

Federated Model and Scheduling by Implementing Building Information Modelling in the PNJ Center of Technology (PUT) Laboratory Building

**Irika Wideasanti¹, Budi Afriani¹, Lenggogeni¹, Erna Septiandini¹,
Muhammad Haristo Rahman², Selvia Agustina¹, Mirara Kanza¹,
Syadila Nur Hanniyah¹, Intan Puspa Wangi¹**

¹*Building Construction Engineering Technology Study Program, Faculty of Engineering,
State University of Jakarta, Indonesia*

²*Universitas Negeri Makassar, Indonesia*
Email: irika@unj.ac.id

In Indonesia, the use of Building Information Modeling (BIM) is still very minimal, especially in the field of building construction and one of them is the building of the Center for Technology Excellence Laboratory (PUT) PNJ which at the time of construction was carried out did not use BIM and there was a clash on the plumbing elements (pipes) between structures (beams) and affected the scheduling process and also the scheduling process did not use the BIM method. Based on this background, the purpose of this study is to produce a federated model product from the three model disciplines (structure, architecture and MEP) and also its scheduling and visualization. The method used in this research process is the 4D method. The first stage is to conduct an analysis for the product development process to be created and continue with the selection of a federated model and scheduling software, namely using Autodesk Navisworks. This federated model plan is carried out starting from the stage of collecting 3D modeling data from three disciplines, creating scheduling data on Microsoft Project and ending with connecting the results of the federated model and scheduling data from Microsoft Project. The results of this study are in the form of visualization and simulation of the scheduling plan. The results are then validated by experts. Based on the validation process, the product results are declared suitable for use. The total scheduling duration results in 230 working days.

Keywords: Building Information Modeling, Federated Model, 4D Method,

model discipline, scheduling.

1. Introduction

The development of the construction world in Indonesia is currently accelerating rapidly and construction players are competing to create and use technology that really supports construction so that it can be carried out effectively and efficiently, one of which is Building Information Modelling (BIM) (Afandi, 2022). Such as combining 3D BIM models or federated model Which useful for integrating various disciplines such as structures, architecture and MEP and can predict what will happen clash in the field (Gunawan & Kartika, 2021)

Then, one of the most important stages in the success of construction project development is planning and scheduling (Sukindrawati et al., 2023). 4 Dimensional (4D) modeling in BIM can be said to be one of the aspects that influences the work process of a project compared to traditional project scheduling methods which can only display written data because in 4D BIM the data is not only written and numbers but can also display a visualization (Faiz Maulana et al., 2023).

Delays in the completion process in a project will be an annoying triple constraint which has an impact on waste because the project still uses conventional methods (Afriani et al., 2024). Based on previous research data by Yulyardi (2018), conventional methods result in waste of around 10% of materials, 40% of projects experience over budget, 30% of projects experience rework, and almost 90% of projects experience delays. Therefore, by implementing Building Information Modelling (BIM) in every project, we are able to compete with current digital developments and are able to balance all aspects to anticipate waste and lagging developments in the world of construction, especially in scheduling.

The obligations regarding the use of BIM are stated in (Technical Guidelines for the Construction of State Buildings, 2018) which reads "must be applied to non-simple buildings with criteria of an area of more than 2,000 square meters and more than 2 floors." Based on interviews conducted with the building planners of the PNJ Center for Excellence in Technology (PUT) Building, during the drawing process until the construction of the building still used software Autocad 2D and also in scheduling not yet implemented the system Building Information Modelling as well as available clash which occurred during the implementation of work in the field on the avur/drain pipe elements closet (plumbing) with beam elements (structure) and planning changes need to be made so that it affects the work implementation time.

Building Information Modelling (BIM) is a system or technology that includes several important information in the process Design, Construction, Maintenance which is integrated in 3D modeling. The aim of implementing BIM is very important to develop in Indonesia because it can simplify and speed up the work process on projects (Ministry of Public Works and Public Housing, 2021). Regarding BIM not yet implemented in the PUT PNJ Laboratory Building, this research will carry out product development in the form of federated model namely combining structural, architectural and MEP 3D BIM models to create one integrated model as well as time management planning or scheduling for each building discipline in

structural work, architectural work and mechanical electrical plumbing (MEP) work in the Jakarta State Polytechnic PUT laboratory building by implementing BIM.

By making products federated model and scheduling at the Jakarta State Polytechnic PUT Laboratory Building, it is hoped that it will be one of the efforts that can be used to find out how far BIM optimizes each building construction planning process and creating a comprehensive and integrated digital model scheduling visualization covering all building element disciplines to detect the presence of clash between models before construction begins to prevent delays as well. The product being developed is expected to become a reference for many building plans that implement BIM for companies in the construction contractor sector. Product manufacturing process federated model and also scheduling that contains simulations will be made with the implementation of BIM which is expected to become a useful product for building owners and planners.

