# Project Cost Estimation Based on Standard Price of Goods and Services (SHBJ)

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**Abstract.** Cost estimation is determining the probable cost of a project, which is critical in project development. For government projects in Indonesian construction industry, it is common to use a standard price of goods and services (called SHBJ) publised by the government as a cost reference. This research examines whether the SHBJ provide sufficient and reliable data. A case study from a contractor's bidding document (RAB) and the SHBJ from the city of Yogyakarta are employed. The result shows that cost estimation based on the SHBJ and the contractor's RAB gives 12% difference. Using SHBJ data from years 2010 – 2016 a regression equation is obtained as $Yi = 62,156 X + 2,003,962$ which can be used to estimate project cost in the future. This research also suggests some improvments for the SHBJ.

## 1 Introduction

Cost estimation is determining the probable cost of a project, which is critical in project development. Cost estimation is needed by all parties of project such as owner who to obtain reasonable price; engineer to develop enginner's estimate and contractor to bid a project.

There are several methods of cost estimation such as expert judgment, analogous estimate, parametric estimate, detailed estimate, etc. [1]. Expert judgment is determining cost estimates based on expert's experience from the past. Analogous estimate calculates based on similar projects. Parametric estimate applies parameter such as area per square meter. While detailed estimate calculate based on detail components of the project. Each method has its own certain level of accuracy, feasibility estimate 25-30%, appropriation 15-25% and detailed estimate 5 - 15% [2]. Cost accuracy is not easy to determine, but it can be detected from large cost overrun or underrun [3].

In construction projects parametric and detail estimates are the most commonly used methods. Here is an example of parametric estimate for a building with area of 1.000 m2 and cost per square meter Rp. 5.000.000; so the estimated cost will be 1,000 m2 x Rp. 5,000,000 = Rp. 5.000.000.000. Whereas in detail estimate the calculation is based on the volumes of all components of the project multiplied by the unit prices. So cost will be equal to volume times the unit price. The unit prices are determined from a standard unit price and depend on the cost of resources (materials, wages, equipment, etc.).

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There several sources of data as cost references such as catalogs, surveys, historical data, etc. Reliable data is very important since inaccurate data can cause loss [4]. Standar price of goods and services (SHBJ or Standar Harga Barang dan Jasa) published by the government annually is widely used. The prices in the SHBJ are the highest price limit allowed in a government project. For construction sector the SHBJ provide prices of materials and wages and the unit price per square meter for building projects [5].

This research aims to examine data of the SHBJ, i.e. the price of materials and wages and the unit price per square meter, whether the SHBJ has accomodated all data required for developing cost estimate and whether they provide fair prices. This research also utilises SHBJ from 2010 to 2016 to obtain regression equation for cost prediction. Lastly this research suggests improvment of the SHBJ.

## 2 Methodology

This research uses a case study from a contractor's bidding document (called RAB) which is a detailed estimate. The RAB consists of several tables, i.e. Recapitulation, Bill of Quantity, Unit Price Analysis and Price of Material and Wages. Calculations in the RAB basically following steps as shown in Figure 1 and can be explained as follows:
- Detemine the price of material dan wages
- Calculate the unit price, usually using SNI standard
- Calculate the bill of quantity
- Cost recapitulation
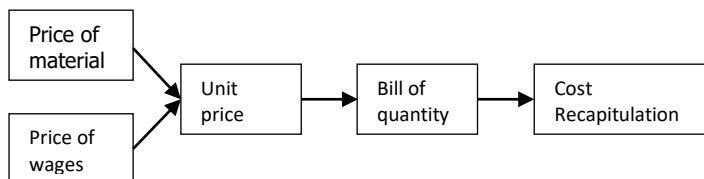


**Fig. 1.** Steps in cost calculation

To calculate cost estimate based on the SHBJ, data from the SHBJ are inputted into the table of Price of Material and Wages. If data are not available in the SHBJ then data from the contractor's bidding is applied. The contractor's bidding is in 2015, so to obtain prices for different years, annual indexes of construction prices are used. Table 1 shows construction indexes published by the Central Bureau of Statistics. Price of material in year i is calculated as follow:

$$\textit{Price (year i) = (indexyear-i / index 2015) x Contractor's price} \qquad (1)$$

For example, a material iron strip is not found in the SHBJ 2010 and the contractor's price is Rp. 12.000. Then the price in 2010 is calculated as (100 / 130,27) x Rp. 12,000 = Rp. 9.211.

**Table 1.** Construction Index

| Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|------|------|--------|--------|--------|--------|--------|--------|
| Index | 100 | 103,78 | 108,64 | 111,89 | 122,70 | 130,27 | 132,43 |

# 3 RESULT AND DISCUSSION

## 3.1 Project in the Case Study

The case study project is a two-story office building with an area of 1,258 m2 located in Gunung Kidul distric, Yogyakarta. The building is a reinforced concrete structure with lightweight steel roof truss. The components of the building consist of 14 groups of work, some of which are preparation, earthwork, masonry, concrete, roof works, etc. The RAB is Rp. 2,743,289,872 before tax and it is in 2015.

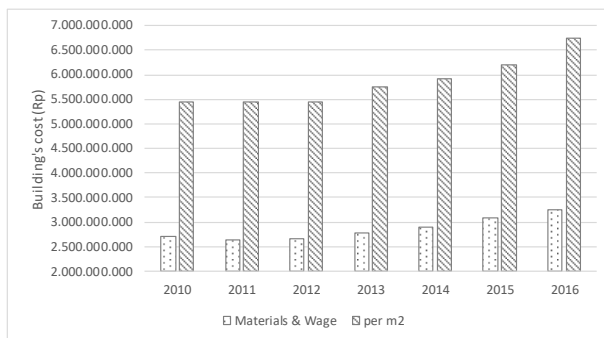## 3.2. Project Costs Based on the SHBJ

Based on the price of materials and wages from the SHBJ 2015 it is found that the cost of the project is Rp. 3,076,787,720. Compared to the contractor's bid Rp. 2,743,289,872 there is a difference of 12%. This difference is reasonable as it is in range of 15 – 25 % detailed estimate accuracy [2].

