

MAINTENANCE MANAGEMENT OF TRANSPORTATION EFFECT TO NATIONAL ROAD INFRASTRUCTURE COST PERFORMANCE IN ACEH PROVINCE

Hafnidar A. Rani

Civil Engineering Department
Engineering Faculty
University of Muhammadiyah
Aceh
Banda Aceh 23245
Telp: (0651)29921
hafnidar.ar@teknik.unmuha.ac.id

RiskiArief

Civil Engineering Department
Engineering Faculty
University of Syiah Kuala
Banda Aceh 23111
Telp: (0651) 7552018
sayariski@gmail.com

IrinCaisarina

Architecture Department
Engineering Faculty
University of Syiah Kuala
Banda Aceh 23111
Telp: (0651) 7552018
irene1805@yahoo.com

Abstract

It is being implemented the constructions of national roads laid from Takengon to Blangkejerenin Aceh province. The study objective is to identify maintenance management factors related to and affect to road infrastructure cost performance and also relation and influence levels to the each of the factors. To improve maintenance cost performance is required contract system solution for the future to road maintenance construction infrastructure. The response to the *Performance Based Maintenance Contract* (PBMC) is the majority of respondents (67.39%) agree and very agree to apply in the road infrastructure maintenance work in Aceh Province. The study results show that organizing factor becomes the most dominant factor that affects the cost performance, it is 80.70%. The whole maintenance management factors effects (planning, organizing, directing dan controlling) give 90.90% contribution to cost performance. It is expected that the positive response from the maintenance manager party of Construction Unit of Region I National Road of Aceh Province to a desire for a change from this time contract to performance based contract.

Keywords: Road infrastructure, maintenance management, cost performance, contract, Performance Based Maintenance Contract

Abstrak

Saat ini sedang dilaksanakan pembangunan jalan nasional yang terbentang mulai dari Takengon sampai Blangkejeren Provinsi Aceh. Tujuan dari penelitian ini adalah untuk mengidentifikasi faktor-faktor *maintenance management* yang berhubungan yang berpengaruh terhadap *cost performance* infrastruktur jalan serta tingkat hubungan dan besarnya pengaruh masing-masing faktor. Untuk meningkatkan kinerja biaya pemeliharaan jalan diperlukan solusi sistem kontrak untuk masamendatang pada infrastruktur konstruksi pemeliharaan jalan. Hasil dari opini responden terhadap sistem kontrak *Performance Based Maintenance Contract* (PBMC) adalah mayoritas responden (67,39%) setuju dan sangat setuju untuk diterapkan pada pekerjaan pemeliharaan infrastruktur jalan nasional di Provinsi Aceh. Hasil penelitian menunjukkan bahwa faktor *organizing* merupakan faktor yang paling dominan mempengaruhi kinerja biaya yaitu sebesar 80,70%. Pengaruh faktor-faktor *maintenance management* secara keseluruhan (*planning, organizing, directing dan controlling*) berkontribusi sebesar 90,90% terhadap kinerja biaya. Diharapkan adanya respon yang positif dari pihak pengelola pemeliharaan jalan Satuan Kerja Pelaksanaan Jalan Nasional Wilayah I Provinsi Aceh terhadap keinginan akan perubahan dari bentuk kontrak saat ini ke bentuk kontrak berbasis kinerja.

Kata kunci: Infrastruktur jalan, manajemen pemeliharaan, kinerja biaya, kontrak, *Performance Based Maintenance Contract*

Introduction

The changes due to the age and the loading factor as well as natural conditions have resulted the road constructions facing some changes like the shape, the strength, and the utility. Therefore the maintenance of road infrastructures becomes very important, so they can be refuctioned in accordance with the original purpose of development and extend the design period. In the road infrastructure maintenance, it is required binding contract between the owner and the implementers (contractors).

In the maintenance management implementation of the road infrastructure, it is required the contract that engage between the owner and the contractor. The contract that is usually used from some existing contract types is a unit price contract and fixed price contract. For the both contract types, the contractor only has responsibility to the contracted works.

