

# Key Success Factors Implementing BIM Based Quantity Take-off in Fit-Out Office Work using Relative Importance Index

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# Key Success Factors Implementing BIM Based Quantity Take-off in Fit-Out Office Work using Relative Importance Index

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**Abstract:** Interior work is the last phase of a building project before it can be habitable. An important element of interior work is: 1. Function 2. success 3. Elements of Identity, branding, company priorities, and actualization. The need for office space that meet the requirements continues to increase discussing the use of materials to meet no 3 increasingly limited and constantly updated. Office Fit-Out work is directly related to the company's image and the productivity of its employees makes the budget for its construction so often in a large proportion. Like other construction work, a suitable work life cycle exiting the office will go through the design process, making Bill Of Quantity until the construction phase will go through the Quantity Take-Off process. Traditional quantity take-off takes time, low accuracy and create miscalculation, automatic take-off using BIM base Quantity take-off is a solution to help prepare cost estimation. Previous research found that a traditional take-off (manual take off) process took five times longer than the BIM Quantity Take-Off did. The quantity take-off for fit-out offices work has obstacles because the model for the Fit-out office building work has not been standardized.

This study uses the Relative Important Index (RII) statistical tool to find the main factor that influences the BIM process of Quantity take-off with the results of the 10 sub factors that most influence the BIM Quantity take-off process.

**KEYWORDS:** Fit-Out, Office, Quantity Take-Off, Implementing, RII

## I. INTRODUCTION

### A. Inaccuracies in estimated costs in the construction industry.

Project management focuses on objectives to meet specifications, time and cost budgets [1]. The budget is made through a cost estimation process prepared by first carrying out the quantity take-off process. The cost estimation in a construction project is very important both at the project initiation stage and at the design stage and requires short accuracy and time [2].

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Inaccurate estimates will cause problems of lack of material resources, labor, and equipment and lead to waste of time and excess material that will cause waste, which will be part of 12% of total project costs, while weak material management will add a cost of 10- 12% of total labor costs. The amount of time used for unproductive work can reach 2/3 of the total duration of the construction project and a weak security factor causes additional costs of 6% of the total project cost [3]. Previous research on the causes of cost swelling in interior fit-out workplaces scheduling inaccuracies and estimated costs in the order of six causes of cost overruns (Figure 1), [4]



Figure 1. Cost Overrun Causative

### B. Overcoming the problem of estimating costs by using BIM quantity take-off

It is very important to find a way to reduce the waste of costs during construction later by making estimates that are faster and more accurate. Material calculation accurately will reduce waste from the material transportation side even more so if the distance between the material supplier and the site project is far [5]. The quantity take-off process is the core of the process of estimating costs and is one of the causes of wasteful costs as illustrated in figure 1. In line with the implementation of BIM in the construction industry, stakeholders such as owners, architects, and general contractors pay more attention to ways to reduce time and costs, including estimating the cost of using BIM [6], [7]. Previous research on the application of BIM based quantity take-off has taken place on research objects such as Structural Work, walls, door, beams, Mechanical Electrical Works, etc.

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Meanwhile, other construction fields such as office building fit-out have never been used as research objects in terms of the implementation of BIM-based quantity take-off. Previous research has shown that estimation using BIM Quantity take-off will reduce time and errors while increasing performance-estimators when compared to traditional estimation practices [8], [9]. Quantity take-off automatically saves time as the results of previous studies.

### C. The importance of quantity take off for work fit-out of office buildings

The Fit-out design of office buildings is often explored to meet other objectives besides its main purpose as a place of reporting activities. Other objectives include building a company image and other message messages such as the company's reputation. The company's vision and mission are abstracted in the interior of an office. The implementation is the use of various finishing and decoration materials, both on walls, floors and ceilings and types of furniture used.

The number of types of finishing materials used and the price of the units that are expensive and different from each other requires a quantity process that takes precision and a short time. The precision in question is the accuracy of the complete volume in the material modules available on the market and the volume needed according to the desired design.

This research involves steps consisting of the introduction of the literature study of the research method by taking respondents to find the most influential key success factors for implementing quantity-based BIM take-off on work fit-out of office interiors.

## II. LITERATURE REVIEW

### A. Fit-out Office

Fit-Out Office work is always at the final stage of the work before a building can be used, Fit-out work has the main characteristics and attention to the function of the room, followed by the comfort of the room, and finally, the room must be able to describe the strata of the company occupying the office. Office room design is very varied and explores the material and elements of an office interior (Figure 2&3). Office fit-out work is divided into three main parts, namely 1. Finishing the floor, walls and ceilings 2. Mechanical electrical work 3. Furniture work.



Figure. 2 Fit-out meeting room  
Source : Archive project



Figure 3. Fit-out Working Area  
Source : Archive Project

Finishing work is a series of work after the basic elements and structures are carried out to complete the final results of the construction work [10]. Work Finishing floors, walls, and ceilings are explored in such a way as to lift the appearance and impression of a luxurious and artistic room.

