

# **“Building Information Modeling BIM as a Development tool for the Management of Construction Projects”**

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## **Abstract:**

Despite the tremendous development in the field of digital technology that produced the software and techniques influenced in the field of architecture and construction, and thus the production of architectural and urban, which is imperative that we keep up with this development, and employment and continuation of the same efficiency in all phases of the project will bridge the gap between design and implementation phase, and the most important of these techniques the use of Building Information Modeling (BIM), it is a Database, Not just 3D Drawings, it refers to a digital collection of software applications designed to facilitate coordination and project collaboration, BIM has the potential to provide more efficient operation, not only as part of design and construction but also in operations and maintenance. Accuracy is another main reason. BIM appears to offer greater accuracy than what our current practices produce. This paper aims to determine the benefits of integrating BIM technique in project management and recognize the role they play in The construction industry and practical feasibility of it compared to the previous systems, the practical study depended on two parts, the first by carrying out structured questionnaire survey from construction industry' experts. The second is a case study. The paper is concluded with some important results. It seeks to show that the BIM systems improve communication, collaboration, higher-quality project decision making, and more comprehensive planning and scheduling. In the end, we should see better quality, plus increases in productivity and profitability.

**Keywords:** BIM, Management, Construction project.

## **1. Introduction**

BIM is a representation of the information model, it is not like AutoCAD technique that can barely draw everything is done but uses a specialist in all phases of the project from design and implementation until the operation phase of the building. BIM is the current expression of digital innovation in the field of building and construction. The project team was able to be clear, fast and more accurate trading information than traditional methods, which is reflected positively on the progress of all phases of the project and provide a supportive model for the process of decision-making and thus avoid problems and minimize losses and save cost. It gives a clear picture of the project to encourage departments to participate and avoid any conflicts, allowing early to find solutions before starting the implementation of the project. This paper aims to determine the benefits of integrating BIM technique in project management and recognize the role they play in The construction industry and practical feasibility of it compared to the previous systems, the practical study depended on two parts, the first by carrying out structured questionnaire survey from construction industry' experts. The second is a case study. The paper is concluded with some important results.

## **2. Research Objectives**

The main problem which faces the construction projects is not about the building or the management, it is about information. The paper seeks to study the effect of implementing Building Information Modeling BIM on the mitigation of construction project management during all phases of the project. The study was

depended on a designed survey via emails and face to face interviews. This survey represents two parties. The first one is about implementing BIM in the construction industry. The second one investigates BIM as a management tool (Implementation, Cost of applying, benefits, and effects on project risks). Besides, one case study was investigated with and Without BIM.

### 3. Literature Review

This paper reviews a series of studies that dealt with in context the benefits of using BIM in construction projects, (Rana Mamdouh Hosney, 2016) characterized Conclusions concerned with benefits of using BIM in construction industry These benefits include, Increases safety management of the project, Ensures cost and time control for the project, Improves risk management, Facilitates value engineering process and application, Introduces clash detection process for the project activities to check the coordination between project systems (civil, architectural, electromechanical, HVAC, telecommunication, firefighting systems, and others), Improves and accelerates cost estimation for the project and makes it more accurate, Helps in resource allocation and making storage plan (procurement plan) for projects, Provides visual representation of project model, Helps in energy saving, understanding project different plans (execution plan, logistic plan, safety plan, etc.), applying sustainability features for the project, (William Michael Duke, 2013) examined that BIM benefits usually result in decreased cost, decreased time, increased quality, or a combination of the three. The main benefit BIM offers any project is increased collaboration. By using BIM, project teams can more effectively communicate with one another and create innovative and optimized solutions. While creativity is encouraged in construction, (Kiavash Parvan, 2012) proposed a model has the potentials to include other project factors such as project size, construction type. He examined that among all parties who are involved in the design process; architects are exploiting BIM more than the others. The MEP design also is shifting fully to BIM. (Hammad,

Rishi, and Yahaya, 2012) researched how to mitigating construction project risk using Building Information Modeling (BIM). Mitigating risk in construction projects has been considered as an important attempt to achieve the project's objective in terms of time, cost, quality, safety, and sustainability. (Darrell Ernest Thompson, 2012) researched quality with BIM in Texas. The findings regarding the Quality BIM revealed 40% were not engaging in the use of the Quality BIM at all and 60% were suggesting the use or familiarity of the Quality BIM ranging from some use\awareness moderate use\awareness, and extreme use\awareness. However, those truly engaged in utilizing Quality BIM accounted for 22.1% while the remaining 87.9% were not fully engaged in the use of Quality BIM. (Kamal Shawky, 2012) always say, two software's are essential and are the most important two-dimension software in the world, and it operates its style and technology. The Revit is the most important software in the modern era that uses BIM technology, so the user should have sufficient knowledge of both software, beginner AutoCAD and advanced Revit. Therefore, I do not encourage leaving AutoCAD completely and move on to Revit, but instead develop our knowledge, experience, and proficiency by learning Revit along with AutoCAD, when the world dispenses AutoCAD completely, at that time I will tell you to forget AutoCAD.

### 4. Research Methodology

The reason for this paper is to show the returned benefits and constraints of using BIM in the construction industry. The methodology used for this research approach depends on a detailed literature review; a field survey. The questionnaire covers how to deal with the implementation of building information modeling BIM in construction projects with viewing charts to view the percentage of implementation of BIM in Egypt. Then, the case study to cover the role of Building Information Modeling BIM in dealing with the project management and provide 4-Dimensions and 5-Dimensions models to view the difference in

time and cost with and without using BIM. at the end the paper discusses the Conclusion.

