone in project documentation and challenges faced by the Nigerian construction industry (NCI) (Olugboyega, 2016). Though, previous studies on BIM in Nigerian construction industry have not been able to utilize BIM to address interface problems (Toyin & Mewomo, 2022). In view of the foregoing, this study looked at the impact of BIM on professionals' interface in addressing interface challenges.

II. LITERATURE REVIEW

BIM Usage Among the Professionals in the Construction Industry

BIM improves professional members to play out their exercises in powerful and productive way over the advancement of three dimensional (3D) models. BIM needs adjustments in recent tradition among construction actors as far as the procedures and innovations for utilising projects management (Aryani, Juliana and Mohamad, 2015). BIM is portrayed as a novel innovation to enhance production firms through the usage of BIM equipment's (Ahmad, Brahim and Fathi, 2014). Many project members use BIM for several purposes which assist owners to have extra information and understanding on the projects' requirement (Eastman *et al.*, 2011; Azhar, Khalfan and Maqsood, 2012; Reddy, 2012; Bryde, Broquetas and Volm, 2013). BIM assists construction firms to deal with the construction exercise and arrangement by implementing four-dimensional (4D) model while Quantity surveyor (QS) utilises BIM to create exact project cost. Project manager utilises BIM for broad activities which includes operation management and facility maintenance (Azhar, 2011; Bryde *et al.*, 2013; Nagalingam, Jayasena and Ranadewa, 2013). To accomplish the BIM benefits, the actors in the industry required to be aware of the modification in recent exercise and the utilisation of data required in contracts using BIM. The improved way by which various professionals collaborate on a construction work are the major features, following BIM expansion usage in the firm (Bynum, Issa and Olbina, 2013). Reddy (2012) indicated that professional members utilises BIM to accomplish improved integration of contract data, production procedure development and to upgrade coordinated effort between them from the early period of project activities which is in accordance with the contention of Bynum *et al.* (2013) that expressed BIM as an innovation that upgrade the procedures of coordinated effort for architects, structural engineers and mechanical, electrical and plumbing professionals by permit various professionals to solve out similar model. In this manner, the usage of BIM unquestionably changed the jobs and obligations of parties' members (Gu and London, 2010; Porwal and Hewage, 2013). Surveys on the roles and obligations of professionals in construction developments utilising BIM recognises the exercises that should be led by them.

Interface Issues among Construction Professionals

Construction industries have experienced various interface that occurs among many constructors, clients, engineers, as well as material producers, and sub-contractors (Mortaheb, Rahimi, & Zardyneshad, 2010). Lack of teamwork, inadequate trust, and insufficient communication, result to poor relationship between the stakeholders in the projects. This type of relationship causes delaying in projects, challenges in settlement of entitlements, cost overruns, litigations, and compromising the quality of projects (Moore, Moskey and Slagle,

1992). In such conditions, professionals could manage to deal with them based on their own perception rather than the standards and therefore individual cannot be provided with a comprehensive picture of the interface issues. Therefore, these interface challenges required to be solved cautiously and promptly, mainly through appropriate harmonisation, collaboration, and communication among the project team members (Rong-Yau, Chien-Tien, Hung, & Wen-Hsiang, 2008). In production phase of building projects, team members of the project need to ensure cooperation, collaboration and effective communication, and coordination of work from the commencement of the contract work to the successful complete phase. These crews comprise of designers, clients, contractors, contractors, and also the maintenance contractors (Wang, 2000). Construction project activities are distinguishing by extreme multifaceted and non-standardisation of production, which are designed and carried out to satisfy clients' requirements.

