Implementation of Quality Management System to Determining the Quality Cost in Construction Company Which Undertaking Single Project

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Abstract
Efforts to improve the quality of national construction often causes increased quality cost involved as well. Therefore, this study was conducted to test variables in the quality cost of the management system that is most influential in determining the quality cost and model it using multiple linear regression methods. The data collected comes from questionnaires distributed to workers of PT Jasa Bhakti Nusantara who understand construction quality issues. The results showed that four variable costs in the quality management system simultaneously does not have a significant effect on the quality cost because the significance value 0.104 > 0.05 error rate. However partially, appraisal cost has a significant influence on the quality cost which is 0.021 < 0.05 error rate. While the regression model obtained is \( Y = 3.708 + 0.705 X_1 - 1.215 X_2 + 0.376 X_3 - 0.448 X_4 \). Based on this model, the cost elements of quality management system that can reduce the quality cost are appraisal cost and external failure cost. While prevention cost and internal failure cost potentially could increase the quality cost.

Keywords: quality management system; quality cost; multiple linear regression; model

INTRODUCTION
Toward the ASEAN Free Trade era in 2015 is an opportunity as well as challenges that are inevitably encountered in each field, including the national construction business. This field would be more promising and ready to face the ASEAN Economic Community (AEC) 2015. However, the AEC also practically cause reverse effects. It means Indonesia construction market is also not spared from the target of foreign contractors as a consequence. Therefore, a solution to overcome this is by upgrading the quality of construction. In this context, quality is regarded as one of the key elements of the methods and techniques of project management. As a consequence, the quality management system should be applied both at the corporate level (corporate level) as well as in the project (project level).

The application of quality management system can provide added value to the implementation of construction projects, such as minimizing product that does not meet the requirements, reduce reworking that could eventually optimize marginal profits, and increase.

This study aims to test empirically the variable costs in the quality management system of the most influential in determining the cost of quality, as well as to search for multiple linear regression model of the relationship between the variable cost of the quality management system at the cost of quality. This research was conducted by reexamine variables that affect the determination of the cost of the quality of the research conducted by Matulatan, et al (2013). In accordance with the recommendation of the previous studies, the sample used in this study is more homogeneous.
LITERATURE REVIEW

Quality management is an overall method for measuring the quality of an organization including product, service, process performance, and human resources. While the quality management system is a set of documented procedures and standard practices for management system that aims to ensure the suitability of a process and a product (goods and / or services) to specific needs or requirements.

Nugroho, et al (2012) suggest a quality management system is a system that evolved from quality inspection systems, quality control, and then developed into a quality assurance until then be integrated quality management system. The quality management system is closely related to quality cost. Quality costs are the costs that may be incurred due to poor quality and do exist. Quality costs related to the two subcategories of activities about quality control activity and failure activity.

Control activities are activities undertaken by an organization to avoid or detect poor quality. So control activities consist of preventive activities and assessment activities. And control costs are costs incurred as a result of the control activities.

Failure activities are activities undertaken by an organization or its customers in response to poor quality. In response to the appearing quality before shipping a bad product to customers, the activity is classified as an activity of an internal failure, otherwise the activity is classified as an activity external failure. Failure costs are incurred or posed by the organization for doing failed activity. Aspects of quality costs by Indhira, et al (2013) include:

a) Prevention costs are those costs related with all activities to prevent future damage and to keep the appraisal and failures to a minimum.

b) Appraisal costs are the costs that appear because of the need to control products and services to ensure a high level of quality in all fields, suitability quality standards, and implementation requirements.

c) Internal failure costs are the costs caused by deficiencies found before shipping products and services to outside parties, which consequently may lead to dissatisfied customers.

d) External failure costs are the costs caused by deficiencies discovered after shipping products and services to outside parties, which led to a dissatisfied customer.

Fig. 1: Research Model
RESEARCH METHODOLOGY
Samples in this study are employees of PT Jasa Bhakti Nusantara, the executor of development projects RSP UHO first phase, which is considered to understand the problem of construction quality. These employees are the people who already have work experience in the field of construction at least 3 years.