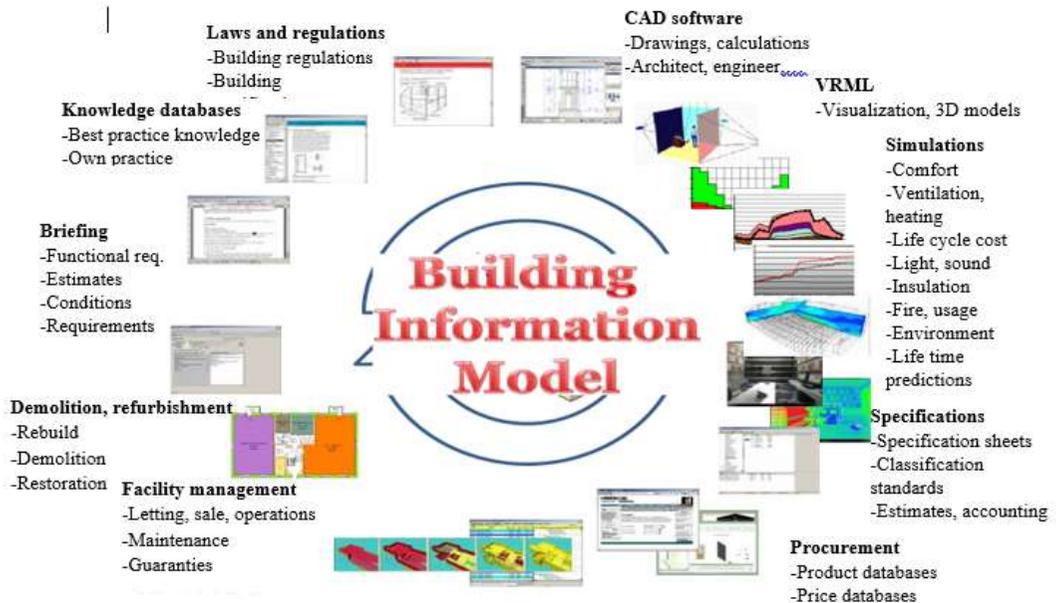


fig. 1 Large scale BIM lifecycle information view.

## 5. Questionnaire Survey

### 5.1. Survey Population Selection and Sample Size Calculation

The sample is of a limited extent that goes about as a representation of the absolute focus on the population. The focus of this research is to examine how incorporated organizations' classes 1&2 as indicated by the Egyptian Federation of Construction and Building Contractors consider the use of BIM.

#### Equation 1 – Cochran Formula

$$N = (P * Q * Z^2) / C^2$$

Where: N = the first estimate of sample size, Z = 1.96 for 95% confidence level, P = 0.5% selecting a choice, C = 0.09 margin of error 9%, Q = 1-p

#### Equation 2 – Solv in's Formula

$$N_0 = N / ((1+N(C^2)))$$

Where: N = Total population

According to The Egyptian Federation of Construction and Building Contractors which

located in Nasr City in Cairo. The number of building contractor category 1 is 218 contractor companies, the number of building contractor category 2 is 187 contractor companies and the number of building contractor category 3 is 286 contractor companies.

A survey is developed for category 1 and category 2 from the building contractors so,

$$N = 218 + 187 = 405 \text{ contractor companies.}$$

$NO = 405 / ((1+405(0.09)^2)) = 94.615$  contractor companies.

Take sample size of 95 contractor companies.

100 companies are selected as a sample.

There were 130 copies of questionnaires distributed to the potential respondents in the organizations within the construction industry. Different ways used to distribute questionnaires: (Delivered for the number of companies directly through a meeting with their engineers- Delivered to different companies by

email. Questionnaire was created in a survey website to be easier to reach different companies-a copy of the survey and its link was

put in public media outlets like groups for BIM engineers at different pages to collect random responses of the 130 questionnaires, 100 copies (70 percent) returned and there were 86 copies (86 percent) from the contractor and 14 copies (14 percent) from consultants. The collected questionnaires were reviewed and analyzed by the SPSS (Statistical Package for Social Sciences) program.

Cronbach's  $\alpha$  coefficient. This technique is utilized to gauge the unwavering quality of the poll between each segment and the mean of the considerable number of classifications of the survey. The ordinary scope of Cronbach's  $\alpha$  coefficient is somewhere in the range of 0.0 and +1.0, and the higher qualities mirror a higher level of interior consistency. The general dependability of all gatherings approaches 0.897. This range is viewed as high, and more noteworthy than 0.70. Along these lines, the unwavering quality of the survey is guaranteed.

#### Reliability Statistics

Cronbach's Alpha	N of Items
.897	100

### 5.2. Results and Data Analysis

#### 5.2.1. Does Your Company Currently Implement BIM?

As seen Fig. 2, 75% of the total respondents did not implement BIM in their companies, 23% of the total respondents implemented BIM in their companies and 2% of the total respondents will implement BIM soon. That means that 77% of all respondents did not use BIM yet.

The companies which apply BIM in Egypt are (Orascom Construction-IBIMS(Integrated BIM Services)-CCC Consolidated Contractors International Company-Dar Al-Handasah-Talent Engineering Company Egypt-SIAC Construction-EHAF Consulting Engineers-Hassan Allam Holding-The Arab Contractors(Alex branch)-Rowed Modern Engineering-REDCON Construction-Dorsch International Consultant-Arabian International Company AIC-Gama Construction-DMG Dar Al Mimar Group-Zuhair Fayez Partnership-Al-Marasem International For Development-

Khatib&Alami-UECC United Engineering Construction Company-Saudi Diyar Consulting-ECG Engineering Consulting Group-Petrojet-ENPI).

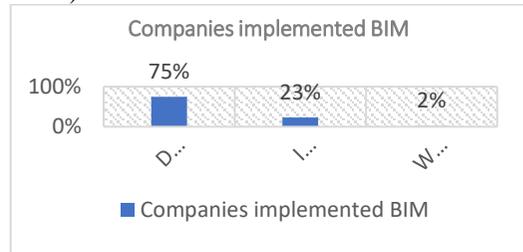


Fig. 2- Implementation of BIM

#### 5.2.2. The effect of the implementation of BIM on preparation of tender and contract documents:

As seen in Fig. 3, 12% of the total respondents say that the implementation of BIM had medium effect on preparation of tender and contract documents which represent 52% from who implemented BIM, 8% of the total respondents say that the implementation of BIM had a low effect on preparation of tender and contract documents which represent 35% from who implemented BIM and only 3% of the total respondents say that the implementation of BIM had a high effect on preparation of tender and contract documents which represent 13% from who implemented BIM. That means that more than 50% of the companies which implemented BIM suggested that the effect of BIM system on the preparation of tender and contract documents is medium and the remaining of those who implemented BIM suggest BIM had no effect on the preparation of tender and contract documents.