BIM Usage on Construction Professionals at Design Stage

Customarily, the ways of communicating designs in construction projects were the working drawings, specifications and descriptions. Whenever there is a need for revised designs, the design teams will produce novel documents and convey them to construction site for operations. This leads to creation of on-site management of those plans and to ensure that each professional worker utilises the revised version of the drawings. With the use BIM software, reproduction of new drawings become obsolete, as professionals are accessible to every updated plan, descriptions and models on the BIM software (Fredrik, Vegard, Ola, Frode and Jardar, 2017). The advantages entailed in BIM utilisation as a coordinating instrument are: reliable data, enhancing good organisation, synchronisation, and project sequence, by giving every construction team member to have assess and questioned the contract data (Onungwa and Uduma-Olugu, 2017). BIM software usage is important to many construction professionals in project work. The architects produce drawings; provide building representations and simulation utilising numerous BIM working platforms while the engineers do their drawings with comfort and without any pressure. Furthermore, many BIM platforms served as a gathering point for several construction professionals in the firm to work together in the areas of drawings, structure procedures and approaches as a result of numerous interfaces that can aid good relationship among the construction professionals (Ayodeji, Funsho, Gbemisola, Kunle, Sakariyau, Eseohé and Hezekiah, 2017). BIM has resulted to many effective design developments in construction industry and enhances the communication and collaboration among various party members in the production of construction projects (Khanzode, Fischer and Reed, 2008). At the design phase, visualisation assist project designers to work in collaboration and interact about the drawing viewpoints more effectively as each of the party members shared similar view on 3D designs (Ayodeji *et al.*, 2017). A unified BIM model device improves teamwork, collaboration as well as communication processes among construction professionals at the early stage of design to efficiently offer a good-performing structure throughout the processes (Hungu, 2013). Haymaker, Ackermann and Fischer (2000) opined that collaboration is important for architectural designs, structural or civil, construction and mechanical engineering designs.

III. METHODOLOGY

The data required for the study were primary data and sourced using structured questionnaire. Two hundred and sixty (260) completed questionnaires were obtained through physical contacts and online administration. The first set of respondents for this study were selected through snowball sampling method. Respondents were asked if they knew professionals who had used BIM in construction projects. The questionnaire was designed to obtain data on the impact of BIM usage on professionals' interface at the design stage of construction projects. Data were analysed using frequency, percentages, factor analysis and structural equation modelling. Frequency and percentage were adopted to analyse respondents' profile such as nature of firm, professional background, position, years of experience and academic qualification while factor analysis and structural equation modelling were obtained to analyse the impact of BIM usage on professionals' interface at the design stage of construction projects. The model for the goodness of fit was determined by means of absolute fit, parsimonious and incremental fits. These indices and the recommended values are presented in Table 1.

Table 1: Goodness of Fit Indices for Structural Equation Modelling.

Goodness of fit measure	Recommended Value	Reference
<i>Absolute fit indices</i>		
Normed Chi Square (χ^2/df)	<5	Sahoo (2019)
Goodness of Fit Index (GFI)	>0.9	Hu and Bentler (1999)
Adjusted Goodness of Fit Index (AGFI)	>0.8	Hu and Bentler (1999)

Non-centrality-based indices

Comparative Fit Index (CFI)	>0.9	Sahoo (2019)
Root Mean Square Error of Approximation (RMSEA)	<1	Schermelleh-Engel, Moosbrugger, and Muller (2003)
Relative fit index		
Tucker-Lewis Index (TLI)	0<TLI<1	Schermelleh-Engel <i>et al.</i> (2003)
Normed Fit Index (NFI)	>0.8	Hu and Bentler (1999)

IV. DISCUSSION OF RESULTS

Demographic Characteristics of Respondents

The socio-demographic characteristics of respondents were analysed and the results are listed in Table 2. The characteristics analysed were professionals' nature of work undertaken by organisations, position occupied, working experience, academic qualification and professional qualification. The result of the nature of work undertaken by organisations showed that 26.5% of the respondents were in consultancy or design firms, 40.4% were general contractors, 23.5% were constructors; 1.2% were in non-governmental organisations and 8.5% were with the federal or state ministries. The result shows that the responses for the study were sourced from all relevant work categories. The result of the position occupied by respondents showed that 23.8% of the respondents were designers, 22.3% - supervisors, 24.6% - site engineers, 22.3% - project manager while other positions constituted 6.9%. The outcome of professionals' years of working experience revealed that 26.2% had 1-5 years working experience, 34.2% had 6-10 years, 23.8% had 11-15 years, and 13.1% had 16-20 working experience while 2.7% had over 20 years working experience. The outcome disclosed that professionals had adequate working experience required to supply the required data for the study. As regards the academic qualification of professionals, 36.2% holds HND degree, 40% were B.Sc. degree holder, 23.8% of the respondents had M.Sc. degree. The result of the respondents' profession indicated that 31.5% were Architects, 12.7% - Builders, 14.2% Quantity Surveyor, 21.5% Civil/Structural Engineers while 20% were Mechanical or Electrical Engineers. The results imply that the respondents were academically and professionally qualified to give the information required for this research.