This study is limited only to the national road project that lay from Aceh Tengah to Blangkejeren, Aceh Province, on routine road infrastructure maintenance in Aceh Reconstruction Project (IP-545) Road Sub Project Package No. 1, 2 & 3. This project is divided into three packages, they are: Aceh Reconstruction Project, Road Sub Project Package No. 1 which length is 34.510 km (Simpang Kraft Section – Aceh Tengah Border Section); Package No. 2 which length is 38.047 km (Aceh Tengah Border Section – Blangkejeren Section), and Package No. 3 which length is 52.182 km (Kebayakan Section - Simpang Kraft Section). The study involving 80 (eighty) respondents intern implementers' staff such as construction unit of Region I National Road of Aceh Province (owner), contractor, supervision consultant related to road maintenance activities.

Problem faced during the activities is the maintenance contract that has 1 (one) year period which is issued not in the appropriate time and this condition causes the waiting time (period), it affects the road construction maintenance and then the implementing activity delays 1 or 2 months or sometimes more. The delay could impact to the road damage volumes that become more if not urgent handling. With this condition, it is required to create a better contract type in order to make road maintenance management activity consisted of organizing, actuating and controlling factors not face any obstacles, in other words there is guarantee that the construction infrastructure is always well maintained.

Related to the existing problem, this study objective is to identify maintenance management factors related to and affect to road infrastructure cost performance and also relation and influence levels to the each of the factors mentioned above. To improve maintenance cost performance, it requires a contract system solution for the future contracts on national road maintenance construction infrastructure in Aceh Province.

Literature Study

1. Road Infrastructure Maintenance

Road maintenance handling at Public Work Agency (PU) of Aceh Province conducted regularly or periodically. Road routine maintenance is maintenance activities as well as

repair the damage that occurred on the road section with steady service conditions and road periodic maintenance is the prevention handling activities in order to prevent the wider damages and every damage calculated in design so that the road condition decreasing can be restored to the early design condition (Public Works Minister Regulation Number. 13/PRT/M/2011).

Road operation and maintenance activity is conducted to create the good enough condition, it arises because there is the tendency to spend the budget for the development and improvement purposes. Besides the limitation budget problem, the other problem that must be concerned is road institution capacity. Various aids from developed countries have been given to help in improving road institution performance, but the results are still not satisfactory. Indonesia as a developing country also faces a similar problem, where the budget becomes the main obstacle in road operation and maintenance activities (Zietlow et al., 1999).

2. Maintenance Management

Soeharto (1997) explains that management as a process of planning, organizing, directing and controlling the organization member work and using all the organization resources to achieve the organization expected goals, so generally management process can be grouped into: design (planning); organization (staffing); leadership (directing); control (controlling).

3. Contract

The contract is a document containing voluntary collective agreement, which has the law enforcement, where the first party promises to give services and provide material (for project construction) for the second party, while the first party promises to pay some money to the second party as a reward for services and material that has been used (Soeharto, 1997).

The Law of Construction Services No. 18/1999 which states that construction work contract is the whole documents managing legal relationship between service users and service providers in construction work implementation.

According to Nazarkhan (2009), the existing contract forms in Indonesia usually competed in the bidding, there are two kinds of contracts, they are lump sum contract and unit price contract, it is possible to create a contract that is a combination of the types of mentioned contracts and it is known as the combined contract/lumpsum and unit price.

Zietlow et al. (1999) argues that the Performance Based Contract (PBC) is a contract type based on payment to fulfill the minimum performance indicators. The contract period is long term between service users and service providers, which service providers carry out the work and the work evaluation is not based on the work volume of that has been done, but based on the service performance that has been achieved. The standard of this contract is a minimum performance of a contracted work and must be maintained by the service provider as the contract winner.

Stankevich et al. (2005) in the study explain that service providers tend to move to PBC approach is caused by some advantages compared to traditional contracts, they are:

- a. Maintenance cost savings and asset management;
- b. A service provider can estimate the certain budget;
- c. Smaller number of the workers needed to manage the project;
- d. Project user satisfaction to the service and higher project conditions;
- e. The guarantee budget for the multi-year maintenances.

