

# INTRODUCTION OF PERFORMANCE-BASED MAINTENANCE CONTRACT IN EXPRESSWAYS IN JAPAN

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## ABSTRACT

These days, efficient maintenance and management of deteriorating highway structures under severe budgeting restriction are becoming serious issues in many countries worldwide. In order to cope with these difficult situations, an innovative PPP-based contracting method for routine maintenance of highway structures has been widely applied in several countries. Under this type of contract, routine maintenance works of road assets are contracted out to private sectors by indicating targeted performance level and functional requirements. The contractor is responsible for decision-makings on maintenance strategy in order to ensure required performance criteria, resulting drastic cost reduction by applying efficient operation and innovative technologies from the private sector.

In traditional contracts, the road agency as a client normally specifies techniques, technologies, materials and quantities of materials to be used, together with the time period during which the maintenance works should be executed. The payment to the contractor is based on the amount of inputs. In performance-based contract the contractor is paid based on the “outcomes” reflecting the target conditions of the roads under contract, they are; required service levels, and the durability and performance of the roads over a longer period.

It is said that there are several benefits in performance-based maintenance contract such as, reducing maintenance cost, improving management efficiency, ensuring better quality, avoiding delay of the maintenance works, reducing risks and promoting innovative technologies.

Under these circumstances, recently privatized Japanese intercity expressway company (NEXCO-West) has been trying to reduce maintenance cost by introducing performance-based maintenance contract for its highway routine maintenance. NEXCO-West is executing routine maintenance by its group companies (called ‘partner companies’). So far, maintenance works have been executed by traditional-based unit price contract. The unit price contract is a traditional contracting method where payment is made for the quantity of input specified by the client. In order to improve efficiency in highway maintenance by NEXCO-West group, development of innovative framework providing incentives to partner companies is required.

This paper reviews the current status of performance-based maintenance contract worldwide and describes the effort to introduce the new contract method and lessons learned from the pilot application both from the viewpoint of highway agency (client) and maintenance companies (contractors).

## 1. INTRODUCTION

World trend on highway maintenance contract has been gradually changed from traditional maintenance contracting to performance-based contracting, an approach that has been deployed rapidly in the road sector in the past decade [1]. Performance-based contracts

differ significantly from the method that has been traditionally used to maintain highway structures. Performance-based contract is a type of contract in which payments for the management and maintenance of road assets are linked to the contractor successfully meeting certain performance criteria specified in the contract.

In traditional contracts, the highway agency as a client normally specifies “what to do”, “when to do” and “how to do” the maintenance works to the contractor, and the payment is based on the amount of inputs (e.g., square meters of asphalt patched, amount of man-hours, and so on). In performance-based contract the client specifies performance criteria that the contractor is required to meet when delivering maintenance services. There are several advantages in performance-based maintenance contract over traditional approaches:

- (a) Cost savings in managing and maintaining road assets;
- (b) Uniform (fixed) annual expenditure for highway agencies;
- (c) Decreasing workloads for agency engineers;
- (d) Better customer satisfaction with road conditions and services;
- (e) Applying long-term maintenance strategy.

## **2. OVERVIEW OF THE PERFORMANCE-BASED CONTRACT**

In this chapter, the worldwide experience of the performance-based maintenance contract is reviewed, with emphasis on the advantages over the traditional maintenance contract. In order to apply the new contracting method, clear understanding of the benefits and risks should be necessary. World experience of performance-based maintenance contract showed significant cost-saving effects from 10% to 40% [1]. For example, the USA Virginia Department of Transportation pays USD 22,400 per mile per year under PBC, while in-house maintenance costs USD 29,500 per mile per year [2]. In New Zealand, there has been a 30% decrease in professional costs and 17% decrease in physical works with traffic growth by 53% [2]. It is said that the performance-based maintenance contract can lead to cost savings through:

- Incentives to the private sector for innovation and higher productivity (flexibility in decision making process)
- Reduction in workload for engineers in highway agencies, due to better packaging of contracts and fewer supervising cost

That means the new contracting method is financially beneficial for both highway agency (client) and maintenance company (contractor). Under the traditional maintenance contract, client's side has been spending tremendous amount of time and cost for supervising daily maintenance works and dealing with the piles of paperwork for periodic payment. These days, most of the highway agencies are facing the issues of lack of engineers to maintain increasing number of deteriorating highway structures. Therefore, the amount of workload for each engineer is increasing year by year. The traditional unit-price contract also requires agency engineers to be prepared for ‘unexpected’ extra expenditures. Generally speaking, the operation of public agency's budget is less flexible than that of private sectors, and sometimes influenced by political opinions. Those restrictions sometimes cause decision-makings that are not always consistent with the ‘best’ solution from engineering point of view.