Impact of BIM Usage on Professionals Interface at Stages of Construction

In order to determine the impact of BIM usage on professionals' interface at the stage, an exploratory factor analysis and structural equation modelling was employed to analyse problems related to design phase.

Table 2: Socio-Demographic Characteristics of Respondents

Nature of Work	Frequency (n)	Percentage (%)
Design/Consultancy	69	26.5
General Contractor	105	40.4
Constructor	61	23.5
Federal/State Ministry	22	8.4
NGO	3	1.2
Total	260	100.0
Position Occupied		
Designer	62	23.9
Supervisor	58	22.3
Site Engineer	64	24.6
Project Manager	58	22.3
Others	18	6.9
Total	260	100.0
Years of Experience		
1-5 years	68	26.2
6-10 years	89	34.2
11-15 years	62	23.8
16-20 years	34	13.1
Above 20 years	7	2.7
Total	260	100.0
Academic Qualification		
HND	94	36.2
B.Sc.	104	40.0
M.Sc.	62	23.8
Total	260	100.0
Professional Qualification		

Architect	82	31.5
Builder	33	12.8
Quantity Surveyor	37	14.2
Civil/Structural Engineer	56	21.5
Mechanical/Electrical Engineer	52	20.0
Total	260	100.0

Factor analysis of the impact of BIM usage on professionals' interface at design stage

To determine the impact of BIM usage on professionals' interface at the design stage, 20 variables were analysed using factor analysis to determine the major factors that will be used to determine the impact of BIM usage on professionals' interface at the design stage. A Kaiser-Meyer-Olkin of 0.876 showed that the study sample is adequate. The result of the Bartlett's Test of Sphericity ($\chi^2 = 1869.451$, $p = 0.000$) showed that the correlation of variables is not an identity matrix. The results of the communalities of impact of BIM usage on professionals' interface at the design stage are presented in Table 3. All communalities of variables were greater than 0.4 implying that the underlying factors are measured by the variables. Table 4 shows the extraction of the principal components. The components have eigen values which were not less than 1 and rotation sum of square loadings which fell between the range of 1.981 and 3.244. This shows that five factors could be extracted from the variables. The principal one accounted for 32.648% of the observed variance with eigen value of 3.244; component 2 accounted for 10.325% with eigen value 2.638; component 3 accounted for 6.431% with eigen value of 2.100; component 4 accounted for 5.426% with eigen value of 2.006 and component 5 accounted for 5.017% with eigen value of 1.981. Table 5 shows how the items in the components loaded after rotation. The rotated component matrix shows the factor loadings for each component. The factors in component-1 which include ID5, ID10, ID3, ID11 and ID12 were labelled Impact at the Design Stage 1 (IDS1), components-2 comprising ID14, ID15, ID20 and ID6 were labelled (IDS2), component-3 comprising ID8 and ID7 were labelled (IDS3), component-4 comprising ID18 and ID1 were labelled (IDS4) and component-5 comprising ID4 and ID9 were labelled (IDS 5) loaded above 0.50 which is adequate. Factors that loaded very strongly were highlighted in the table and selected as major impact of BIM usage on construction professionals' interface at the design stage. These factors have loadings of at least 0.700. These factors are: produce tools for reporting task completion, quality value and mistakes of the design team (ID5) (IDS1=0.836), automatic low-level of amendments whenever modification occurs in design (ID14) (IDS2=0.794), improve design quality (ID8) (IDS3=0.771), reduce the risk of errors in design documents (ID10) (IDS1=0.771), saves design time and cost (ID18) (IDS4=0.747), improve visualisation of design for better understanding (ID7) (IDS3=0.744), it gives room for interoperability (ID9) (IDS5=0.717), enhances earlier collaboration of different designs by means of integrated project delivery (ID1) (IDS4=0.707) and less printing and distribution of drawings (ID4) (IDS5=0.706). The result is similar to the studies of Eastman *et al.*, (2008); Tarmizi (2013) and Celanto (2017) which shows that there is early teamwork of many designs profession, automatic low-level of amendments once alterations are made to design, enhanced visualisation and documentation, reducing ambiguities and errors to designs. This shows that BIM usage have great prospects in addressing many of the interface challenges that is being encountered during traditional process of designs among construction professionals.