4. Cost Performance

Thaher (2002) argues that the output of maintenance working process is cost performance. Cost performance measures from the percentage of actual cost with the detail design cost. The smaller percentage between actual cost and project design cost, means better performance of the project implementation.

Data

The primary data is obtained directly by distributing questionnaires and interviewing construction unit of Region I National Road of Aceh Province (owner), contractor and consultant involved in road infrastructure maintenance activity. The sampel determination is taken 22.3% from the population that is 358, so the sample number in this study is 80 respondents.

Secondary data is obtained from references of the road, the regulation of the public work ministry about the road maintenance and related journals. This data is required to obtain the theories, concepts and variables to support and strengthen this study.

Analysis

Quantitative analysis method used is SPSS (Statistical Product and Service Solution) version 19 analysis.

1. Descriptive Test

Respondent characteristics in this study were analyzed with descriptive test, respondents are grouped based on the latest education, respondent position, respondent experience, and the construction project type that he ever carried out. For the contract category, 56.25% of the respondents choose lumpsum contract, 30.00% of unit price contract, 13.75% of multiyear contract, while for Performance Based Maintenance Contract (PBMC), the respondents never use it for road infrastructure maintenance construction project.

The response to the PBMC, the majority of respondents (68%) agree and very agree that on road infrastructure maintenance work applies performance based contract or performance based maintenance contract in Aceh Province, it is shown in the below figure.

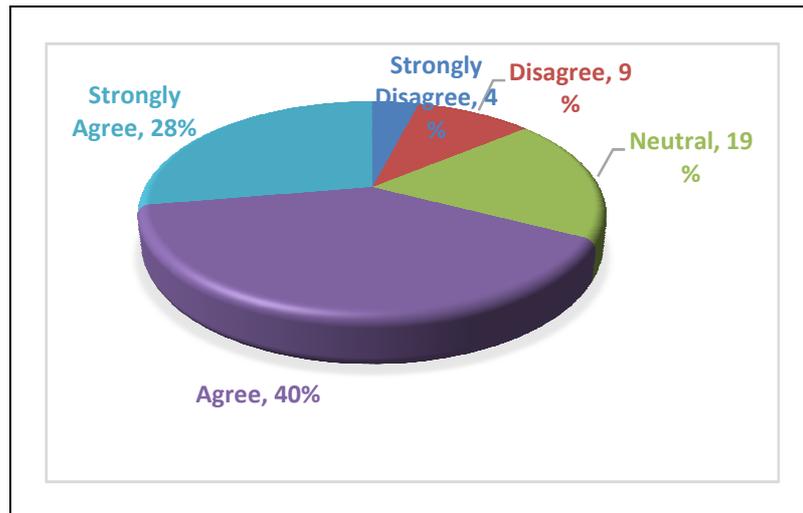


Figure 1 Response to the Performance Based Maintenance Contract

2. Reliability Test

In this study, the instrument reliability coefficient calculation is done using the cronbach alpha, in which to influence maintenance management to the cost performance of road infrastructure performance is obtained cronbach alpha coefficient of $0.955 > 0.6$. Because the reliability test fulfills in the questionnaire, the size stability and respondents consistency to the questionnaire in answering the questionnaire has been achieved thus the questionnaire achieves its reliability.

3. Correlation Analysis

From the calculation results, it is obtained the correlation relation of pearson correlation moment occurs among X1, X2, X3, X4 variables with Y variable (cost performance), which there is positive correlation relation and it is very strong on planning and organizing aspects, and there is a positive and strong correlation relation on directing and controlling aspects, as shown in Table 1 below.

Table 1 Correlation Analysis Result

No	Correlation Relation between X and Y Variables	Sig. value	Correlation value	Relation Level
X1	Planning aspect	0.000	0.876	Very Strong
X2	Organizing aspect	0.000	0.898	Very Strong
X3	Directing aspect	0.000	0.723	Strong
X4	Controlling aspect	0.000	0.698	Strong

4. Multiple Linear Regression Analysis

Multiple linear regression analysis result between X and Y variables are shown in Table 2. regression models formula obtained are:

$$Y = 1.851 + 0.529X_1 + 0.602 X_2 + 0.048 X_3 - 0.208 X_4$$

From the multiple linear regression model formula shows that the cost performance will increase if there is an improvement in planning, organizing and directing aspects. While the cost performance will be reduce if there is an improvement in of supervising and controlling aspects. The regression coefficient for the planning, organizing and directing aspects are greater than the regression coefficient for supervision and control.