The performance-based maintenance contract does not require agency's engineers to deal with those kinds of issues, enabling them to focus on the ‘other concerns’ such as communicating with local residents, re-examining the optimum performance criteria and

analyzing past inspection results to develop better life-cycle maintenance strategy for highway structures.

Another benefit of applying performance-based maintenance contract is reasonably sharing the risks by client and contractor. The new performance-based contracting method can drastically change the agency's role from a micromanager (checking the amount of works done or quality of materials) to a strategic manager (ensuring level of service or conditions).

For contractor's side, significantly greater flexibility in the private sector (than in the public sector) can reduce the time and cost for most of the maintenance works and react quickly against the maintenance needs. Relatively longer contract period (3-5 years) allows contractors to invest on the cost effective equipments. The duration of contract period can be extended depending on the contractor's rating during the original contract. Longer contract period can provide a more stable business environment and good opportunity for human resource development.

The other factor for cost reduction is the efficient procurement process. Most of the rules for public procurement do not apply to the private sectors, resulting in efficient 'just-in-time' preparation for labor forces, equipments and materials depending on the maintenance needs.

### **3. INTRODUCTION OF PERFORMANCE-BASED MAINTENANCE CONTRACT**

In Japan, most of the routine maintenance for expressways has been contracted by traditional unit-price contract with attached bills of quantities, where payment is based on the input (amount of works completed). This type of contract has been widely applied for routine maintenances, because it has been considered as reasonable contracting system taking consideration of the characteristic of highway maintenance works. Generally speaking, the amount of works of routine maintenance for a certain period of time within contracted area cannot be estimated precisely because it is affected by uncertainties in various factors such as numbers of accident, total required pavement patching areas, and winter road conditions. The unit-price contract also satisfies timeliness requirement for road management. However, several problems have been pointed out as follows;

- Tremendous amount of paper works to verify contractor's works and to determine regular payments has been time consuming for both highway agency and the contractor.
- In recent years, amount of works for each agency engineer has been increasing due to advancement of aging and deterioration of the structures. As a result, in-house engineers are always facing the problem of lack of time to deal with the other concerns such as introduction of innovative technologies, proposing efficient inspection and maintenance planning, development of inspection database, analyzing past inspection record, and communicating with local residents.
- Annual cost for maintenance works depends deeply on the random phenomena with uncertainty. Therefore, management of annual budget has always been a cause of headache for agency engineers. Sometimes the non-engineering issues such as political opinions affected the decision-making process, and timely maintenance works has not always been applied.
- Preventive maintenance strategy is in many cases not applied, although it is known as effective maintenance strategy to reduce lifecycle cost.
- Proposal on innovative technologies and new materials are not easily accepted, because of the agency's traditional customs.

In many cases management of traditional contract has been less than optimal. The problem was that the contractor might not have the right incentive, which is to carry out the

minimum amount of works to obtain maximum outcomes. The purpose of introducing performance-based maintenance contract is to give overall solutions for above issues and achieve efficient management of group structures, by providing contractors ('Partners') right incentives and responsibilities. Under these circumstances, one of the Japanese intercity expressway company (NEXCO-West) decided to introduce the performance-based maintenance contract for routine maintenance works of its highway structures. In order to find the issues to be concerned with introducing the new contract system, some maintenance offices in NEXCO-West were selected to carry out the pilot project in FY2009 and 2010.

#### 4. INTRODUCTION OF PERFORMANCE-BASED CONTRACT

NEXCO-West has decided to implement pilot project to introduce performance-based contract for routine maintenance. Rehabilitation works for highway structures were not included in the pilot application, because there is no established methodology to evaluate the effects of investments for long-term structural performance on its lifecycle cost and residual life. Table 1 summarizes the pilot project scope.

