Production Cost Budgeting and Evaluating using Android Device Application

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Abstract

For manufacturing companies, production costs are the largest cost components. These costs consist of raw material cost, labor cost and factory overhead cost. Miscalculation of production costs can make manager difficult to assign company profit. Therefore, the calculation of profit using profitability rasio, plays important role for measure of compay eficiency. This research proposes an application for calculating production cost budget, from calculation of the cost of raw materials, labor costs, and factory overhead costs. This application can also evaluate budget realization, and perform variance analysis. Android platform was chosen for its mobility of use and operating system popularity. With system proposed, the company can set standards and budgetary target, determine their production cost precisely and evaluate budget realization. Costs caused by over or under buying raw material can be avoided. Furthermore, variance analysis generated can be used as performance measurement and control at the level of responsibility center (such as unit, department or division) of the company.

Keywords: *production cost; budget, measurement, evaluating, application, android*

1. Introduction

Raw material cost, labor costs and factory overhead costs are the largest cost component in manufacturing process. These three costs also known as production cost. Miscalculation in determining this cost can drastically reduce the profit, and the manager will be difficult to calculate the company profitability (the ability of company make a profit). The production cost depends on the number of units have to be manufacture, which is the sum of units to be sold and units to be stored. Budgeting is one method to make a profit planning.

There are number of factors to be considered in calculating budget, such as material price, transport cost, labor cost, utilities. These costs may fluctuate in a matter of time, sometimes unpredictable, making it challenging to calculate precisely. In this research, we propose a design to an application that can calculate production cost budget from calculation budget of raw material cost, direct labor cost and factory overhead budget. The application also records the budget realization and perform variance analysis for each budgeted costs. To achieve higher level of portability, this application is developed on mobile device (smartphone) platform. The application is designed as a general, which means it can be used by various manufacturing companies, not exclusively designed for one company. Android-based platform is chosen since it has higher marker share as smartphone operating system, as shown in Figure 1. While the unpredictability of the cost is still out of the equation, the application can perform calculation in much shorter time and better precision. Result from the application can be distributed to related department quickly, so that management can perform faster decision making and adjustment to the production process.
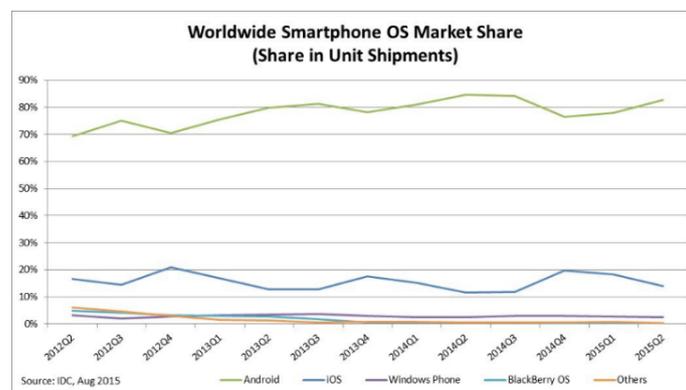

Fig. 1: Worldwide Smartphone OS Market Share (IDC, 2015)

Some of related research are as follow. (Cheung, April 1986) presented the widely use of operating budget in Hong Kong company by 35 managers. (Joshi, Al-Mudhaki, & Bremser, 2003) conducted a survey and proposed that budgeting and evaluating cost become an important thing in many kind of company. Later, the variance budget was used to evaluate manager performance. (Fruitticher, Stroud, Laster, & Mehenna Yakhou, 2005) described budgeting process in health care, education firm and insurance. (Raghunandan, Ramgulam, & Raghunandan-Mohammed, July 2012) conducted budgeting behavior research in many industries.

An algorithm, model and application was introduced to budgeting and evaluating company cost. (Guimarães, Klabjan, & AlmadaLobo, March 2012) introduced an algorithmic method to budgeting annual cost in beverage industry. (Cesarotti, Silvio, & Introna, 2009) made a model of process budget and control to estimate the industry. Anderson made an application for scheduling and budgeting in food and travel company (US Patent No. US 2009/0063245 A1, 2009). (Cui, Xu, Hou, He, & Wang, 2011) made an application to budget the material needed in ship building.

2. Production Budget and Variance Analysis

In this section we will discuss theories about production budgets and variance analysis.