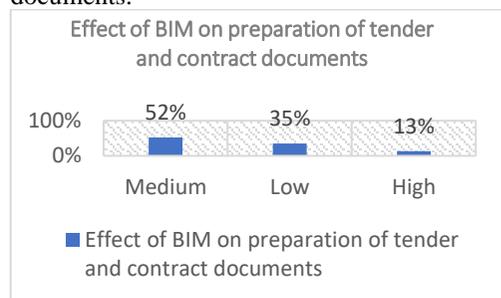
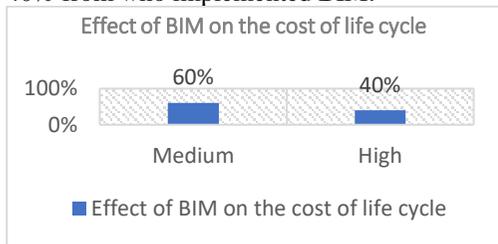


Fig. 3- BIM and preparation of tender and contract documents.

**5.2.3. The effect of the implementation of BIM on the cost of the lifecycle:**

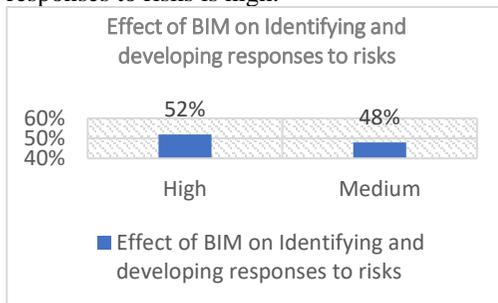
As seen in Fig. 4, 14% of the total respondents said that the implementation of BIM had a medium effect on the project lifecycle costing which represents 60% from who implemented BIM and 9% of the total respondents said that the implementation of BIM had a high effect on the project lifecycle costing which represent 40% from who implemented BIM.



**Fig. 4- BIM and project lifecycle costing**

**5.2.4. The effect of the implementation of BIM on identifying and developing responses to risks:**

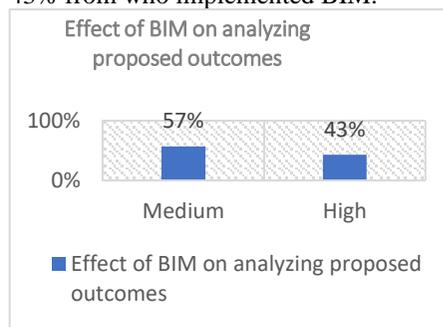
As seen in Fig. 5, 12% of the total respondents said that the implementation of BIM had a high effect on identifying and developing responses to risks which represent 52% from who implemented BIM and 11% of the total respondents said that the implementation of BIM had a medium effect on identifying and developing responses to risks which represent 48% from who implemented BIM. That means that approximately 50% of the companies which implemented BIM suggested that the effect of the BIM system on identifying and developing responses to risks is high.



**Fig. 5- BIM and identifying and developing responses to risks**

**5.2.5. The effect of the implementation of BIM on analyzing proposed outcomes:**

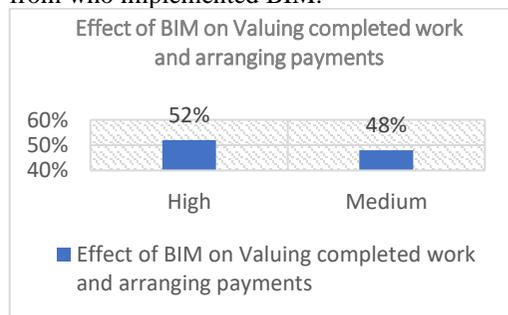
As seen in Fig.6, 13% of the total respondents said that the implementation of BIM had a medium effect on analyzing proposed outcomes which represent 57% from who implemented BIM and 10% of the total respondents said that the implementation of BIM had a high effect on analyzing proposed outcomes which represent 43% from who implemented BIM.



**Fig. 6- BIM and analyzing proposed outcomes**

**5.2.6. The effect of the implementation of BIM on valuing completed work and arranging payments:**

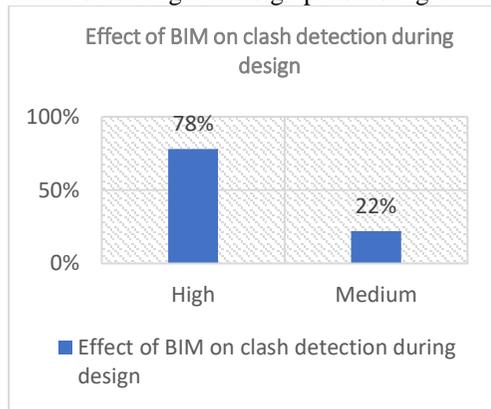
As seen in Fig. 7, 12% of the total respondents said that the implementation of BIM had a high effect on valuing completed work and arranging payments which represent 52% from who implemented BIM and 11% of the total respondents said that the implementation of BIM had a medium effect on valuing completed work and arranging payments which represent 48% from who implemented BIM.



**Fig. 7- BIM and valuing completed work and arranging payments**

**5.2.7. The effect of the implementation of BIM on clash detection during the design phase:**

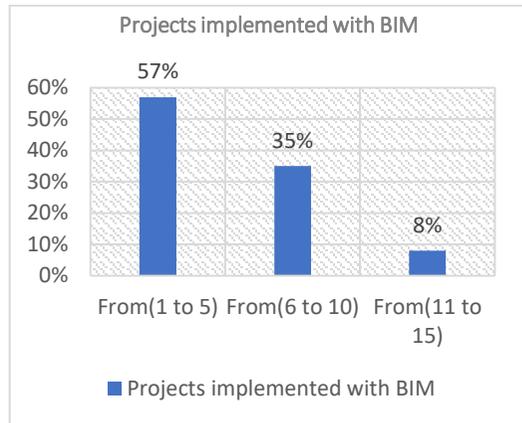
As seen in Fig. 8, 18% of the total respondents said that the implementation of BIM had high effect on clash detection during the design phase which represents 78% from who implemented BIM and 5% of the total respondents said that the implementation of BIM had a medium effect on clash detection during the design phase which represents 22% from who implemented BIM. That means that approximately 78% of the companies which implemented BIM suggested that the effect of the BIM system on clash detection during the design phase is high.



