

PAPER • OPEN ACCESS

Study on the Implementation of the Combination of 2 BIM and ERP Systems to Improve Project Cost Estimation Accuracy at the Auction Stage

To cite this article: Ispandi Pudael *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1117** 012013

View the [article online](#) for updates and enhancements.

You may also like

- [Integration capabilities of business process models and ERP-systems](#)
D V Kapulin, P A Russkikh and I A Moor
- [The Link Model of ERP-Usage, Absorptive-Capacity, and Task-Technology-Fit, to Task-Innovation in ERP User](#)
A Velahyati Baharuddin
- [Analysis of Implementation and Proposal Development of ERP System in CV Indah Jaya](#)
P Supangi, P C Rahayu and A Christiani



245th ECS Meeting
San Francisco, CA
May 26–30, 2024

PRiME 2024
Honolulu, Hawaii
October 6–11, 2024

Bringing together industry, researchers, and government across 50 symposia in electrochemistry and solid state science and technology

Learn more about ECS Meetings at
<http://www.electrochem.org/upcoming-meetings>

 Save the Dates for future ECS Meetings!

Study on the Implementation of the Combination of 2 BIM and ERP Systems to Improve Project Cost Estimation Accuracy at the Auction Stage

Ispandi Pudael¹, Rusdi Usman Latief², Syarif Burhanuddin³

Civil Engineering, Hasanuddin University, Indonesia

Civil Engineering, Hasanuddin University, Indonesia

Civil Engineering, Hasanuddin University, Indonesia

email : ispandipudael@gmail.com, rusdiul@gmail.com, syarifbur9@gmail.com

Abstract. This study aims to obtain a process flow model of an organizational function that functions effectively in increasing the accuracy of project cost estimates at the auction stage by including implementation elements from a combination of 2 BIM and ERP systems in it. The location of the research was carried out in a state-owned contractor company, namely PT. Nindya Karya (Persero). This state-owned company has used ERP and BIM in its business processes. The methodology used in this study is a questionnaire-based primary data research where data relating to the development of process flow involving BIM and ERP elements in it have been collected from the Estimating department unit in the company PT. Nindya Karya. The questionnaire was developed to evaluate the importance of implementing BIM and ERP in improving the accuracy of cost estimation identified through responses obtained from the respondents to the questionnaire survey. The research data are then processed using Flow chart analysis techniques. The results of the study obtained that the process flow model of the estimating department of PT. Nindya Karya has currently implemented BIM in the tender calculation process, but has not involved ERP elements. The final result of drawing conclusions in this study is in the form of a workflow flowchart or process flow from the estimating department which in the process involves 2 BIM and ERP systems.

1. Introduction

The development of construction technology in Indonesia is increasingly advanced and growing rapidly, especially in the field of construction digitization. One application of construction digitization is BIM (Building Information Modeling) and ERP (Enterprise Resource Planning). BIM is a new innovation that is intended for working on a construction project, while ERP is a software system that is intended for systems within the company.

The concept of BIM imagines virtual construction before the actual physical construction, where we can simulate 3D building modeling, simulation of construction time and stages, simulation of cost estimation, simulation of energy analysis and operational cycles. ERP is an application integration program, with cross-functional parts such as marketing, production and HR, of a company organization, so that the information needed can be obtained instantly and up-to-date.

Seeing the benefits and advantages of BIM and ERP, it is very possible to apply them to help estimate the cost of the auction stage. In calculating the estimated cost of the initial stage of a project tender, there is often an increase in costs during the project implementation stage, this is due to the short time of preparation for the tender so that the cost estimate is less accurate.



Zainuddin and Fakhrial (2015), in their research found that the factors that affect the accuracy of project cost estimates at the auction stage are the work method factor, the information factor, and the subcontractor factor. Seeing the potential of 2 BIM and ERP systems, these three risk factors can be minimized effectively by applying BIM and ERP technology in the cost estimation process at the auction stage.