Budgets

Production budget shows the number of units to be manufactured. It is derived from projected sales and desired inventory (Garrison, Noreen, & Brewer, 2014). The result from production budget is used to prepare direct material budget, direct labor budget and manufacturing overhead budget. Direct Material Budget describes how much raw material needed, to be processed in production as well as to be stored for inventory. Direct Labor Budget, indicates the number of direct labor hours required to meet the production multiplied by the standard direct labor cost per hour. Manufacturing Overhead Budget, shows budget and schedule of the entire production costs other than raw materials and direct labor. The formula to determine the estimated overhead is as follows.

Estimate Overhead=total cost overhead÷total hours

After breaking down production budget to direct material budget, direct labor budget and manufacture overhead budget, cost to produce one unit can be determined. Budgeting process can be seen in Fig 2.
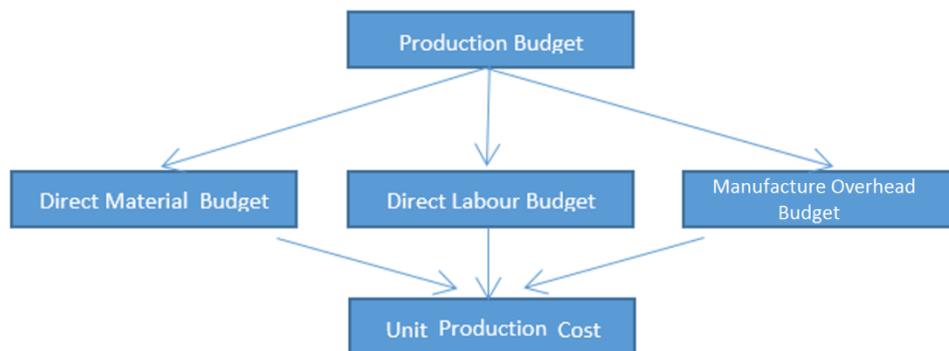

Fig. 2: Budgeting Process

Variance Analysis

After production process, it is necessary to compare actual costs to standard or normal costs. When the actual costs is lower than the standard costs, it will be stated as "favorable variance", otherwise, when the actual costs higher than the standard costs, it will be stated as "unfavorable/adverse variance" (Atkinson, Kaplan, Matsumura, & Young, 2012). Variance for each component in production budget and fixed overhead variance can be analyzed to determine whether it is "favorable" or "unfavorable" (Whitecotton, Libby, & Fredphilips, 2011). These components are as follow.

- Direct Raw Materials Variance, indicates the difference between budget and actual cost of direct material, also known as direct material total variance. This variance can be divided into material price variance and material quantity variance.
    - o Material Price Variance (MPV) measures the difference between projected cost and the actual cost of the raw materials (Whitecotton, Libby, & Fredphilips, 2011). MPV is calculated using equation below.
    $$MPV = (SP \times AQ) - (AP \times AQ)$$
    where
    AP = actual price/unit
    SP = standard price/unit
    AQ = actual quantity of raw materials used in production
    - o Materials Quantity Variance (MQV) measures the difference between the quantities of projected and the actual direct raw materials used in production. MQV is calculated using equation below.
    $$MQV = (SQ \times SP) - (AQ \times SP)$$
    where
    AQ = the actual quantity of raw materials used
    SQ = standard quantity of materials
    SP = standard price/unit

- Direct Labor Rate Variance, indicates the difference between budget and actual cost of direct labor, also known as direct labor total variance. This variance can be divided into labor rate variance and labor efficiency variance.
    - o Labor Rate Variance (LRV) calculates the difference between direct labor to be paid and actual cost of the labor.

LRV is calculated using equation below.

$$LRV = (SR \times AH) - (AR \times AH)$$

where
AR   = the actual hourly wage rate
SR   = the standard hourly wage rate
AH   = actual labor hours used

- o Labor Efficiency Variance (LEV) measure the difference between actual and projected manpower hours occurred. LEV is calculated using equation below.

$$LEV = (SH \times SR) - (AH \times SR)$$

where
SH   = standard direct labor hours
SR   = the standard wage rate per hour
AH   = actual direct labor hours.

- Factory Overhead Variance, indicates the difference between budget and actual cost of variable overhead, also known as variable overhead total variance. This variance can be divided into variable overhead rate variance and variable overhead efficiency variance.
  - o Variable overhead rate variance (VORV) measures the difference between the actual and standard of variable overhead costs, multiplied by the actual direct labor hours used. VORV is calculated using equation below.

$$Variable\ Overhead\ Rate\ Variance = AH \times (SR - AR)$$

where
SR   = standard variable overhead cost
AH   = actual hours used
AR   = the cost of the actual variable overhead.