**Fig. 8- BIM and clash detection during the design phase**

**5.2.8. Projects implemented BIM in them:**

As seen in Fig. 9, 13% of the total respondents implemented from (1 to 5) projects with BIM which represent 57% from who implemented BIM, 8% of the total respondents implemented from (6 to 10) projects with BIM which represent 35% from who implemented BIM and 2% of the total respondents implemented from (11 to 15) projects with BIM which represent 8% from who implemented BIM.



**Fig. 9- Projects you implemented BIM**

**6. Model Verification**

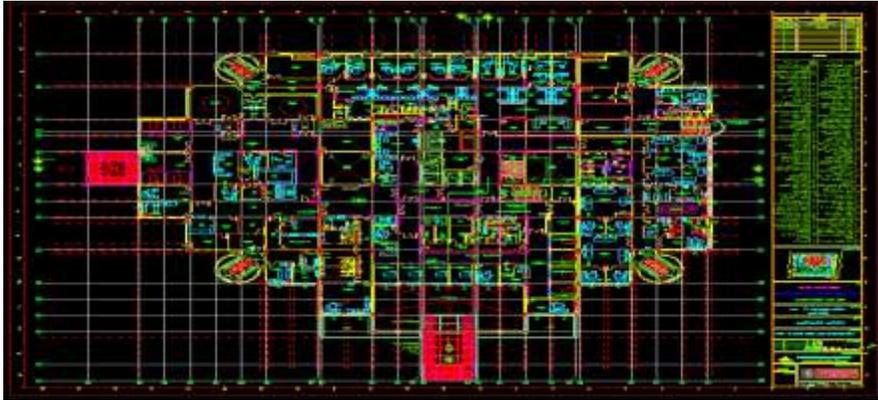
This paper included one case study explained in detail. The following case study displays the difference between executed the project with the traditional method and with applying BIM technology on it and showed the effect of applying BIM to controlling risk in construction projects especially in the design phase. Case study el-sheik Zaid Al Nahyan Nasr road Hospital.

A case study is presented in a hospital located in Egypt is considered for this purpose. The hospital has a capacity of 150 beds with a total area of 27500 square meters. The main hospital building is a basement, a ground floor, and five floors, with a floor area of 2000 square meters, in addition to the service buildings. It is a cylinder store, the ground reservoir, the pump room, Boilers, medical gases, fences, and

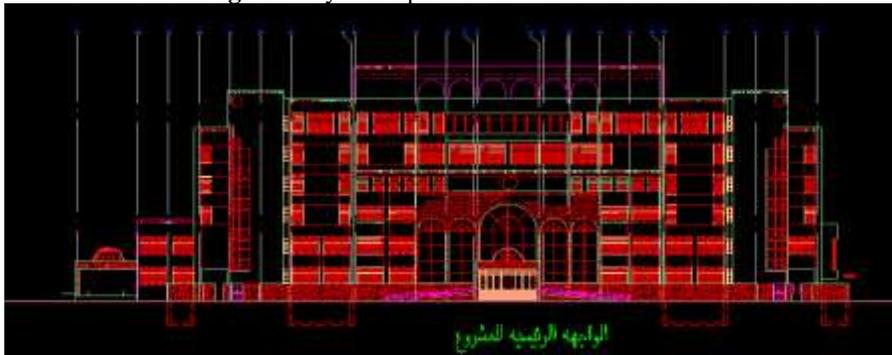
general site coordination. The hospital cost approximately = 118,000,000EGP.

**6.1. 2D Model from AutoCAD (Traditional Way)**

In the traditional way, the plans showed by AutoCAD programs it is a 2-dimensional model



**Fig. 10-** Zayed hospital Arch. First - floor slab



**Fig. 11-** El Sheikh Zayed 2-Dimensional model elevation from AutoCad

3D model from Revit (BIM)

In BIM technology the plans showed by Revit program in 3-D models. It's very clear and easy to be clear for all the stakeholders.



**Fig. 12-** El Sheikh Zayed Hospital 3D models from Revit

From 3D model extract details for the construction component shown in figures below.



**Fig. 13-** El Sheikh Zayed Hospital 3D section from Revit

From the received 3D model, the contractor starts to extract some needed data about each element of the project. Such as, bill of quantities, schedules and shop drawings data will be available in the model and can be extracted quickly. so, these data are collected in a table extracted from the BIM model.

- Different sorts of conflict may include the booking of contractual workers, the conveyance of hardware and materials, and the general course of events clashes. These are frequently alluded to as 'Work process or 4D conflicts'.

## 6.2. Clash Zone at Design Phase The 3D model most benefit is Clash Detection such as:

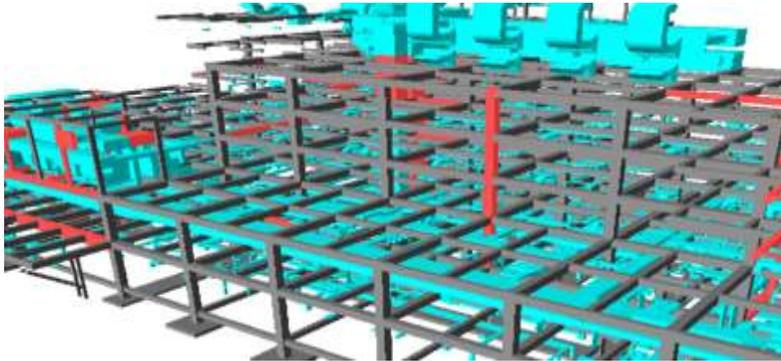
- Eliminate defects and conflicts during design and modeling.
- Eliminate defects and conflicts during the overlap between systems of the project like (civil, architect, electrical, mechanical, etc.).
- Reduce cost and time consumed in correcting the defects appeared in the construction phase and instead correct it early in the design phase.
- Increase the overall productivity of the project.
- Have a trusted one model for the project to transfer it to the parties of the project, (Bloomberg, (2012)).
- Fire Protection Systems vs. Electronics Systems, (Bloomberg, (2012), Campbell, D.A., (2007).