While the literature obtained cost elements in a quality management system which is used as the independent variable (X) and dependent variable (Y) is quality cost, as presented in Figure 1 below:

RESULTS AND DISCUSSION
Validity Test
Dimensions in this study is valid if the correlation value of each indicator with a total score indicator ($r_{count}$) greater than $r_{table}$. Significance $r_{table}$ used by 5% with 2-sided test. The test results of four independent variables i.e:

Table 1. Validity Variables

<table>
<thead>
<tr>
<th>Indicator</th>
<th>$r_{count}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Control ($X_{11}$)</td>
<td>0.843</td>
</tr>
<tr>
<td>Quality Planning ($X_{12}$)</td>
<td>0.954</td>
</tr>
<tr>
<td>Quality Audit ($X_{13}$)</td>
<td>0.954</td>
</tr>
<tr>
<td>Training ($X_{14}$)</td>
<td>0.866</td>
</tr>
<tr>
<td>Verification/Inspection ($X_{21}$)</td>
<td>0.735</td>
</tr>
<tr>
<td>Product Quality Audit ($X_{22}$)</td>
<td>0.952</td>
</tr>
<tr>
<td>Maintaining and Calibrating Equipment ($X_{23}$)</td>
<td>0.893</td>
</tr>
<tr>
<td>Evaluating of Stock ($X_{24}$)</td>
<td>0.771</td>
</tr>
<tr>
<td>Scrap ($X_{31}$)</td>
<td>0.959</td>
</tr>
<tr>
<td>Rework or Retification ($X_{32}$)</td>
<td>0.812</td>
</tr>
<tr>
<td>Material-procurement Cost ($X_{33}$)</td>
<td>0.959</td>
</tr>
<tr>
<td>Failure Analysis ($X_{34}$)</td>
<td>0.817</td>
</tr>
<tr>
<td>Repair and Servicing ($X_{41}$)</td>
<td>0.859</td>
</tr>
<tr>
<td>Warranty Claim ($X_{42}$)</td>
<td>0.859</td>
</tr>
<tr>
<td>Complain ($X_{43}$)</td>
<td>0.818</td>
</tr>
<tr>
<td>Liability ($X_{44}$)</td>
<td>0.818</td>
</tr>
</tbody>
</table>

Based on the above output, the value of $r_{count}$ of each indicator is greater than $r_{table}$ value amounted to 0.576. This means that the four variables are valid as dimensions.

Reliability Test
Instrument reliability testing conducted using Cronbach Alpha formula. The result can be seen in Table 2.

Table 2. Reliability Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>$r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention Cost ($X_1$)</td>
<td>0.921</td>
</tr>
<tr>
<td>Appraisal Cost ($X_2$)</td>
<td>0.855</td>
</tr>
<tr>
<td>Internal Failure Cost ($X_3$)</td>
<td>0.910</td>
</tr>
<tr>
<td>External Failure Cost ($X_4$)</td>
<td>0.859</td>
</tr>
</tbody>
</table>

Multicollinearity
Output value of variance inflation factor (VIF) of the four models no larger than 10. So even his tolerance value there is no value less than 0.10. This shows that the model is free from multicollinearity.
### Table 3. Collinearity Statistics

<table>
<thead>
<tr>
<th>Model</th>
<th>Collinearity Statistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tolerance</td>
<td>VIF</td>
</tr>
<tr>
<td>Prevention Cost</td>
<td>0.186</td>
<td>5.387</td>
</tr>
<tr>
<td>Appraisal Cost</td>
<td>0.224</td>
<td>4.456</td>
</tr>
<tr>
<td>Internal Failure Cost</td>
<td>0.416</td>
<td>2.403</td>
</tr>
<tr>
<td>External Failure Cost</td>
<td>0.545</td>
<td>1.835</td>
</tr>
</tbody>
</table>

#### Autocorrelation
Autocorrelation test conducted using the Runs Test with significance level of 5%. From the results obtained Asymptotic Significant value amounted to 0.762 is greater than 0.05. This shows that there is no autocorrelation in this research model.

#### Heteroskedastisity
From the heteroskedastisity test result appears that the distribution point not form a pattern / a certain groove, so that it can be said does not happen heteroskedastisity or in other words going homokedastisity. It can be stated that the requirements of classical assumption test for freed from heteroskedastisity has been fulfilled in this model.

#### Normality Test
Normality test results can be seen on the figure above. The figure shown distribution points relatively close to a straight line. It can be concluded that the data are normally distributed.
Countability Model Test (F Test)
Probability value of F count (Sig.) obtained from F test table is 0.104 greater than the error rate (alpha) of 0.05. This means that four independent variables simultaneously did not have a significant effect on the dependent variable on a 95% confidence level.