2. Research Methodology

This research was carried out for 6 months (January 2024 - June 2024). The building specifications that will be researched are as follows:

- a. Number of Floors : 4 Floors and Top Roof
- b. Building area : 8.000 m²
- c. Building Function : Lecture building
- d. Building location : Kukusan, Beji District, Depok City, West Java

The development model used in this thesis is the 4D development model (Define, Design, Develop, and Disseminate). 4D Model This 4D model was chosen because it is more concise and detailed without any layered test stages so that the implementation time is effective and efficient. In doing federated modeling and scheduling by implementing Building Information Modeling (BIM), there are materials and equipment needed in research to compile detailed building models and accurate scheduling. The materials used are BIM software such as Autodesk Naviswork to create a combination between disciplines and then use assistance in preparing scheduling Software Microsoft Project which will later be data from software this will be integrated with Autodesk Naviswork so that it displays an appropriate form of scheduling visualization. In addition, a computer or hardware with adequate specifications is required to run BIM software smoothly. In the development method design, the design created to achieve the research objectives will be explained. In the image below it is flowchart from the description of the design of the development method of the research carried out.

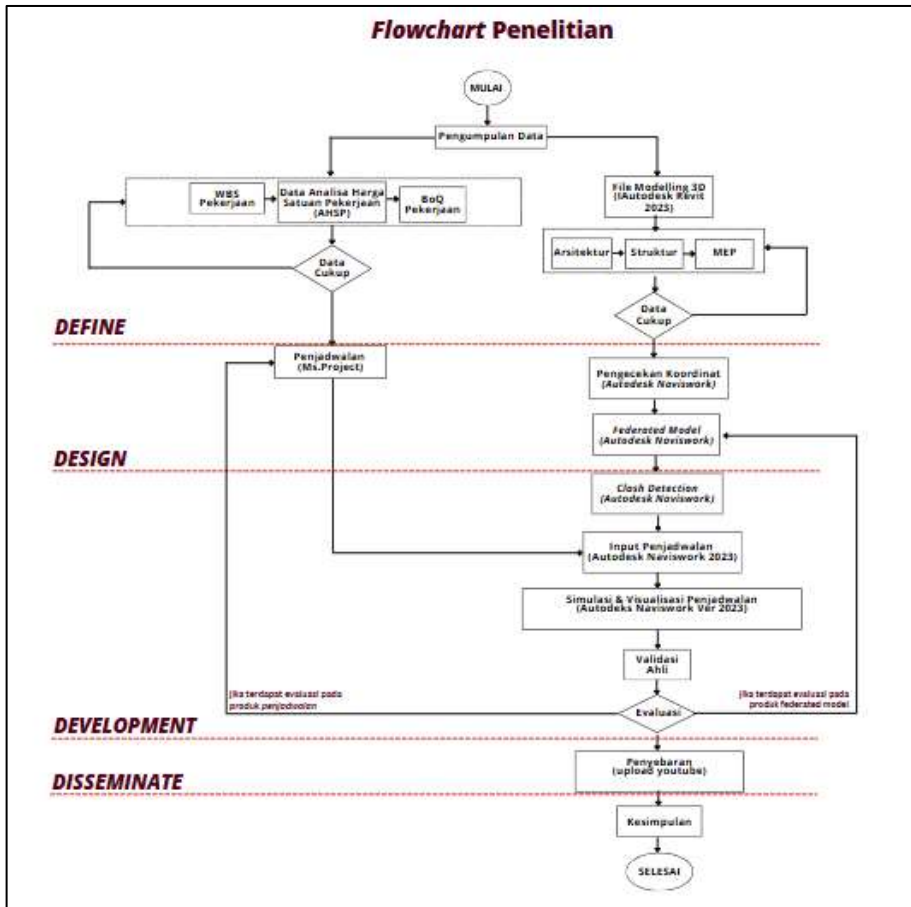


Figure 1. Research Flowchart

The data collection technique in this research was carried out by interviews. Interviews are carried out directly by giving an instrument questionnaire to the validator to obtain an assessment and also provide input on the product being developed. The input from the validator will later be used as evaluation material to improve the product. In this research, the data analysis technique is carried out descriptively by describing the input by the validator on the product that has been created and developed. This is done with the aim of analyzing the feasibility and assessment by the validator so that it can be concluded that the product is suitable/not suitable for use.

3. Results and Discussion

Based on the results of the feasibility test carried out on Thursday 27 June 2024 offline that is, the validator provides an answer through the instrument and the conclusion is obtained that the product is "ready"worthy" and can be used as needed. Validators also provide suggestions for improving the product. Of the 13 questions, there are 2 questions on the scheduling instrument.