### 6.2.1. Clash zone and Clash detection:

According to the poor communications between the stakeholders, there are a lot of clashes happened between their works like the clash shown in figure 14, 15 and figure 16 showed how to resolve it.



**Fig. 14-** Hospital BIM modeling-MEP



**Fig. 15-**3D model for the hospital MEP system



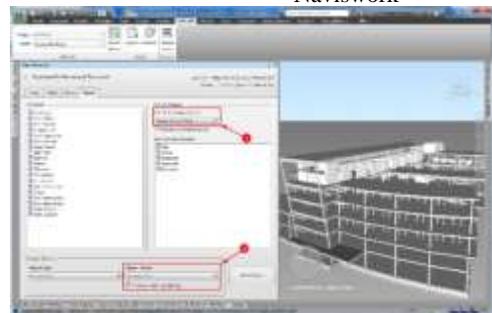
**Fig. 16-** Zayed hospital MEP modeling plan

### 6.2.2. Clash detection steps:

- Import 3D Revit files into Naviswork.
- Press the Clash Detective tool to test conflict performing in Naviswork programming
- Snap-on the 'Select' tab that is situated inside a conflict analyst device in Naviswork programming as observed in fig.17.
- Autodesk Naviswork consequently gives status to each conflict for sometimes later. So, after that the Clash Detective apparatus that continues refreshing the status of the conflicts after they are distinguished and is recorded inside the Results tab as observed in fig.18.



**Fig.17.** Clash report generated by Naviswork



**Fig.18.**Clash Detective showing the results

### 6.3. 4D BIM model with Navies work program (Time schedule)

The 4D model is the combination of the 3D model and the schedule of the project.

Achieved benefits from combining of 3D model and time in El Sheikh Zayed Hospital Project:

- Coordinated timelines of construction operation between all systems.
- What-If-Scenarios/hosting of alternatives.
- Availability of materials of each activity before the start date.

Developing a time schedule model with the Navies work program by connecting with the Revit model that model is more accurate and solves a lot of problems.

The following images show the steps of some weeks of the project in details and showing the overlap of the works that happen at the same time in the different zone in the project. Daily activities taking place during the project is reflected as shown below with previews of works done in the project.

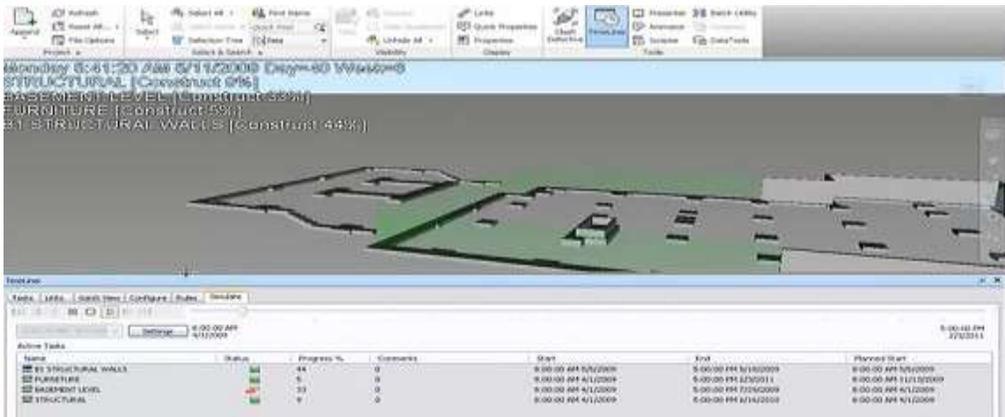


Fig.19. Day 30 in week 8 → .

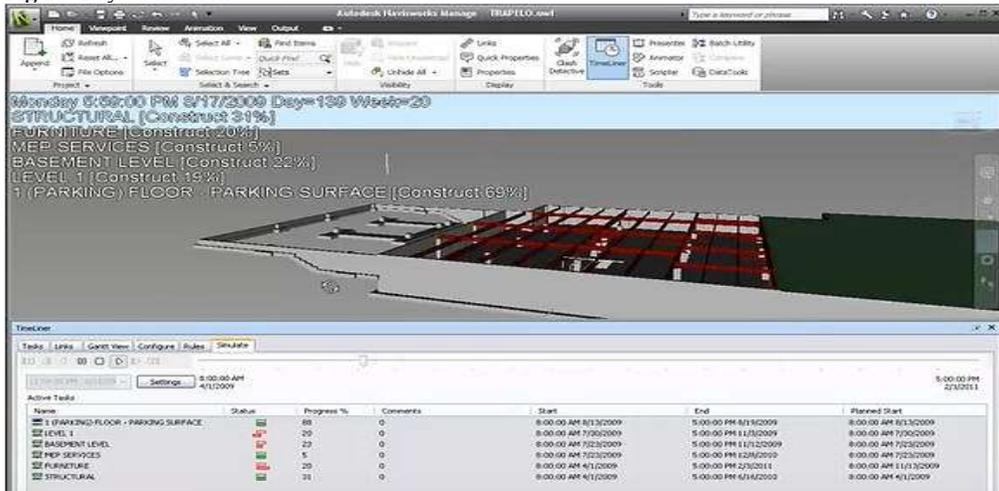


Fig.20. Day 139 in week 20 → excavation (38% stage 2 & 2% stage 4).  
 →construction(88% Columns standalone Z1 ).  
 →construction (90% first slab type z zone 1)&(41% second slab)  
 →construction (82% first wall type z zone 1)&(55% roof slab