Coefficient Regression Test (t test)
Based on the results of the t test, the obtained statements as below:

a) Probability value of t count from independent variable Prevention Cost amounted to 0.164 greater than error rate (alpha) of 0.05. So it can be stated that the prevention cost does not have a significant effect on the quality cost at 95% confidence level.

b) Probability value of t count from independent variable Appraisal Cost amounted to 0.021 less than the error level (alpha) of 0.05. So it can be stated that the appraisal cost has a significant effect on the quality cost at 95% confidence level.

c) Probability value of t count from the independent variable Internal Failure Cost amounted to 0.149 greater than error rate (alpha) of 0.05. So it can be stated that the internal failure cost has no significant effect on the quality cost at 95% confidence level.

d) Probability value of t count from independent variable External Failure Cost amounted to 0.191 greater than error rate (alpha) of 0.05. So it can be stated that the external failure cost has no significant effect on the quality cost at 95% confidence level.

Coefficient of Determination
Seen from value of Adjusted R Square that amount of 0.409 indicates that the proportion of four independent variables to the dependent variable just amounted to 40.9%. Thus, it can be said that the effect of prevention cost, appraisal cost, although internal and external failure cost against quality cost is just around 40.9%. While the remaining 59.1% is affected by other variables that are not included in this study.

After passing several tests, the regression model is obtained as below:

\[ Y = 3.708 + 0.705 \; X_1 - 1.215 \; X_2 + 0.376 \; X_3 - 0.448 \; X_4 \]

Explanation:

\( Y \) = Quality cost

\( X_1 \) = Prevention cost

\( X_2 \) = Appraisal cost

\( X_3 \) = Internal failure cost

\( X_4 \) = External failure cost

The coefficient constant has positive value shows that by assuming the absence of prevention cost, appraisal costs, internal failure costs and external failure costs, the quality cost will be increased by 3.708 per unit.

Meanwhile, the regression coefficient of prevention cost is also has positive value. This shows that by assuming the absence of other independent variables, then if prevention cost has increased, the quality cost tends to increase as well. In other words, every unit increase in the cost incurred for the prevention would causes quality cost increased 0.705 per unit.

While the regression coefficient of appraisal cost has negative value. Assuming there are no other independent variables, it can be stated that each unit of increase appraisal cost causes a decrease against quality cost amounted to 1.215 per unit.

The regression coefficient of internal failure cost shows a positive value. If assuming no other independent variables, then each unit of increase in the internal failure cost, increased quality cost amounted to 0.376 per unit.

The fourth regression coefficient that is external failure cost. The coefficient has a negative value if it is assumed that there are no other independent variables, then each unit increase in external failure costs, quality cost decreased by 0.448 per unit.
CONCLUSIONS AND RECOMMENDATIONS
The results of this study show that prevention cost ($X_1$), appraisal cost ($X_2$), although internal failure cost ($X_3$) and external failure cost ($X_4$) have no significant effect on quality cost ($Y$) simultaneously because the significance value 0.104 greater than error rate (alpha) of 0.05. However partially, appraisal cost ($X_2$) has significant effect against quality cost which is 0.021 less than error rate (alpha) of 0.05. Furthermore, the regression model obtained from this study is $Y = 3.708 + 0.705 X_1 - 1.215 X_2 + 0.376 X_3 - 0.448 X_4$. Based on this model, the cost elements of a quality management system that can reduce quality cost are appraisal cost and external failure cost. While prevention cost and internal failure cost could potentially be adding quality cost.

For further research, there are several recommendations in order to achieve completeness in this study.

a) The company sampled in this research project dealing with a contract value of Rp. 43,990,500,000 and unit price type. So further research is recommended to use a sample company whose characteristics are different, which is handling the project with a contract value is greater or smaller, although different types of contract.

b) There is a 59.1% proportion of large-small determinant variable quality costs that are not included in this study. So further research is recommended to do the research by adding new variables.

c) It is recommended to use more samples so that the results of further research more able represent the actual conditions than implementation of quality management system in determining quality cost.

d) It is recommended to use a more varied assessment scale to measure the variables used. This meant that there is a significant difference in the respondents' answers.

REFERENCES