Exploration of the design of wall and ceiling flooring materials becomes very diverse and creative using a variety of materials with a large number of costs both from the price of materials and wages of production. The needs and desires of end-users are the main focus in the construction of this fit-out office [1]. These conditions make the quantity take-off process important and crucial for accuracy and cost savings.

### B. BIM Quantity take-off

In the process of work on the implementation of high-rise building construction project, the obstacles often encountered is from the time that the delay of the project and of the quality of that quality is not in accordance with the technical specifications required [11].

The process of quantity take-off from this design document is known as the take-off or Take-off Material (MTO) process and is an important part of the estimation process [12], [13]. Today the manual take-off process is still popular. Manual take-off process is done by manual measurement of the elements involved such as drawing documents, cross-section, elevation, and other similar documents [14]. BIM Quantity take-off allows integration between 3D models with all parties involved in the construction process with benefits in the form of volume and cost calculations can be previous known at the planning stage[15].

But the use of the BIM model still has obstacles from its users, architects, engineers, and other design consultants, they are still reluctant to provide the full version of their models for quantity surveyors, contractors and other parties. There are various reasons for the main reason being what will be done with the model and the potential for designer responsibility[16]. The BIM-based quantity of Take-Off process consists of 4 steps which consist of 1. BIM modeling, 2. Verifying the physical quality, 3. Property verification 4. Quantity take-off (Figure 4).

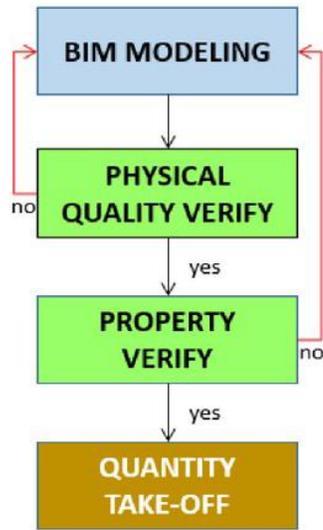


Fig 4 Open BIM Based Quantity Take-Off process  
Source: [2]

BIM models can reduce time because estimators can extract measurements and material quantities straight from models. [17]. Many BIM software applications have included Bill of Material (BOM) functions within the software that assists with material procurement. The amount of reduction in time spent on can be as much as 80% while providing quantity take-offs and estimates that are accurate to within 3%. [18]

### III. RESEARCH METHODOLOGY

To implement the BIM Quantity take-off, the determination of the most influential factor in the BIM-based take-off process was carried out first. Factors that influence advance are collected from the literature and expert recommendations. The characteristics of the floor, wall and ceiling material in its character review are influential factors for the implementation of the QTO BIM [19], [20] These factors are sorted using the RII Method (Relative Importance Index) see Figure 8. The value of RII has a range between 0 up to 1 (value 0 is not included). The highest score of RII will become the most influential factor in the research. RII is then ranked for each sub-factor. Calculation of the average value of RII is used as the value of RII for each main factor contained in the sub-factor. The result is a ranking of sub-factors, main factors, and variables. [23].

Respondents were selected contractors who were competent and had implemented BIM or at the preparation stage using BIM. From the viewpoint or subject of the study, the fit-out contractor who has the Fit-Out Office field of work is also a respondent to get any information related to Quantity take-off on the fit-out work of the office building.

Indonesia has 1,550 large size contractors, 28,000 intermediate size contractors and 138,000 small size contractors.

The random sampling is used to represent the contractor population.

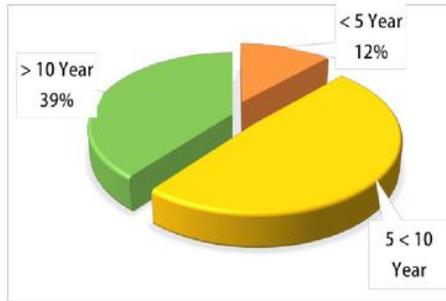


Figure 5. Respondent work experience ( year)



Figure 6. Title of respondent

Respondents were selected from several areas, Indonesian national contractors to represent the contracting profession population in Indonesia, The Composition of the respondent consist of; respondent year experience, the title of the respondent, and project under their responsibility, see Figure 5, Figure 6, Figure 7.

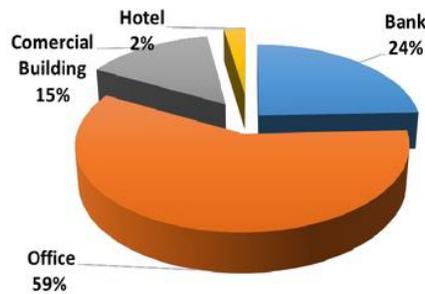


Figure 7. Current Respondent's project.