Impact of BIM usage on professionals' interface at design stage

Structural Equation Modelling (SEM) was further adopted to examine the impact of BIM usage on professional's interface at the design stage. The dependent variable includes major interface problems related to design in construction project stages among professionals. These were lack of project-stipulated data (C4), difficulty in detecting trade clashes at earliest design stage (C14), difficulty in obtaining complete project documents leading to late issuance of some designs (C11), design complexity (C9), poorly written contract (C15) and excessive amendments when changes occur in designs (C16). The independent variable were the major impact of BIM usage on professionals interface at the design stage which include: Produce tools for reporting task completion, quality value and mistakes of the design team (ID5), reduce the risk of errors in design documents (ID10), automatic low-level of amendments whenever modification occurs in design (ID14), improve design quality (ID8), improve visualisation of design for better understanding (ID7), saves design time and cost (ID18) and enhances earlier collaboration of different designs by means of integrated project delivery (ID1).

Table 3: Communalities of the Impact of BIM Usage on Professionals Interface at the Design Stage

Impact of BIM Usage at Design Stage	Code	Initial	Extraction
Enhances earlier collaboration of different designs by means of integrated project delivery	ID1	1.000	0.714
Eliminate long processes of exchanging papers and project documents among the	ID2	1.000	0.659

professionals			
Assist project participants in identifying design issues	ID3	1.000	0.547
Less printing and distribution of drawings	ID4	1.000	0.667
Produce tools for reporting task completion, quality value and mistakes of the design team	ID5	1.000	0.596
Allows integration of project members at the early stage of design	ID6	1.000	0.575
Improve visualisation of design for better understanding	ID7	1.000	0.642
Improve design quality	ID8	1.000	0.638
It gives room for interoperability	ID9	1.000	0.686
Reduce the risk of errors in design documents	ID10	1.000	0.705
Better coordination among trades and design team	ID11	1.000	0.442
Minimising late issuance of construction drawings	ID12	1.000	0.617
Eliminating project mismatch or internal contradictions in the content of project documents	ID13	1.000	0.582
Automatic low-level of amendments whenever modification occurs in design	ID14	1.000	0.448
Give room for proper storage of project designs or construction documents	ID15	1.000	0.686
Stress free and easy work output on design team.	ID16	1.000	0.723
Extraction of cost estimates during the design stage	ID17	1.000	0.580
Saves design time and cost	ID18	1.000	0.703
Helps in detecting collision between trades	ID19	1.000	0.373
Provide clearer design details and specifications	ID20	1.000	0.387

Table 4: Total Variance Explained of the Impact of BIM usage on professionals Interface at the Design Stage

Variance Explained									
Comp	Initial Eigen value			Extraction sum of square loadings			Rotation sums of squared loadings		
SN	Total	% of variance	Cumul. (%)	Total	% of variance	Cumul. (%)	Total variance	% of variance	Cumul. (%)
1	6.530	32.648	32.648	6.530	32.648	32.648	3.244	16.222	16.222
2	2.065	10.325	42.974	2.065	10.325	42.974	2.638	13.190	29.412
3	1.286	6.431	49.405	1.286	6.431	49.405	2.100	10.499	39.911
4	1.085	5.426	54.831	1.085	5.426	54.831	2.006	10.032	49.943
5	1.003	5.017	59.848	1.003	5.017	59.848	1.981	9.905	59.848
6	0.960	4.801	64.649						
7	0.829	4.143	68.792						
8	0.760	3.799	72.592						
9	0.700	3.498	76.090						
10	0.602	3.010	79.100						
11	0.566	2.831	81.931						
12	0.528	2.642	84.573						
13	0.514	2.571	87.143						