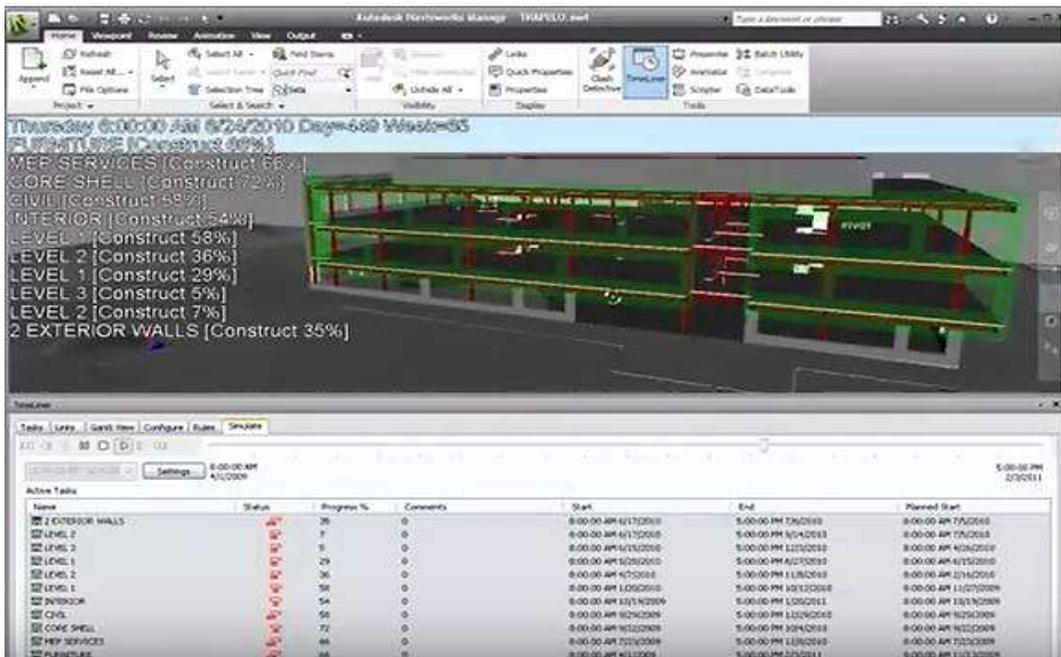


Fig.21. Day 689 in week 55 → excavation (38% stage 2 & 2% stage 4).

→construction(88% Columns standalone Z1 ).

→construction (90% first slab type z zone 1)&(41% second slab)

→construction (82% first wall type z zone 1)&(55% roof slab

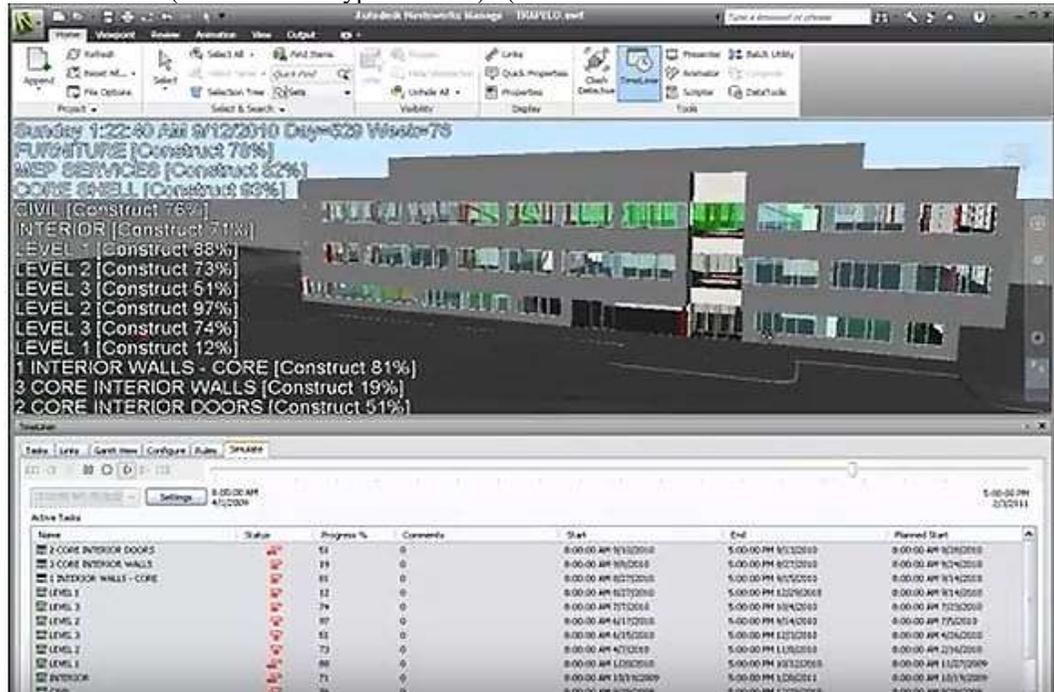


Fig.22. Day 539 in week 78→construction (100%)

The BIM 4-dimensional model shows every day in the project life cycle and the percentage done in every activity every day.

The 4D model shows that the construction of all units without finishing took 114 weeks approximately 2 years and the finishing for all types took 21 weeks

#### 6.4. Bill of Quantities (BOQ)

The traditional method calculated of the Bill of Quantities (BOQ) shown in Table 1 and defining alternatives on the application and exported quantities from Revit files.