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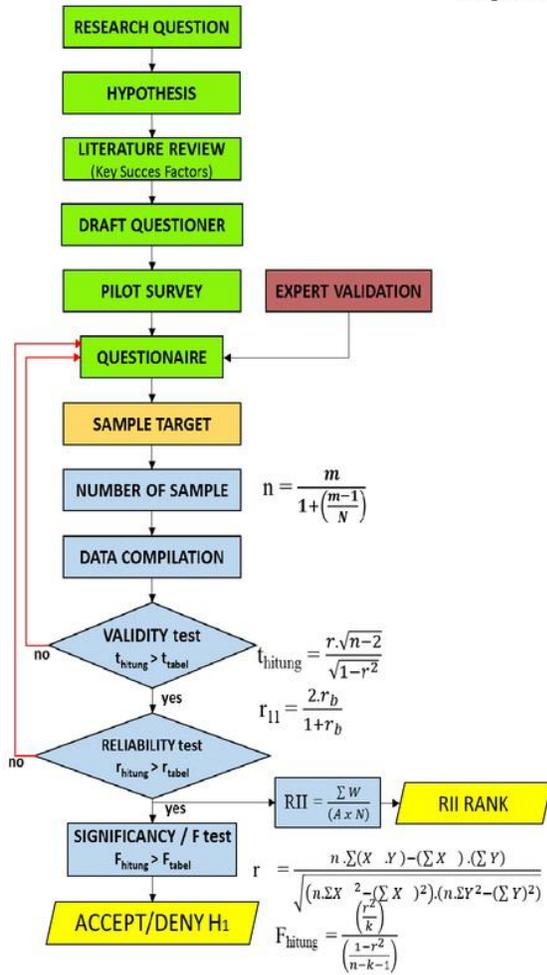


Figure 8. Diagram Process of Relative Importance Index

### IV. RESULT & DISCUSSION.

After going through the reliability validity test and the significance obtained the result that there is a significant relationship between the BIM based Quantity take-off Implementation process and the fit-out office work. Ranking using the statistical tool Relative importance Index produces a ranking sequence of main factors and sub-factors. Figure 9 shows Main factor related to Implementation of BIM quantity take-off

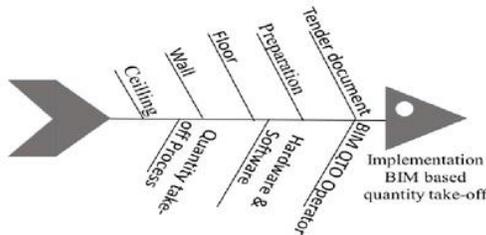


Figure 9. Fishbone Diagram  
Tabel 1. Rank Of Main Faktor

Rank	After Process	Total	Sub Factor	Mean
1	Tender Document	5,766	6	0,961
2	BIM Quantity take-off Process	8,590	9	0,954
3	BIM QTO Operator	3,707	4	0,927
4	Hardware & Software	5,356	6	0,893
5	Floor	3,346	4	0,837
6	Preparation	3,322	4	0,830
7	Ceiling	4,956	6	0,826
8	Wall	4,941	6	0,824

For the ranking of the sub-factors of the results of the Relative Importance Index, the image is the most influential sub-factor for doing quantity take-off using QTO BIM. Ranking of sub factors can be found in Table 2.

Tabel 2. Rank of Sub Factor

Rank	Sub Factor	Main Factor	RII
1	Drawing	Tender Document	0,995
2	Bill Of Quantity	Tender Document	0,990
3	Specification	Tender Document	0,985
4	Operator Experience	BIM Operator	0,980
5	BIM 3D Modeling	BIM QTO Process	0,976
6	Selection Individual model	BIM QTO Process	0,971
7	Quantity Take-Off	BIM QTO Process	0,966
8	Calculation	BIM QTO Process	0,961
9	Cost Database	BIM QTO Process	0,956
10	Operator Education	BIM Operator	0,951

### V. CONCLUSION

- Tender Document is the most important source data to make BIM quantity take-off work accurately.
- Quantity take-off on office building fit-outs has specificities and variations in forms and finishing modules that are dynamic by following the creativity of designers, complete and detailed 3D BIM models will facilitate quantity processing take-off.
- Considering that the material used in the fit-out has a variety of different types and raw material modules, if modeling has followed material standards and updating between designers and material products through the BIM interface, it can be expected in the future the compatibility between material production modules with the material dimensions of the fit-out design will result in efficiency and minimization of waste [20], [21]

- Further discussion is needed between fit-out industry players to discuss together the standardization of how to measure finishing building materials for office buildings in order to facilitate perception equalization, which will reduce dispute from the tender design process to the implementation process quantity take-off in the office building fit-out, it has the distinctiveness and variety of forms and finishing modules that are dynamic according to the creativity of the designer, a complete and detailed 3D BIM model will facilitate the processing of quantity take-off.

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