  - o Variable overhead efficiency variance (VOEV) measures the difference between the amount of actual direct labor hours used and the number of hours of direct labor standards multiplied by the cost of standard variable overhead. VOEV is calculated using equation below.

$$Variable\ overhead\ efficiency\ variance = SR \times (SH - AH)$$

where
SR   = standard variable overhead cost
AH   = actual hours used
SH   = standard hours are supposed to be used.

- Fixed overhead variance measures the difference between the actual and standard of fixed overhead cost. Fixed overhead variance is calculated using equation below.

$$Fixed\ overhead\ variance =$$
$$fixed\ overhead\ standard\ tarif - fixed\ overhead\ actual\ tarif$$

The total variance can be analyzed into fixed overhead expenditure and volume variance.

3. Proposed Application

Application was designed by using use case diagram and class diagram as design tools (Rosa & Shalahuddin, 2015). MySQL is used for the database.

System Architecture
Error! Reference source not found.3 shows system architecture for the proposed application. Database is stored in a server connected to the internet through access point or router. Web server acts as service provider for the user to access the service. To use the service, users install the application in their android-based mobile device, and connect to the server via internet.
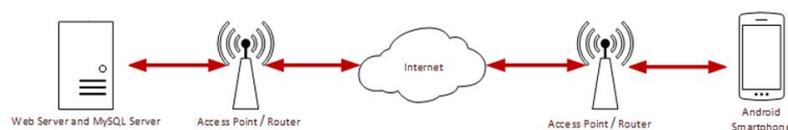

Fig. 3: System Architecture

Application Design
To model application behavior, use case diagram is used. This diagram describe interaction between actors within application. Use case diagram for proposed application can be seen in Fig. 4.
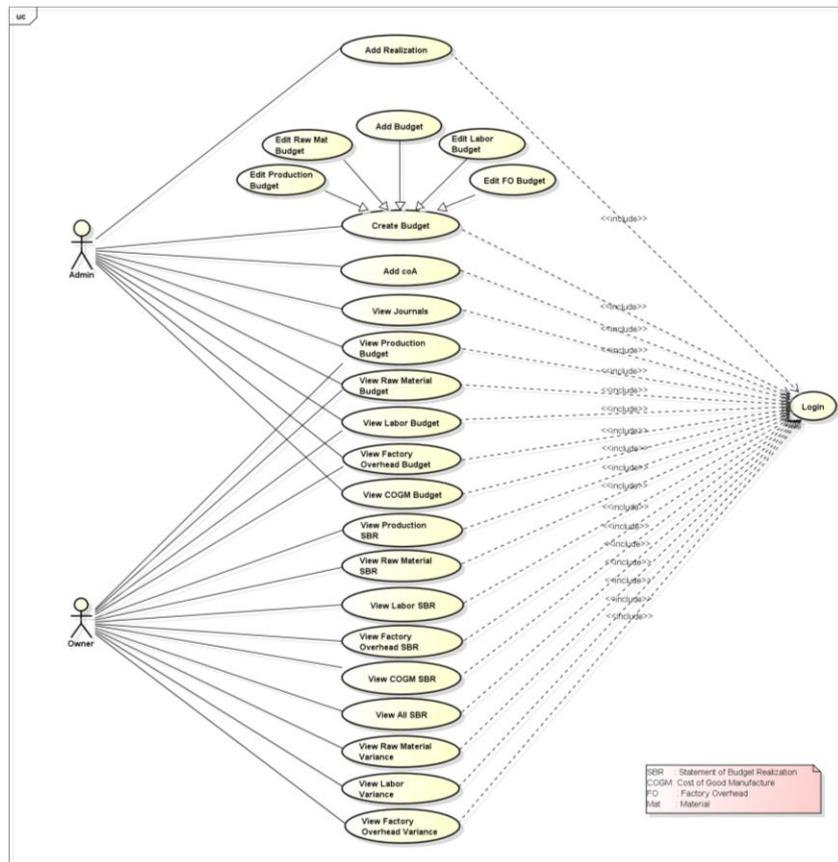
Fig. 4: Use Case Diagram