PROJECT : KATAMIA EXTENSION - PK2					
BUILDING : FACILITY BUILDING					
ITEM No	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT
1	<b>DIVISION 4- MASONRY WORK</b>				
Notes:					
Prices of block works shall include supply of hollow clay block or solid cement blocks from good and approved factory in perfect dimension and build it in good manner , cement sand mortar ( 1:3 ), concrete fill (BS8) between columns & block walls (15 cm wide ), compressive strength 35kg/cm2, works shall include all materials, testing, scaffolds, placing of approval blocks, work man slip, all ducts, sleeves, opening areas, fiber board , protection concrete (R-010) around sleeves and pipes (for electrical, sanitary & mechanical), tools and any others else needed, all according to drawings , specifications, conditions and directed instructions by the Engineer or his representative.					
1.1	Supply and build hollow clay block 25cm thickness with dimension 28x12x10 cm				
1.1.1	For Basement floor	M3	33		
1.1.2	For Ground floor	M3	46		
1.1.3	For First Floor	M3	38		
1.1.4	For Second Floor	M3	34		
1.1.5	For Prefhouse & roof	M3	24		

**Table.1.**Case study BOQ by traditional method

#### Risk analysis summary report

ID	Risk Identification	Cost impact (L.E)	Delay(date) (Day)	BIM model effect
	<b>Revolution</b>	99,150,000	-418	No effect
	<b>Site Condition</b>			
	The delay in starting the project is a wrong result in the determination of the soil and the presence of rocks and the work of 3000 pumps, which led to breaking some drainage pipes	9,000,000	-180	No effect
	Poor communication and coordination			

Activities classifications

$$\text{Duration Index (DI)} = \frac{\text{Actual Duration}}{\text{Original Planned Duration}}$$

$$\text{Duration Index (DI) for the project} = \frac{\text{Actual Duration}}{\text{Original Planned Duration}} = \frac{1890}{1095} = 1.726$$

$$\text{Cost Impact \%} = \frac{(\text{New cost} - \text{Previous cost})}{\text{Previous cost}}$$

$$\text{New cost} = (242,000,000 + 118,000,000) = 360,000,000 \text{ EG.P}$$

$$\text{Cost Impact \%} = \frac{(360,000,000 - 242,000,000)}{242,000,000} * 100 = 48.76\%$$

According to the contract: The amount of liquidated damages for delay in completion of sections is calculated as the following:

- 1- (EGP 24,200 per day shall be applied for each day of delay up to ten days).
- 2- (EGP 36,300 per day shall be applied for each day of delay after ten days up to 20 days).
- 3- (EGP 48,400 per day shall be applied for each day of delay after 20 days).
- 4- Liquidated damages not to exceed 10% of the contract price.

The main cause of delay for AL Nahyan Hospital is the Revolution in Egypt on 25 January 2011 and this problem no one can expect or avoid it and because of that, the Cost Impact is very high and not acceptable. The total delayed date is 795 day but only 90 days can be affected by implemented BIM technology.

1	A clash between Air conditioning and windows and doors of the architect	605,000(10*24,200+10*36,300)	-20	3D
2	A clash between drainage pipes and beams	968,000(20*48,400)	-20	3D
3	Lack of shop drawings	484,000(10*48,400)	-10	3D
4	Lack in receiving BOQ	387,200(8*48,400)	-8	3D
Delay due to late in delivery				
5	Delay in supplies	3,000,000	60	No effect
Changing orders				
6	Change the walls of the radiology rooms from ordinary walls to lead walls	726,000(15*48,400)	-15	3D&5D
7	The Ministry of Health during the completion of the ground floor said the list has changed and must move outpatient clinics from the ground floor to the first floor	532,400(11*48,400)	-11	3D&5D
Delay due to errors				
	Brickwork to roof level	290,400(6*48,400)	-6	4D
<b>Total (without BIM)</b>		<b>118,000,000</b>	<b>-795</b>	
<b>Total (with BIM)</b>		<b>114,007,000</b>	<b>-705</b>	
<b>BIM Saved</b>		<b>3,993,000</b>	<b>90</b>	

**Table 2.** Risk summary report

The difference between the traditional method and applied BIM technology achieved from the result of Implemented BIM in the case study

	Traditional method	BIM
Programs	AutoCAD 2D Primavera	Revit Naviswork
Data	Not accurate	Extract more accurate data
Drawings	Traditional drawings	Enhancing the coordination and integration between the drawings
Cost Estimate	Take long time	More accurate
Stakeholders	Difficult to connect	Enhancing the collaboration between the stakeholders
BOQ	Take long time and not accurate	Fast and more accurate
Clashes	Not detected	detected
Cost overrun	More cost	Save cost
Time overrun	more time	Save time

**Table 3.** Comparison between traditional method and BIM

## 7. Discussion

### 7.1. The Questionnaire Results Discussions

The questionnaire consisted of 2 parts (questions for engineers used BIM-questions for engineers didn't use BIM) and the most important result from it is as follow:

- Approximately 50% of the total respondents did not have a team management that faces the projects in their companies.
- Approximately 67% of the total respondents dealt with problems which face the project during the project periodically in their companies.
- Approximately 77% of the total respondents did not use BIM in their companies.
- Approximately 9% of the total respondents said that most important benefit of using BIM in their projects is cost-saving and quality control, 8% of the total respondents said that most important benefit of using BIM in their projects is quality control, saving time, saving money, and achieving safety (all of them), 6% of the total respondents said that most important benefit of using BIM in their projects is quality control.

From analyzing the data, the following discussion is obtained on checking whether the results are expected or unexpected, comparing these results to the previous work

### 7.2. The Case Study Results Discussions

- The results of the case study discuss the difference between the traditional methods and applying Building Information modeling BIM at the construction projects in all stages. As shown in the table below. The spread of BIM in Egypt is still limited and has many restrictions. Some big companies only implemented BIM such as EHAF, Palm Hills and ECG. In the 3-Dimensional model clash detection is the most

benefit of used BIM that controlled cost and time. In the 4-Dimensional model the rework and any change in time schedule applied so easy to the model.

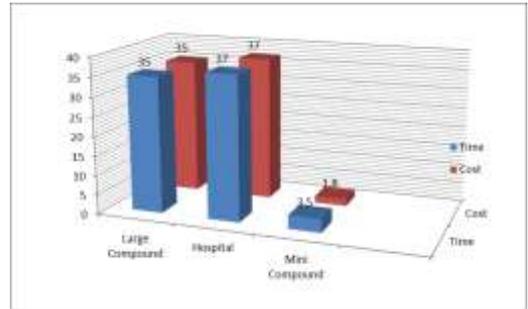
- Control the Poor communication and coordination
  - Clashes between Sanitary and electrical in facility building at twelve positions, everyone takes one day to defect.
  - Clash between Structure and MEP in facility building.
  - Lack of shop drawings.
- Control the Delay due to design error.
  - Wrong in calculating column initial duration.
  - Lack of slabs due to the columns lack.
- Control changing material type.
  - Change order from the traditional to FRP.
  - Change interfaces from traditional to stone.
- Control the Rework due to errors during construction.
  - Order to execute second-floor column at the same time the under a slab is demolition.