In reality in the field ERP and BIM applications are separate application systems where ERP is more used to build enterprise systems and BIM is more used for a construction project cycle, each of which produces 2 separate outputs. This allows for potential errors in addition to the time lag. To overcome these problems, it is necessary to integrate 2 BIM and ERP systems in one platform.

Sarkar, et al, (2017) in their research results show that the proposed integrated BIM-ERP-IoT Module is a unique effort for real-time monitoring, asset management, inventory management, and improved enterprise revenue management for construction projects. This shows that the 2 BIM and ERP systems can be integrated.

The integration of 2 BIM and ERP systems in the cost estimation process at the auction stage can be started by designing the process flow of a company organizational function that includes elements of BIM and ERP implementation in it. The results of this flow process will later serve as a reference or guide for the company's IT department in its efforts to integrate 2 BIM and ERP systems into one digital platform.

Based on these problems, this study aims to design the process flow of an organizational function that functions effectively in increasing the accuracy of project cost estimates at the auction stage by including implementation elements from a combination of 2 BIM and ERP systems in it. The scope of this research focuses on corporations, namely the contractor company PT. Nindya Karya (Persero). This state-owned company has used ERP and BIM in its business processes, so it is very relevant to the theme of our research.

2. Literature review

2.1. *The Concept of BIM*

The concept of BIM envisions virtual construction prior to actual physical construction to reduce uncertainty, improve safety, solve problems, and analyze potential impacts (Smith, Deke 2007), Although BIM has been known since the 1970s, the term Building Information Modeling (BIM) is gaining popularity. after Autodesk released the paper "Building Information Modeling" in 2002. The term BIM reappeared in 2005 when the US General Service Administration (GSA) made the decision to build a new courthouse in Jackson, Mississippi (SIBIMA Construction, PUPR, 2019).

2.2. *Understanding of ERP*

ERP is an acronym for "Enterprise Resource Planning", which is the process of collecting and organizing business data through an integrated software suite. Basically, ERP is an application that automates business processes, controls, and collects input from various data. The data includes accounting, manufacturing, supply chain, sales, marketing and human resources (HR) data.

2.3. *BIM + ERP integration*

2.3.1. *The Concept of BIM + ERP Integration*

BIM is a design technology that creates 3D Visualizations of construction projects using a coherent system of computer models. This allows real-time collaboration across all departments rather than using separate sets of images. ERP is a business management solution that manages finances, operations and projects and enables companies to run their business, automate key processes and save costs. When combined, these create a powerful project management system that revolutionizes construction projects.

BIM creates a full-size three-dimensional building project inside a computer. ERP allows the user to determine the final costs, the time frame involved and where the equipment and subcontractors will come from. BIM is responsible for every system, channel, structural column, and pipeline. ERP schedules production and ensures project requirements are met. The bundled product ensures building projects are completed on time, with few errors and changes. Collaboration between all departments is seamless and a wide variety of tools are available immediately.

2.3.2. The Benefits of BIM + ERP Integration

Integrating BIM and ERP enables the integration of actions and controls through effective communication of information available to everyone from a central location. Always-on access to updated data will allow managers to gain transparency into the actual state of the project and then help make profitable business decisions. Of course, ERP and BIM integration is more than just collecting data. Let's take a look at other important benefits of integrating ERP and BIM in construction projects:

a. Financial management

Contract work is the norm in the construction industry. Tender bids are issued for large-scale projects. Accurate estimates of materials and labor are key in both situations. The combination of BIM + ERP can be used to get accurate estimates for each item in the BOM and for the efforts involved in project execution as well. This calculation is more precise and accurate. This helps achieve more profitable and predictable project resource planning.

b. Enabling Better Performance

Communication is an important factor in determining the success of a construction project. The integration of BIM and ERP provides a centralized source of information for everyone working on a project. These are fed into defined workflows so the right people get the right info when they need it. Updates are made and recorded in real-time, eliminating errors due to time lags in communication. What if scenarios could be analyzed quickly and their implications downstream This helped people and teams deliver better results and take responsibility for their efforts.

c. Avoiding contract conflicts

The solution helps in avoiding contractual conflicts with clients. This is done by making a baseline estimate and then tracking inventory, raw material requirements, labor, finances, and project budget against the forecast. Careful analysis of construction aspects leaves little or no room for misunderstanding and helps encourage more timely interventions if deviations become inevitable.

d. Simplify Data Several Projects

Handling multiple projects or several aspects of one project at a time will inevitably create confusion in communication.