The SHBJ provides cost of area per square meter for simple building and complex building. For the year 2015 cost per square meter for the simple building is Rp. 3,522,142 and for complex building is Rp. 4,931,000. The building in the case study can be classified as complex building as it is more than 500 m2 and two-story, so the price is 1,258 m2 x Rp. 4,931,000.00 = Rp. 6,203,198,000. Compared to the contractor's bidding (Rp. 2,743,289,872) it is 126% more expensive. This difference is very large so it needs to be checked further. Another research also found that cost per square meter of the SHBJ is over estimate up to 90% and suggested improvement of the standard [6]. If applying the classification of simple building, the building price would be 1.258 m2 x Rp. 3.522.142 = Rp. 4,430,855,714 or 62% deviation and it is also consider quite large different.

Table 2 shows the SHBJ's cost per square meter in 2010 – 2016. By multiplying these costs with the area of the buildings, costs of the building for these years can be obtained. Figure 2 compares these costs with the project costs based on the SHBJ's price of materials and wages.

**Table 2.** SHBJ's Cost per square meter for complex building in Gunung Kidul Distric

| Year | Cost per m2 (Rp) |
|------|------------------|
| 2010 | 4,322,000.00 |
| 2011 | 4,322,000.00 |
| 2012 | 4,322,000.00 |
| 2013 | 4,582,000.00 |
| 2014 | 4,696,500.00 |
| 2015 | 4,931,000.00 |
| 2016 | 5,367,000.00 |

**Fig. 2.** Costs based on the SHBJ's price of materials and wages v.s. Price of area per square meter

## 3.3 Annual Project Price and Regression Equation

Figure 3 shows project prices based on the SHBJ's material and wages prices in 2010 to 2016. Price in 2011 declined 2,48% caused by the lower price of some materials such as crushed stone, tile, wood, wall paint, door lock and water tap. Then since 2012 the price increased 0.83%, 4.44%, 4.23%, 6.14% and 6.00% yearly.
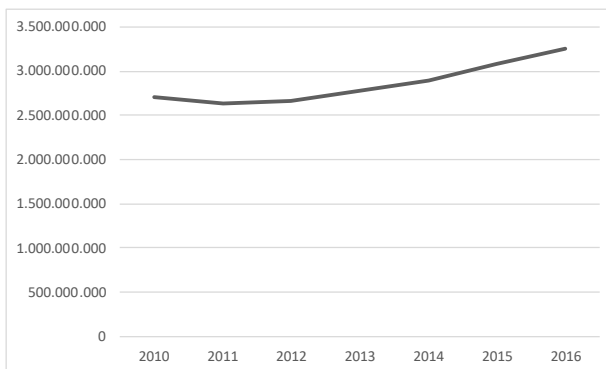


**Fig. 3.** Annual Project Prices based on the SHBJ

Based on project costs in 2010-2016 a linear regression can be drawn and an equation is obtained as $Yi = 62,156 X + 2,003,962$. $Yi$ is cost per square meter in year-i, while $X$ is year-i – 2009. This equation can be used to estimate project cost in the future. For example to estimate building cost in 2020 the cost per square meter can be calculated as $Yi = 62,156$ $(2020 – 2009) + 2,003,962 = 62,156 (11) + 2,003,962 = 2,687,678$. If the the building's area is 1,258 m2 then the price can be estimated as Rp. 2,687,678/ m2 x 1,258 m2 = Rp 3,381,098,924.

## 3.4 Suggestion for Improving SHBJ

From 126 material in the contractor's RAB, 35 items are not available in the SHBJ such as steel plate, plasterboard edge, dolken wood, door hinge, hooks, roster, natural stone, bathtub, floor drain, conblock, weathershield paint, and ridge. This indicate that the SHBJ are not complete. New or innovative materials such as readymix, precast, and other advanced materials have not been accomodated yet in the SHBJ.

Some of material prices in the SHBJ have significant difference from the contractor's prices such as wood, coating and alcasite which have difference up to 24 - 36% and other

materials even have difference greater more than 200% such as ridge, tap, floor and nail. The prices of these materials need to be rechecked.

Some materials have different names on the SHBJ compare to that in the contractor's document such as for sandpaper, door lock, gravel, common rafter, nail, etc. Although these differences can be understood, but standardization of names would be beneficial for clarity. Similarly some materials have different units such as meter vs piece, m2 vs sheets, m3 vs piece, etc. Standardization of units is also important for ease and to avoid errors in cost calculation.

## 4 Conclusions

The SHBJ provides two references for cost estimasting, i.e. the price of materials and wages and the standar price per square meter to estimate building projects. The price of materials and wages in the SHBJ provides quite accurate result as can be seen from the case study that it results in difference of about 12% against the contractor's RAB. Whereas the standar price per square meter gives quite a large difference of up to 62% - 126%. The standar price per square meter therefore need to examined further to provide reasonable price. Based on the analysis of annual prices from the SHBJ in 2010-2016, a linear regression equation is obtained, i.e. $Y_i = 62,156\ X + 2.003.962$ which can be used to estimate cost per square meter in the future. The equation can be applied for projects in Gunung Kidul District of Yogyakarta, but for other places should be adjusted with location factor. The study also suggest some improvement for the SHBJ such as to complete resources which are not available yet, more accurate price, and standardization of resource's names and units.

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