There are two level of user in this application. People who operates at daily basis will be classified as "admin" or "operator" while "owner" can supervise details of the daily operations.
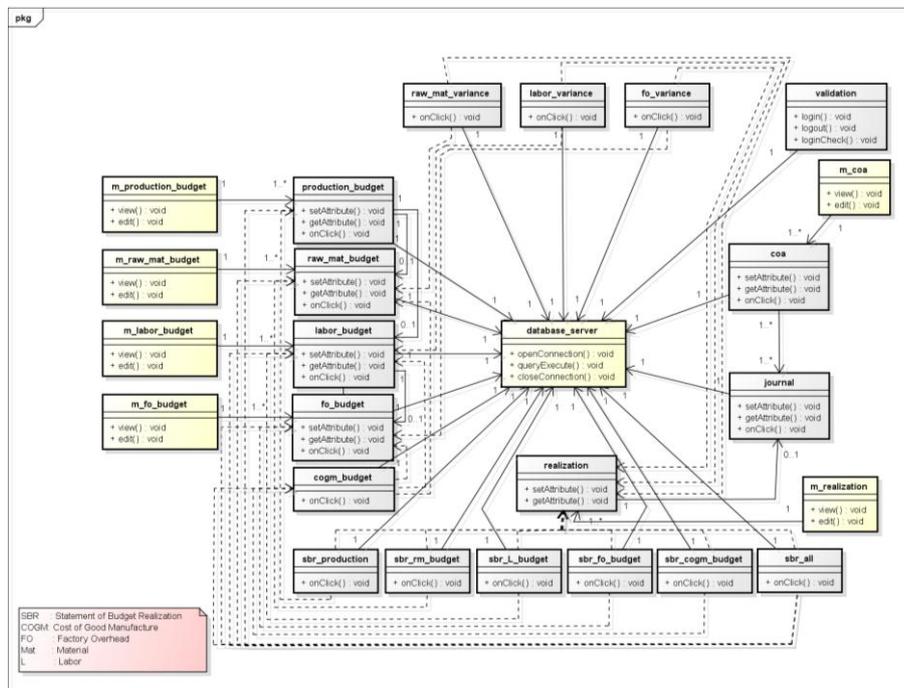

Fig. 5: Class Diagram

Class diagram describes relationship and dependencies among classes in Unified Modeling Language. A class defines methods and variables in an object, which is a particular unit in a program. Fig. 5 shows class diagram for proposed application.

Business Process
Admin enters production budget as the basis of the production process. Direct raw material budget, direct labor budget and factory overhead budget are entered into the application. After the actual production finished, actual costs for each activity are then entered into the application.
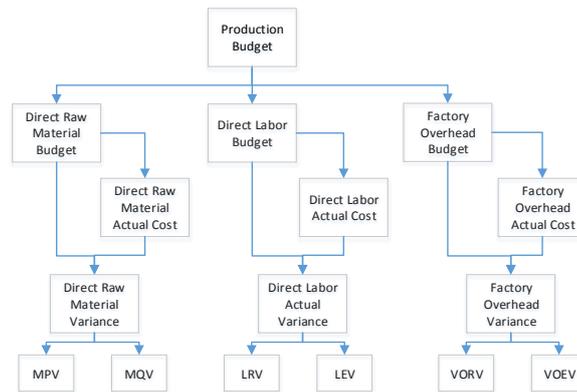
Fig. 6: Application Business Process

Application automatically calculate variance for each budget. These variances calculated by using budget and realization (actual) data previously entered. Then for each output, two variances are analyzed whether it is favorable or unfavorable. Complete diagram of the application business process can be seen in Fig. 6

4. Discussion and Conclusion

This paper proposes android based application to calculate budgeting and evaluating production cost which also calculates production budget, direct material budget, direct labor budget, manufacturing overhead budget and production cost per unit. Each result from budget component is compared with actual cost and then the variance is analyzed.

Total time needed to calculate budget using the application and conventional calculation is compared. Time needed for every budgeting process is described in Table. 1. The result is used to measure efeciency of the application (Garrison, Noreen, & Brewer, 2014). Budget calculation using the application is faster 3.8 times than conventional calculation process.

Table. 1: Comparison Result of Budgeting Process Calculation (in minute)

Method	Budgeting Process					Estimated Total Time (min)
	Production	Raw Material	Labor	Factory Overhead	Production Cost	
Conventional	3	2	2	2	3	12
Mobile	0.5	0.5	0.5	0.5	0.5	2.5

Variance between budgeting and actual cost can be calculated automatically after all parameters are entered into the application, resulting almost instant variance report. The report can be used for managers or decision makers to evaluate planning process, which will become basis to evaluate company profit.

Android device provide convenience and mobility for managers and other decision makers to evaluate their actual performance anytime, in real time. In that matter, they can anticipate higher variance result. Besides, an admin only input the value of the budget as requested application, from the results of input will automatically amount views of each component of production budget made by the system.

Price fluctuation can be caused by predicted events such as season, public holiday or location. Much harder to predict, price fluctuation can also be caused by political event, disaster or act of God. While this application can deliver quick and precise budget calculation, it is interesting if it can predict price fluctuation in the future, at least for the predicted event.

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