Based on the explanation above, the products developed are: federated model and also scheduling by implementing BIM has been evaluated by the validator and several instrument items have also been revised, namely at the scheduling simulation display points. Results of the product federated model able to display 3D building results where in the process there is a collision checking process between model elements or clash detection which can minimize element collisions during the construction process and prevent the impact of scheduling delays. Apart from that, project scheduling becomes more organized and on time and reduces the risk of delays which usually occur due to poor coordination and errors in planning and with the implementation of BIM 4D it is able to display scheduling visualizations so that you can check the scheduling stages before construction is carried out.

Product Evaluation

When evaluating a product, suggestions and input provided by the validator through the instrument are described at each point and will then be evaluated. This evaluation aims to improve the product being developed to suit usage needs. The following are the evaluation points given by the validator in the instrument, which can be seen in Table 1.

Table 1. Product Evaluation

No	Instruments/Items evaluated	Evaluation	Improvement Suggestions
1	Scheduling Instrument/ Butir 2a	There is no display of additional, more complete information such as month, date, or year.	Add information displays to make them more interesting and informative.
2	Scheduling Instrument/ Item 2b	During the simulation, the simulation angle display is still one direction, so other positions are not very clear.	It is better to rotate or take it from all angles during the simulation so that all positions are visible.

Product Evaluation Results

The following is the final result of the product which was improved in accordance with the suggestions or evaluation provided by the validator in Table 2.

Table 2. Product Evaluation Results

NO	Product Improvement
1	Improved the display of additional, more complete information such as month, date, year.

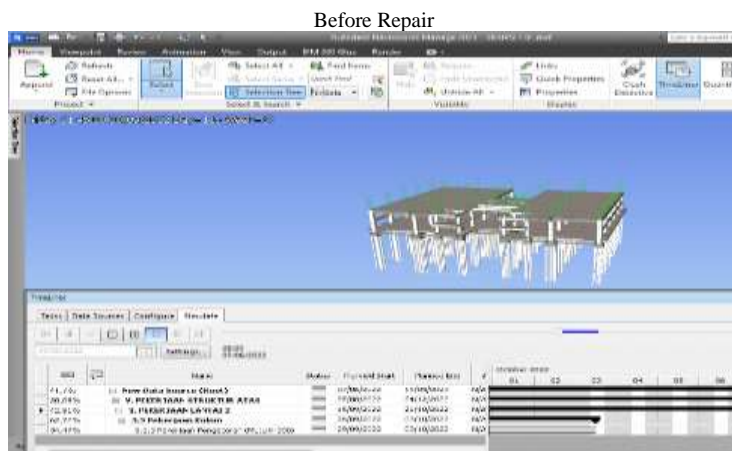


Figure 1. Incomplete Scheduling Simulation Information Display

because the PUT PNJ Laboratory Building has not used BIM, especially in scheduling, so there are clash in the field which influences project delays. Therefore, research was conducted to create a combined model or Federated model as well as scheduling using BIM with software Autodesk Naviswork and software Microsoft Project. Products developed using Autodesk Naviswork can produce a combination of 3D models that are integrated with each other or federated model (structure, architecture, MEP) and generate scheduling and scheduling simulations using software supporters, that is Microsoft Project. The results of this product development produce a duration of 230 days. As for the instrument results from the validation process with experts, it can be concluded that the product federated model and also scheduling is feasible to use. Because, the results of the merger are in accordance with the stages and coordinates. Then, the results of scheduling product development and scheduling simulations are suitable for use because of scheduling and also modelling 3D is interconnected and in accordance with the elements of the work. The results of product development will be disseminated through video simulations of project scheduling in the form of barcode.

References

1. Afriani, B., Wideasanti, I., & Wangi, I. P. (2024). Pengimplementasian Sistem Building Information Modelling Pada Tahapan Penjadwalan Gedung PUT PNJ. *Jurnal Talenta Sipil*, 7(1), 200. <https://doi.org/10.33087/talentasipil.v7i1.435>
2. Faiz Maulana, M., Budi Broto, A., & Wacono, S. (2023). Penerapan Building Information Modelling pada Penjadwalan Proyek Elevee Penthouse & Residence Alam Sutera Tangerang. *Jurnal Teknik Sipil Politeknik Negeri Jakarta*, 2023. <http://bim.pu.go.id/materi/detail.html?>
3. Gunawan, M., & Kartika, N. (2021). Penerapan Building Information Modelling (BIM) Pada Proyek Pasar Soreang Kabupaten Bandung. *Jurnal Student Teknik Sipil Edisi*, 3(2).
4. Kementrian PUPR. (2021). Bimtek BIM Maksimalkan Kompetensi ASN Dari Perencanaan Hingga Pelaksanaan Pekerjaan.
5. Sukindrawati, B., Kartika, W., & Sarju. (2023). Evaluasi Kinerja Waktu dengan Metode Konsep Nilai Hasil. *Menara : Jurnal Teknik Sipil*, 18(2).