Table 1 - Pilot Project Scope

Length of Expressway	Approximately 380km
Location in Japan	Kumamoto (Kyushu Region) Yamaguchi (Chugoku Region) Himeji and Fukusaki (Kansai Region)
Duration	Kumamoto; Two Years (FY 2009-2010) Yamaguchi, Himeji and Fukusaki; One Year (FY 2010)
Contract Amount	4.5 Billion Yen (Approximately USD 56.25 Million)

Successful performance-based contract need a strong "partnering" philosophy between agency (client) and contractor. Good communication is essential between client and contractor, to facilitate the discussion and prompt resolution of issues and concerns.

Generally, under the performance-based contract the agency's risk of responding to complaints from local residents and/or compensation resulting from imperfect highway operation can be transferred to the contractor. However, local residents or road users still think that it is the highway agency to which they should make complaints against road conditions. Therefore, even if those risks are transferred to the contractor by written contract, the agency is still responsible for its public affairs.

NEXCO-West is executing routine maintenance by its 'partner companies'. Those are the companies that signed the partnership agreement with NEXCO-West by sharing policy on management, future vision, and operation of the company. The principles of partnership are;

1. Discuss issues on equal footing with each other
2. Respect partner company's independence
3. Share information and collaborate with each other

NEXCO-West's routine maintenance is not procured by open bid system. Although past experience proved that contracting out the routine maintenance by tendering can contribute to reduce the bidding price, executing maintenance works by partner companies has different advantage of keeping road assets in good condition by sharing the responsibility of operating public infrastructures.

This framework has positive effects on introducing the performance-based contract requiring good partnership between client and contractor, because the agency and the contractor are sharing the same mission and sense of responsibility even before entering into contract. Both parties are also sharing knowledge and experience to achieve the common goal as 'partners'.

Table 2 - Maintenance Works by Partner Company and Contract-out

Items	Partner Company	Contract-Out by Tendering
Contract Period	Long	Relatively Short (1-5 years)
Sharing Common Goal	Sharing Mission and Responsibility	N/A
Cost Reduction by Tendering	N/A	Cost Reduction by Tendering

## 5. PERFORMANCE INDICATORS AND CRITERIA

Performance criteria set a minimum level of service that is expected from the contractor over the entire contract period. Performance indicators shall be established for each asset. The definitions of performance indicators should be simple, clear, understandable and practically achievable by the contractor.

Table 3 shows the established performance criteria for each asset item during the pilot project. Both qualitative and quantitative criteria were considered depending on the characteristics of each item. For vegetation control, pothole patching and snow and ice control, timeliness requirements were also established taking consideration of their significant impacts on road safety.

Contractor's performance level needs to be inspected regularly in order to provide evidence for payment. The inspection should be conducted for appropriate number of samples taken from the completed maintenance works. During the inspection, a certain amount of 'tolerance', which is defined as inspected samples not satisfying the performance criteria shall be allowed for contractor. Otherwise, the agency have to inspect all of the works done by the contractor to make sure that 100% of contractor's output is above the performance criteria. That will significantly increase the inspection cost for both agency and contractor. Under the framework of existing performance-based maintenance contract worldwide, the target level of percentage satisfying the performance criteria during the inspection is established as less than 100% depending on asset items. The target level should be established based on its impact on road safety and structural performance. For the pilot project, the target level was set at 80% for all the asset items. This value will be calibrated using the results of the pilot application.

Table 3 - Performance Criteria for Each Asset Item

Items	Quantitative Criteria		Qualitative Criteria
	Routine Maintenance	Timeliness Requirement	
Road Sweeping and Cleaning	Amount of litters collected is 50t / year or greater	N/A	1. No debris (sand, dirt) at roadside shoulder 2. No litters or objects on

			roadways
Vegetation Control	N/A	1. Complete trimming works for trees or vegetation affecting driver's safety within 6 hours of notification 2. Complete trimming works for trees or vegetation affecting driver's visibility within 3 days of notification	1. Ensure driver's visibility 2. Delineators can be seen at nighttime 3. Attractive esthetic treatment for vegetation
Emergent Pothole Patching	N/A	Complete temporary patching and open traffic within 6 hours of notification.	Temporary patching should function until the permanent repair.
Attendance in Road Accidents	Recovery works shall be completed within 60 days	Response within 90 minutes of notification during normal business hours	(Non-emergency case) Temporary barrier shall be in effect until the permanent repair
Winter Maintenance	De-icing salt shall be spread out within 3 hours after departing from the base	Response within 90 minutes of notification during normal business hours, or within 120 minutes out of normal business hours	De-icing salt is spread out when freezing road condition is expected