Table 4: Total Variance Explained of the Impact of BIM usage on professionals Interface at the Design Stage (continued)

Variance Explained									
Comp.	Initial Eigen value			Extraction sum of square loadings			Rotation sums of squared loadings		
SN	Total	% of variance	Cumul. (%)	Total	% of variance	Cumul. (%)	Total variance	% of variance	Cumul. (%)
1	0.463	2.317	89.461						
2	0.429	2.144	91.604						
3	0.407	2.033	93.638						
4	0.378	1.890	95.527						
5	0.327	1.634	97.162						
6	0.306	1.529	98.691						
7	0.262	1.309	100.000						

Table 5: Component Matrix of the Correlations between Components and Impact of BIM usage on professionals Interface at the Design Stage

IDS (1-5)					
Impact at Design Stage	1	2	3	4	5
ID5	0.836				
ID10	0.771				
ID3	0.617			0.356	
ID11	0.575				0.354
ID12	0.545	0.447	0.316		
ID13	0.494			0.397	
ID19	0.488				

ID14	0.794			0.380
ID15	0.654			
ID20	0.598		0.351	
ID6	0.515	0.506		
ID2	0.489	0.335		0.367
ID17	0.445		0.318	
ID16	0.350			
ID8		0.771		
ID7		0.744		
ID18			0.747	
ID1	0.335		0.707	
ID4				0.706
ID9				0.717

The results of the parameter estimate of the structural model in Table 6 shows that latent variables Design Interface Problems (DIP) and Impact of BIM usage at design stage (IDS) had significant relationship with their construct variables, for instance, lack of project-stipulated data (C4) and produce tools for reporting task completion, quality value and mistakes of the design team (ID5) had p values = 0.000. It further revealed that there was a direct positive relationship between major interface problems related to design in construction project stages among professionals and major impact of BIM usage on professional's interface at the design stage ($\beta = -0.180$, $p = 0.043$). This result implies that BIM usage by professionals had significant impact in reducing professionals' interface problems at the design phase. Based on the regression coefficient of the impact of BIM usage on professional's interface at the design stage, the model below was developed:

$$DIP = -0.180 IDS + 0.089$$

Where, the standardised regression coefficient (β) = -0.180, DIP = Design Interface problems, IDS = Impact of BIM usage on professionals' interface at the design stage and Standard error = 0.089. The result of the measurement model is depicted in Table 7. A chi-square/df ratio of 2.911 which is within the acceptable threshold of < 5.0 confirms that the overall fitness of the measurement equation model. The result of the Root Mean Square Error of Approximation (RMSEA) value of 0.086 is within the acceptable threshold of < 0.1 indicating a good fit. The results of the GFI value of 0.874 and AGFI value of 0.830 are within the acceptable limit of > 0.8 and ≥ 0.8 respectively. The result of the TLI index (0.684) was also within the acceptable limit of $0 < TLI < 1$. However, the result of CFI (0.732) was not within the acceptable range. This result is fairly acceptable since the CFI value tends towards +1 rather than zero (Fang, Thompson & Wang, 1999). The path diagram for the model is shown in figure 1

Table 6: Parameter Estimate for Structural Model of the Impact of BIM Usage on Professionals Interface at the Design Stage