Table 2 Multiple Linear Regression Analysis Result

No	Affect between X and Y variables	Coefficient	Sig.
	Constanta value (a)	1.851	0.254
X1	Planning aspect	0.529	0.000
X2	Organizing aspect	0.602	0.000
X3	Directing aspect	0.048	0.523
X4	Controlling aspect	-0.208	0.011

From the regression analysis results, it is obtained that the most dominant to the cost performance is the organizing factor. Directing factor does not significantly affect the cost performance. While the planning and controlling factors affect the cost of performance.

Table 3 below shows the contribution percentage of each X variable to Y variable. The maintenance management factor that the most contributing factor to the cost performance is organizing aspect.

Table 3 Variable of X Contribution to Y Variable

Variable	Aspect	Contribution
X1	Planning	76.70%
X2	Organizing	80.70%
X3	Directing	52.30%
X4	Controlling	48.70%

Result

1. Planning aspect (X₁);

The number of the relation between planning (X₁) aspect variable with cost performance (Y) has a correlation value of 0.876 and it means the positive correlation and it is very strong, it also can be shown from X₁ significant value is 0.000 smaller than 0.05, it means that there is affect between planning (X₁) aspect variable with cost performance (Y). The value of planning aspect variable affect to the project cost is 76.70%, and 23.30% of the remaining is determined by other variables that are not described in this study.

Planning aspects have a high contribution in determining the successful of the road infrastructure maintenance cost performance. The planning factor affecting 76.70% of the cost performance achievement. Some variables that affect the planning performance in the good cost performance implementation are: pre-qualification and

completing documents, completing facilities, owner estimate, completing drawings and work specifications, awarding meeting quality, realization, technical specifications, tender team quality, the information availability and the SPMK issued time.

2. Organizing aspect (X₂);

The number of the relation between organizing (X₂) aspect variable with cost performance (Y) has a correlation value of 0.898 and it means the positive correlation and it is very strong, it also can be shown from X₁ significant value is 0.000 smaller than 0.05, it means that there is affect between organizing (X₂) aspect variable with cost performance (Y). The value of organizing aspect variable affect to the cost performance is 80.70%, and 19.30% of the remaining is determined by other variables that are not described in this study.

It can be stated that the organizing variable has the highest contribution to the road infrastructure cost performance, and therefore there must be an effort from the owner, contractors and consultants to maintain and improve the organization quality. The organization factor affects 80.70% of maintenance cost performance. Some variables that affect the organization in the good cost performance implementations are: vision, mission, conduct code, high quality worker, entrepreneuring, reward system, network model, easy adjustment, projected organization, flexible and network of relationships.

3. Directing Aspect (X₃);

The number of the relation between directing (X₃) aspect variable with cost performance (Y) has a correlation value of 0.723 and it means the positive correlation and it is very strong, it also can be shown from X₃ significant value is 0.000 smaller than 0.05, it means that there is affect between directing (X₃) aspect variable with cost performance (Y). The value of planning aspect variable affect to the project cost is 52.30%, and 47.70% of the remaining is determined by other variables that are not described in this study.

Leadership capability done to the maintenance activity is not very satisfactory because of this result there must be an effort from the owner, contractors and consultants to maintain and improve the leadership capability in order to give the contribution to the benefit maintenance cost performance. The directing factor affects 52.30% of maintenance cost performance. Some variables that affect the directing in the good cost performance implementations are: leader competency, big autonomy, distributed leadership, learning organization, cost, quality and time, competence and responsibility run together, responsible and authority integrity, and creating the monitoring method and integrated controlling.