2.4. Cost Estimation

Cost estimation is a process of determining or determining the costs involved for a construction for each existing project. According to the National Estimating Society-USA, estimation is the art of estimating (the art of approximating) the possible amount of costs required for an activity based on information available at that time. Cost estimation can also be defined as a cost evaluation of all project elements whose calculations are based on the approved scope of work (Phaobunjong, 2002). Cost estimation can also be interpreted as determining the possible construction costs of any

given project. Many items (i.e., materials, labor, equipment, insurance, and overhead, as well as profit forecasts etc.) affect and contribute to the cost of a building project.

3. Research Method

Data collection for this research was conducted at the office of PT. Nindya Karya, especially the Estimating department, which is responsible for the process of estimating project costs at the auction stage in the DKI Jakarta area in June 2022. The data needed in this study consists of primary data and secondary data. Primary data obtained from interviews, focus group discussions (FGD) and filling out questionnaires, secondary data in the form of company documents, and literature studies. The selection of resource persons is based on purposive sampling with the intention that the selected sample has knowledge, expertise, and competence in the field studied in this study. Respondents consist of internal and external respondents. Internal respondents in this study were company managers. External respondents are other state-owned and private construction contractor companies.

The steps involved in analyzing and processing data in this research are: this research begins with viewing or photographing the process flow model run by the company PT Nindya Karya in the current Estimating department which has responsibility for the project cost estimation process at the auction stage. Furthermore, a detailed assessment of the risk factors that affect the accuracy of cost estimates at the auction stage is carried out. Then identify the ability of 2 BIM and ERP systems to minimize risk factors that affect the accuracy of cost estimates at the auction stage. The data analysis technique used the flow chart analysis technique. This technical analysis consists of three activities, namely data reduction, data display and drawing conclusions/verification. Data reduction is the simplification of data by removing unnecessary data, then displaying the data, namely displaying data in the form of tables, diagrams, or in the form of flow charts.

4. Result and Discussion

In early 2021, PT. Nindya Karya carried out an Organizational Restructuring, which was originally a territory-based business activity, turned into a Job Specialization with Centralized functions such as Supply Chain Management (SCM), Quality Health Safety and Environmental (QHSE) Information Technology & Human Capital (IT & HC). In the organizational structure of the Estimating Department led by a Senior Vice President, who oversees 5 units, namely Contract Administration, Estimating Infra 1, Estimating Infra 2, Estimating Building, and Engineering & BIM, each unit is led by a Vice President and under him several staff. Based on the mapping result of the Estimating department's organizational structure, it can be seen that PT. Nindya Karya has implemented BIM technology in the project cost estimation process at the auction stage, this can be seen in one of the unit units, namely engineering & BIM.

4.1 Identify The Current Estimating Department Process Flow Model.

From the results of interviews and data collection of company documents in the Estimating Department, the process flow model of the Estimating Department of PT. Nindya Karya can now be seen from the Estimating Procedure document. The current process flow model in the estimating department is known as the estimating procedure, there are 4 estimating procedures, namely (1) Contract Administration Procedures, (2) Tender Process Procedures, (3) BIM Modeling Procedures for Tenders, (4) Value Engineering Procedures for tender.

The current process flow model of the estimating department has implemented BIM in the tender process, this can be seen from the BIM Modeling Procedure for tenders in Figure 1. In this procedure

the BIM Levels applied are Level 3D and 4D, where the application of BIM in the redrawing process (major item 3D modeling), perform MS synchronization. Project and work methods, making construction sequence animations (Naviswork).