## 6. CONTRACTOR'S PERFORMANCE REVIEW

During the pilot project, contractor's performance level was reviewed quarter annually by spot check. However emergent pothole patching and snow / ice control were inspected every time the contractor finished their work. During the quarter annual inspection, the quantitative performance criteria have been checked based on the evidences and documents prepared by the contractor. On the other hand, qualitative performance criteria have been checked using video images taken from the vehicle.

The video image was recorded quarter annually for the whole area included in the contract, in order to be used to find the future optimum frequency of sampling for inspection. Bonus or penalty clause for contractor's performance was not included in the contract for the pilot project.

## 7. LESSONS LEARNED FROM THE PILOT PROJECT

In this section, lessons learned from the pilot project for two years are summarized. The purpose of this pilot application was to prove the validity of established performance criteria in terms of road safety and customer satisfaction compared to the traditional approach. By introducing this contract system the partner company was expected to show their engineering and management ability to make the best use of its flexibility in their decision-making processes. For Kumamoto pilot case the partner company's advantage

has gradually been demonstrated after two years of experience. One of the examples is applying more efficient tree trimming method satisfying required performance criteria. On the other hand, the advantage for partner companies has not been demonstrated yet during the other cases after one-year of experience. So far we have not experienced noteworthy cost reduction effect during the pilot project. One of the reasons is that the bonus and penalty clause were not included in the contract during the pilot project.

Results of the contractor's performance review showed that the almost 100% of the inspected samples were above pre-determined performance criteria. Based on the above result, timeliness requirement for tree trimming has been modified from within 3 days to 24 hours for the Kumamoto case. More study will be performed in order to find the proper performance criteria.

Performance review for qualitative criteria depends on inspectors' subjective judgment. For more objective performance review, a guideline with visual appearance should be prepared.

During the pilot project, some of the agency engineers have been dispatched to the partner companies to deal with the project management. This is also good for training the engineers in partner companies to be more independent in their engineering project management. It was a good thing for agency engineers freed from daily supervising duty or cumbersome paperwork, but the real effects of efficient management will not be demonstrated until the partner company engineers become used to this framework. Currently, the agency engineers are working together with the partner company engineers sharing the same office room. This is causing a positive feedback for both parties to communicate with each other and contribute to the improvement of management efficiency. The other issue to be concerned for successful performance-based maintenance contract is to transfer the agency's rights as the designated road administrator to the contractor. In Japan, highway agencies need to obtain permission from the police authority for expressway traffic regulation. Since the contractor is responsible for decision-making and execution of maintenance works, the authority (right) to apply for traffic regulation permission should also be provided to the contractor. Although the contractor is not a designated road administrator, we have agreed with the police authority to provide such right to the contractor. NEXCO-West and its partner company will keep trying their best to expand this successful framework to the other areas with greater traffic volume. As for the future challenge, we will try to find the best practice to provide proper incentives by bonus and penalty clause to our partner companies.

## **8. SUMMARY AND CONCLUSION**

This paper described NEXCO-West's effort to introduce performance-based contracting system for routine highway maintenance. Application of performance-based contract can contribute to providing quantitative explanation for relationship between performance level and maintenance cost, resulting in improving accountability to the public.

NEXCO-West is executing its highway routine maintenance works by its partner companies. The advantages and issues to be concerned were considered both from the viewpoint of the highway agency (client) and the partner (contractor). The agency and contractor will work together with each other as partners, share the same mission and goal in order to provide better service to highway customers. The framework is quite different from the contract-out type highway maintenance commonly applied in many countries.

After two years of pilot application, the partner company's advantage has gradually been demonstrated. For the next step we are trying to extend the scope of works from routine maintenance and asphalt pavement patching. NEXCO-West is expecting the system being fully implemented in the near future after evaluating the validity of performance criteria for

highway sections with different traffic volumes. We will try to seek for the best practice for highway maintenance with partner companies and establish a model case. We will be happy to share our knowledge and experience with highway agencies or maintenance contractors from all over the world to find the best solution.

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