4. Controlling Aspect (X₄);

The number of the relation between controlling (X₄) aspect variable with cost performance (Y) has a correlation value of 0.689 and it means the positive correlation and it is very strong, it also can be shown from X₄ significant value is 0.000 smaller than 0.05, it means that there is affect between controlling (X₄) aspect variable with cost performance (Y). The value of controlling aspect variable affect to the project cost

is 47.70%, and 51.30% of the remaining is determined by other variables that are not described in this study.

Controlling and supervising capabilities done to the maintenance activity done to the maintenance must be another and there must be an effort from the owner, contractors and consultants to maintain and improve the human resources in order to better control the result quality of the contractor and supervising consultant activities. The controlling and supervising factors affect 48.70% of maintenance cost performance. Some variables that affect the controlling and supervising in the good cost performance implementations are: decision making, time, communication and coordination, communication between contractor and owner, payment period, road maintenance standard requirement, budget availability, owner care, process of the evaluation and the change of political policy/government economic.

Thus the overall results of the regression analysis obtained that 90.90% is influenced by maintenance management cost performance, and the rest is influenced by other variables that are not mentioned in this study.

Conclusion

The results study showed that the maintenance management factors; planning, organizing, directing and controlling greatly affect the road infrastructure maintenance cost performance. With the unit price contracts type currently run, the maintenance work is only carried out based on budget nominal value that allocated and is directly proportional to the volume of work, so that when a fixed amount of funds and a greater working volume (overhead costs), so that maintenance work become not effective and efficient. Budget certainty guarantee factor, in this contract does not affect the maintenance cost to the owner, contractor and consultant from the budget available to the road maintenance overhead costs, due to work maintenance carries out on performance based.

Seen that the most prominent respondents' opinion to the maintenance management factor that affect cost performance are: financial cash flow is low, human resource skills is low, the roads damage type, political and security conditions, the differences between planning and realization and implementation time additional. The ready of the maintenance contract in performance based in Aceh Province, the owner, contractors and consultants expressed to receive if it applies because it has benefit of the final result cost performance, quality and effective and efficient time. Therefore it needs a higher attention from the owner, contractor and consultant to the leadership, supervision and controlling in handling road maintenance activities currently running. It is expected that the positive response from the management owner, contractor and consultant to change condition from the current contract types to a performance based contract type.

REFERENCES

- Asyifa, M., 2009. *Kajian Aplikasi Kontrak Berbasis Kinerja Pada Pemeliharaan Jalan di Propinsi Aceh. Thesis for Magister Degree*. Rekayasa Manajemen Konstruksi, Universitas Syiah Kuala, Banda Aceh (unpublished).
- Nazarkhan, Y., 2009. *Mengenal Kontrak Konstruksi di Indonesia*, Jakarta.
- Law of Construction Services, 1999. Undang-undang No. 18, *tentang Jasa Konstruksi*, Indonesia.
- Public Work Agency, 2000. Peraturan Pemerintah No. 29, *tentang Penyelenggaraan Jasa Konstruksi*, Indonesia.
- Public Work Agency, 2010. Peraturan Presiden (PP) No. 54, *tentang Pengadaan Barang/Jasa Pemerintah*, Indonesia.
- Public Works Minister Regulation, 2011. Peraturan Menteri Pekerjaan Umum No: 13/PRT/M/2011, *tentang Tata Cara Pemeliharaan dan Penilikan Jalan*, Indonesia.
- Soeharto, I., 1997. *Manajemen Proyek (Dari Konseptual Sampai Operasional)* Erlangga, Jakarta.
- Stankevich, N, Qureshi. N., & Queiroz, C., 2005. *Performance Base Contract for Preservation and Improvement of Road Assets*, Washington, DC, World Bank.
- Thaher, N., 2002. *Pengaruh Penanganan Kegiatan Pemeliharaan dengan Kontrak Tahunan terhadap Kinerja Biaya pada Pekerjaan Pemeliharaan Fasilitas. Thesis for Magister Degree*. Universitas Indonesia.
- Zietlow, Gunter, & Bull, A., 1999. "Performance Specified Road Maintenance Contract The Road to The Future The Latin American Perspective" of The XX Ist World Congress Kuala Lumpur.