NO	ACTIVITY	SVP.EST	GM DIVISION	VP. EBIM	OUTPUT	DESCRIPTION
1.	Start		START			
2.	Making BIM Modeling Requests				BIM unit request letter	Conducted during the tender process which requires the BIM concept by the Division GM
3.	Dept. Estimating conducts evaluations to meet the demand for BIM modeling					* Estimated time and level from BIM * Files in CAD format are preferred to speed up the modeling process
4.	Submit project data to BIM				* CAD, PDF or Harcopy * Technical specifications	* Drawing * Schedule * Working Methods and Zoning
5.	Clarifying data					Drawing synchronization checks and technical specifications
6.	Performing Redraw process (3D Modeling of Major items)				3D modeling of major items (and their quantification if needed)	The processing time depends on the complexity of the construction and the model requested, a minimum of 4 days
7.	Synchronizing Ms. Projects and Working Methods				* Schedule in the form of Ms. MPX format projects * Working Method	* The processing time depends on the number of WBS at least 1 day * Checking synchronization in the form of zoning, work order, etc.
8.	Creating construction sequence animations (Naviswork)				video formats	
9.	Distribute modeling results to combine with technical documents				RVT, PPT, JPG	
10.	Prepare BIM unit result data				Saved in synology	Shelf life according to document storage guidelines
11.	Informing the results of the BIM modeling evaluation (if any)					
12.	finish		FINISH			

Figure 1. Procedur BIM Modeling for tender

Value Engineering Procedure for Tender is a value engineering process procedure from the volume of the main material work on the BOQ with modeling results using BIM software. This can be seen in Figure 2.

The current estimating department process flow model does not involve ERP elements, this is because the nindya ERP has not accommodated the Estimating department, the new ERP nindya accommodates the HR, Marketing, Finance, Production Departments, Efforts to accommodate the Estimating department in the ERP system are still in the development stage where later it is hoped that ERP can accommodate the estimating department in calculating or making online RAB, making work methods, tracking prices and vendors integrated in ERP.