## 8. Conclusion

- It was clear from the case studies that any construction project faces many errors during the designing phase that may have an effect on the project time, cost and quality which could lead to inefficiency and disappointing results. However, the project. However, using some of the BIM features in project phases especially from the start of any project helps in avoiding these errors and leading to more efficient project.
- Based on the application of the 3D model, it is evident that it is effective to use a 3D model in all the project stages. In these case

studies using the 3D model was very significant in solving the problems caused due to applying the traditional method and the focus on the clash zone which can be limited with using 3D model and build an effective connection with every section in the project( civil, architecture, mechanical, ...etc.).

- Based on the application of the 4D model, it is evident that it is effective to use a 4D model in both the design and the construction phases. The simulation of the 4D model makes every day in the project very clear and accurate.
- Based on the application of the 5D model, it is evident that it is effective to use a 5D model in both the design and the construction phases and also after project delivery. It is also proved that some of the BIM benefits in the first case study will positively affect project's overall cost and time.
- It is concluded from the case study that BIM is an integrated process that includes all implementation steps from the start to the delivery of any project. It is also useful in establishing a controlled system that provides follow-up on all steps of the project and help in achieving the owner's goals.
- With BIM we can successfully increase labor productivity, thereby lowering its net cost, changed or reduced the amount of materials used and wasted on a job site to lower their net cost.
- BIM has the potential to provide us with far more efficient operation, not only as part of design and construction but also in operations and maintenance. Accuracy is another main reason.
- After applying BIM in the project as case study, it is evident that the large and complex projects such as (large compounds-hospitals) are more affected than small ones such as (mini compounds) as shown in figure 23.



**Fig.23.** the Percentage of applying BIM technology on different construction projects

## 9. Recommendations

- Higher coordination between the departments of the project led to the discovery of problems before the start of implementation and resolved during the design phase and thus avoid the problem of non-compliance with the time schedule for the project and extending the period of the project more than once.
- Avoid problems resulting from the continuous modification of the project, which presents the project for an additional cost of extra time. Now the whole amendment is in record time and coordination between all parties to the project
- Continuous communication between the parties to the project. This technique made all the details of the project and clear by everyone.
- Great to take advantage of the technology BIM has to be applied properly between the parties involved in the project and take action to support that training, coordination and identification of tasks and setting standards are working out and follow-up.
- code provides the best way to practice, develop and organize information and help designers prepare the information before passing it to the implementation team

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## Appendix A

### Research Title:

**Building Information Modeling BIM as a Development tool for the Management of Construction Projects**

### The Purpose of This Survey:

The purpose of this short survey is to begin to gather information about the effect of implementing Building Information Modeling BIM on the mitigation of construction project management during all phases of the project in Egypt.

The results of this survey will be summarized in a report that will be shared with all respondents in appreciation for their participation.

**1. Does your company currently use BIM, or is it intending to use BIM in the near future?**

- Yes - No -  
Will be implemented soon

**2. In what way do you think the implementation of BIM will affect the following key tasks performed?**

a. Preparation of tender and contract documents (Low – Medium – High)

b. Cost analysis and lifecycle costing (Low – Medium – High)

c. Identifying and developing responses to risks (Low – Medium – High)

d. Analyzing proposed outcomes (Low – Medium – High)

e. Valuing completed work and arranging payments (Low – Medium – High)

f. Clash detection during a design phase (Low – Medium – High)

**3. How many projects did you implement BIM?**

- From(1 to 5) - From(6 to 10)  
-From(11 to 15)

## "نمذجة معلومات البناء BIM كأداة تطوير في إدارة مشاريع البناء"

### الملخص:

على الرغم من التطور الهائل في مجال التكنولوجيا الرقمية التي أنتجت البرمجيات والتقنيات والتي أثرت في مجال العمارة والتشييد، وبالتالي الناتج المعماري والعمراني، الأمر الذي يحتم علينا مواكبة هذا التطور، والعمالة، والاستمرار بنفس الكفاءة في جميع مراحل المشروع والذي من شأنه سد الفجوة بين التصميم ومرحلة التنفيذ، وأهم هذه التقنيات استخدام نمذجة معلومات البناء (BIM) ، فهو قاعدة للبيانات، وليس فقط رسومات ثلاثية الأبعاد، فإنه يشير إلى حزمة رقمية من تطبيقات البرمجيات المصممة لتسهيل التعاون والتنسيق بالمشروع، BIM لديه القدرة على توفير عملية أكثر كفاءة، وليس فقط كجزء من التصميم والبناء ولكن أيضا في عمليات التشغيل والصيانة. الدقة هو سبب رئيسي آخر BIM تقدم دقة أكبر مما تنتجه الممارسات الحالية لدينا. هذه الورقة البحثية تهدف إلى تحديد فوائد دمج تقنية BIM في إدارة المشاريع والتعرف على الدور الذي تلعبه في صناعة البناء والتشييد والجدوى العملية بالمقارنة مع الأنظمة السابقة، تعتمد الدراسة التطبيقية على قسمين، الأول من خلال تنفيذ إستبيان المسح من خبراء صناعة البناء والتشييد. والثاني هو دراسة حالة. وخلصت الورقة البحثية لبعض النتائج الهامة. وهي تسعى إلى إظهار أن أنظمة BIM تحسن الاتصال والتعاون وبأعلى جودة في صنع القرار للمشروع، والتخطيط أكثر شمولاً والجدولة. في النهاية، يجب أن نرى أفضل جودة، بالإضافة إلى زيادة في الإنتاجية والربحية.

### الكلمات المفتاحية

نمذجة معلومات البناء، الإدارة، مشاريع التشييد.