Causal relationship			Maximum Likelihood Estimate	Standard Error	Critical Value	P
DIP	<---	IDS	-0.180	0.089	-2.020	0.043
C4	<---	DIP	1.000			
C14	<---	DIP	1.108	0.311	3.565	0.000**
C11	<---	DIP	1.352	0.344	3.929	0.000**
C9	<---	DIP	0.778	0.257	3.025	0.002
C15	<---	DIP	1.643	0.392	4.194	0.000**
ID7	<---	IDS	1.000			
ID8	<---	IDS	1.034	0.216	4.798	0.000**
ID14	<---	IDS	1.347	0.259	5.202	0.000**
ID10	<---	IDS	1.837	0.314	5.853	0.000**
ID5	<---	IDS	1.805	0.306	5.891	0.000**
ID18	<---	IDS	0.912	0.210	4.339	0.000**
ID1	<---	IDS	0.803	0.199	4.028	0.000**
ID4	<---	IDS	1.134	0.236	4.802	0.000**
ID9	<---	IDS	1.578	0.277	5.696	0.000**
C16	<---	DIP	2.084	0.481	4.328	0.000**

*Regression coefficient significant at $p < 0.05$

Table 7: Fit Indices of Impact of BIM Usage in Reducing Professionals' Interface Problems at the Design Stage.

Final Model	Df	χ^2	χ^2/df	RMSEA	GFI	CFI	TLI	AGFI
Default	89	2.911	259.038	0.086	0.874	0.732	0.684	0.830
Independent	105	7.045	739.675	0.153	0.655	0.000	0.000	0.606

Recommended Value	<5	<0.1	>0.8	>0.9	0<TLI<1	≥ 0.8
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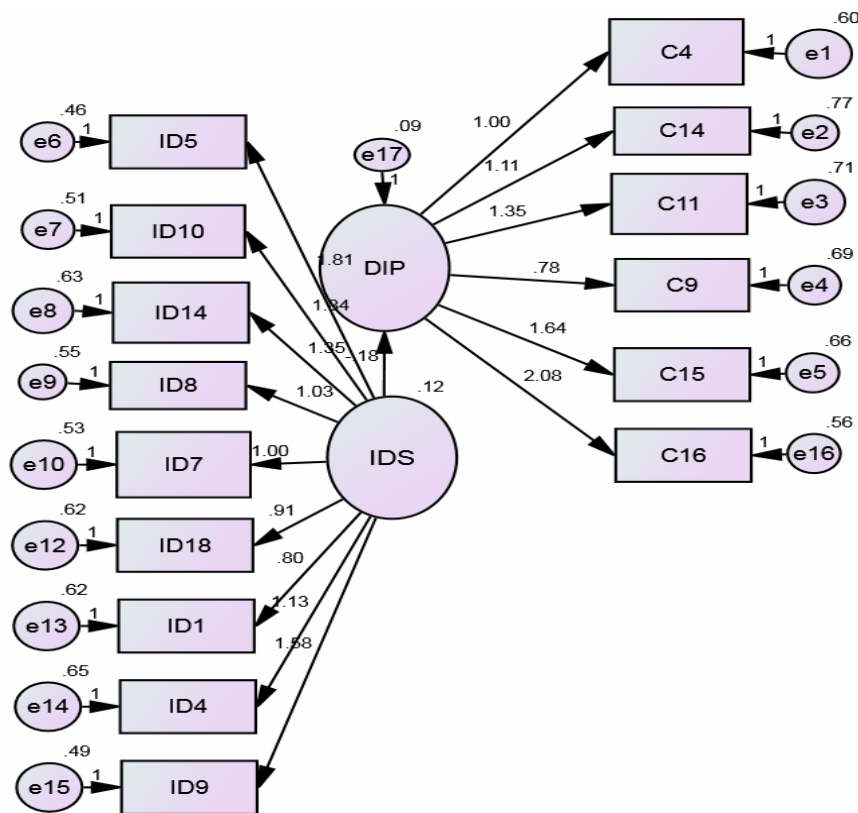


Figure 1: Path Diagram for the impact of BIM usage on professionals' interface at the design stage.

V. CONCLUSION

The study concluded that BIM offer tools that gives report on completion of work, control of quality and mistakes of the designers, automatic low-level of amendments whenever modification occurs in design, reduce the risk of errors in design documents and develop visualisation of design to give professionals a good comprehension of drawings. It also revealed that there is significant impact of BIM usage in addressing interface problems at design stage.

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