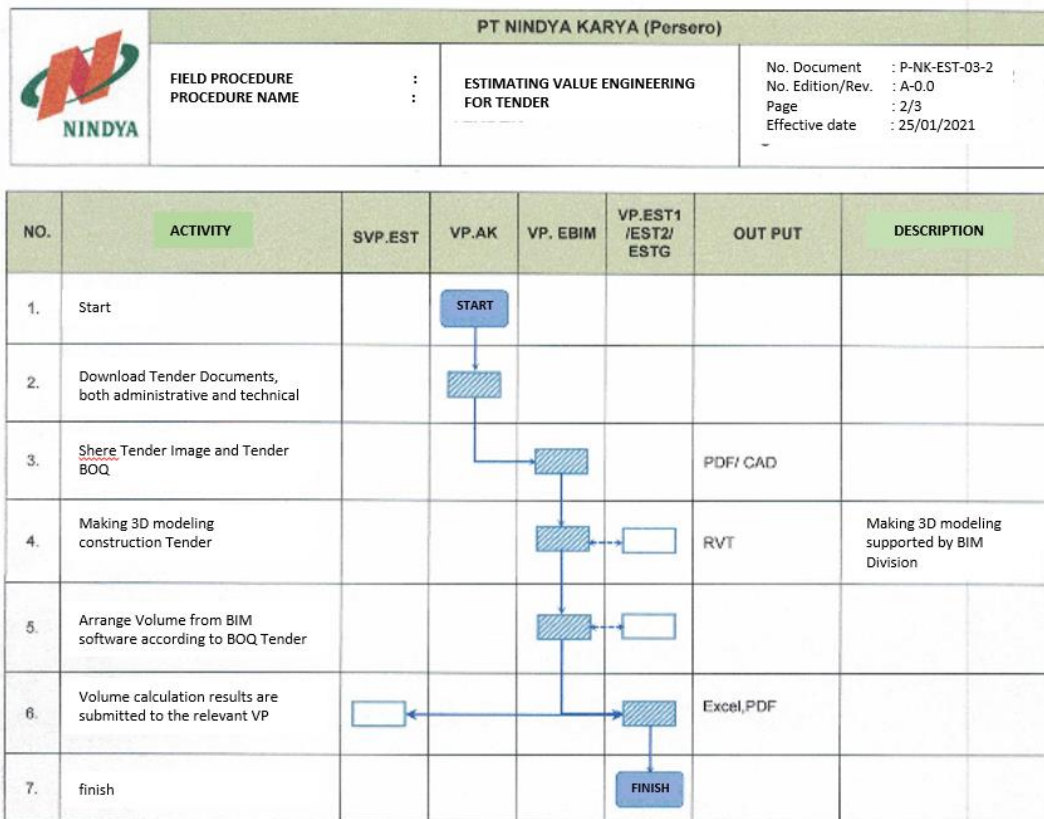


Figure 2. Value Engineering Procedure for Tender

4.2 Designing a Process Flow Model For The Estimating Department Incorporating 2 Systems BIM and ERP

In designing the process flow of an organizational function that functions effectively in increasing the accuracy of project cost estimates at the auction stage by including the implementation element of a combination of 2 BIM and ERP systems in it, this study involved the Senior Vice President and the Vice Presidents of the Estimating Department as respondents to develop a process flow model in the estimating department that integrates 2 BIM and ERP systems. Data retrieval from the respondents was carried out by conducting FGDs, where each respondent answered each of the research questionnaire questions together regarding the development of a process flow model in the Estimating Department which integrates 2 BIM and ERP systems.

The final result of drawing conclusions is in the form of a workflow flowchart or process flow of an organizational function. Flowchart program using Microsoft Visio Software. The results of this flow process will later serve as a reference or guide for the company's IT department in its efforts to integrate 2 BIM and ERP systems into one digital platform.

5. Conclusion

PT. Nindya Karya has applied BIM technology in the project cost estimation process at the auction stage, this can be seen in the organizational structure of the estimating department, one of which is engineering & BIM. The current estimating department process flow model has implemented BIM in the tender process, this can be seen from the BIM Modeling Procedure for tenders and Value Engineering Procedure for Tenders. The current estimating department process flow model does not yet involve ERP elements. Efforts to accommodate the Estimating department in the ERP system are still in the development stage. The final result of drawing conclusions in this study is in the form of a workflow flowchart or process flow from the estimating department which in the process involves 2 BIM and ERP systems. Flowchart program using Microsoft Visio Software. The results of this flow process will later serve as a reference or guide for the company's IT department in its efforts to integrate 2 BIM and ERP systems into one digital platform.

References

- [1] Heryanto S, Subroto G and Rifa'ih 2020 *Study on the Application of Building Information Modeling (BIM) in the Indonesian Construction Services Industry*, Journal of Architecture Innovation ISSN 2549-080X
- [2] Roland M, Simanjuntak A and Baskoro A 2020 *Review Of Project Financing Management In Implementation Of BIM on Building Projects*, ISBN: 978-602-51450-2-5
- [3] Alianto H, and Wijaya S 2013 *Implementation of ERP System Implementation in Making Project Feasibility, Project Status and Project Monitoring in Contracting Companies*, **4** 582-7
- [4] Chen Y and Tserng H 2017 *An Integrated Methodology for Construction BIM & ERP by Using UML Tool*, (Taiwan: University of National Taiwan University)
- [5] Iskandar M and Krisnadi I 2020. *Application of Enterprise Resource Planning (ERP): Literacy Studies in Project Management*. Master of Electrical Engineering Postgraduate Mercu Buana University
- [6] Alianto H and Wijaya S 2013, *Application of the Erp System in Making Project Feasibility, Project Status and Project Monitoring in Contracting Companies*, **4** 582
- [7] Sarkar D, Pandya K, Dave B, Jha K and Dhaneshwar D 2021 *Development of an integrated BIM-ERP-IoT module for construction projects in Ahmedabad*. *Innov. Infrastruct. Solut.* **7**, 50
- [8] Zainuddin and Fakhrizal 2015. *Analysis of Factors Affecting the Occurrence of Underestimate and Overestimate Costs at Cost Accuracy Level*, **2** 22