

11<sup>TH</sup> CONFERENCE ON COMPETITION AND OWNERSHIP IN LAND  
PASSENGER TRANSPORT

Delft University of Technology (The Netherlands)  
20-25 September 2009

*“IT TAKES TWO TO TANGO”*

A RESEARCH ABOUT THE RISKS AND CONTROL  
MEASURES FOR THE MANAGEMENT OF A PERFORMANCE  
CONTRACT FOR REGULAR MAINTENANCE OF RAIL  
INFRASTRUCTURE.

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**SUMMARY**

*A research about the risks and the administrative measures during the management of a performance contract for the regular maintenance of rail infrastructure.*

*In the sector of rail infrastructure output-contracts, in which the contractor is judged on achieved performances, are getting more in use. The assumption is that this will lead to a more efficient and innovative execution of the maintenance, because the parties involved in the contract have less contact and thus need to take more responsibilities for their proper tasks. Unknown however is how to manage such a contract: What are the risks a contracting partner is confronted with during the term of the contract and how could these risks be managed?*

*This article will discuss a method that will provide answers to these questions. The method consists of a matrix of the possible risks and control measures that the management level of both the sourcing partner and the contractor should discuss. These are cooperation risks and not the safety and availability risks. Within HTM, the bus and tram company of The Hague, this method is used to give direction for a new maintenance contract. It was concluded that management based on performances not always means that contracting partner and contractor have less contact but that it resulted in another behavior and cooperation both for the contracting partner as the contracting party.*

## INTRODUCTION

### Introduction and problem

HTM Infra is the rail infra provider of HTM, the bus and tram company in The Hague, The Netherlands. HTM Infra will outsource the regular maintenance of the rail infrastructure of “*RandstadRail*”, a new to build Light rail system. HTM wants to manage the maintenance based on output related performance requirements and not based on input related activity requirements, the standard in the Dutch rail infrastructure sector.

HTM Infra expects that this will result in added value. At this moment there is no insight in the interactions of the new infrastructure system with the Light rail Vehicle and her surroundings. That is why it is difficult to set the right maintenance activities. Output related performance maintenance gives the contractor (and the sourcing partner) the freedom to obtain this insight and improve the performance of the infrastructure system. It is expected that this will result in a sharper learning curve for both parties.

With the results of this research HTM Infra wants to improve the management of its regular maintenance. Therefore HTM Infra wants to know what risks are involved in output related performance outsourcing and what control measures are appropriate to be able to deal with these risks.

### Approach

To answer the question of HTM Infra a theoretical and a practical objective are formulated.

The theoretical objective is: “*Designing of a method to determine the risks and control measures for the management of a performance based contract for regular maintenance of rail infrastructure*”.

The practical objective is: “*To make recommendations for the implementation of control measures at HTM Infra for the management of the maintenance contract for Randstadrail*”.

To realize the theoretical objective a method is developed in which at one side the main risks and on the other side the control measures can be determined in a structured process. This process is made accessible in a spreadsheet. The risks are classified in five categories of risks which are determined in literature about purchase management. Subsequently the risks are indentified in interviews with experts of infrastructure maintenance management of. During these interviews the control measures were determined.

After the development the method is validated and adjusted by testing it for the RandstadRail case. After the validation a conclusion about the usability of the method is drawn. Moreover a number of control measures were specified for the RandstadRail case and recommendations were given how HTM Infra could implement these measures in order to fulfill the practical objective.

### **Reading guide**

In chapter 2 the background and the motivation are discussed, and the problem definition is presented.

Chapter 3 discusses the theory studied for the research. Introduced is the development of maintenance and the differences between activity based management and performance based management of maintenance are addressed.

In chapter 4 a method is developed that enables the determination of possibilities for the management of a performance based contract for maintenance.

In chapter 5 the developed method is applied on the case of HTM Infra and this case is used to validate the developed method.

Finally in chapter 6 conclusions and recommendations of the research will be presented.

### **PROBLEM FIELD**

#### **Background: outsourcing maintenance of rail infrastructure**

This research treats the outsourcing of the maintenance of rail infrastructure in the Netherlands. The Dutch railway sector has experience with outsourcing of the maintenance of rail infrastructure. Prorail, the infraprovider of the main railway network outsources all its activities that reasonably could be dealt with by contracting market parties [Prorail 2002]. Until 2006 the maintenance of the rail infrastructure is outsourced through input related activity requirement contracts.

Since a few years the rail infrastructure sector tries to formulate a contract based on output based performance requirements for the regular maintenance. With this so called performance contract no longer the activities that have to be rendered will need to be prescribed but the description of the required technical or functional quality or quantity level of the infrastructure will be sufficient. These are expressed in output performance requirements that can be objectively measured or controlled. In this way it is tried to develop a healthy relation between the contracting partner (client) and the contractor (supplier) in which the contractor does not just fulfils his tasks but also supplies the full maintenance service. It is expected that this will turn the maintenance more effective because the contractor will do suggestions to improve the maintenance and thus diminish the number of some tasks. This is in consequence of the fact that these performance contracts stimulate contractors to use their own knowledge and experience of the maintenance, and so tasks are not only done because they are prescribed, as is the case with an activity based contract, but because they are necessary [Luiten et al, 2005]

#### **Problem risks involved with the management of a performance based contract**

As has been indicated, the contracting partner and the contractor have to deal with each other in a different way when the maintenance is outsourced by a performance contract. This might result in a situation in which the desired situation of better performance of the rail infrastructure for lower costs is not achieved, due to learning costs. To achieve better performances of the rail infrastructure at lower costs could be seen the principal objective.

Undesirable events that are result of the new way of management could diminish the chance on achieving the principal objective. In this research these undesirable events will be called the "*contract management risks*".

A contract management risk ensues from the new way of contract management and might harm the objective to execute the maintenance in a more effective way.

The problem definition to which this research will contribute is:

There is a lack of insight in the contract management risks of a performance based contract for regular maintenance of rail infrastructure.

## LITERATURE STUDY

### Execution of maintenance: professional management

A literature review about maintenance shows that maintenance could be executed in different ways. It could be done by using the technical specifications of the infrastructure, like the thickness of the tracks. If the tracks do not comply with the prescribed technical specifications, maintenance should be done. Another way is to determine which performances the infrastructure has to provide – like being available for the passage of this number of trains per hour during 20 hours a day, and subsequently executing a risk analysis to determine which elements of the infrastructure have a high failure risk, and thus choose a specific form of maintenance to deal with this risks. This second way is also known as Asset Management.

The consequence for an organization that wants to carry out professional maintenance is that it has to be able to deal with the minimal requirements for professional maintenance:

- Be able to formulate the maintenance requirements based on the company's objectives. These requirements have to be defined in a *SMART way which means that they will have to be Specifically, Measurable, Identifiable, Realistically and Time related*;
- Possess the knowledge and skills to translate the previous demands into maintenance activities;
- The processes should be designed in such a way that the system will be improved continuously by the management chain of *Plan, Do, Check, Act*. (Kessel et al, 2002)

### Differences between activity based management and performance based management

During the management of the contract the contracting partner has to take care that his business objectives are being realized. Besides this he has to determine that the objectives determined on a strategic level - that made him decide to outsource the maintenance, is actually being realized. If this is not the case he should intervene.

The maintenance activities that have to be done for the execution of professional maintenance management are the same for activity based contract management and performance based contract management. The differences are mainly the way of contract management and the division of the responsibilities.

In activity based contract management:

- The contracting partner is responsible for the strategic and tactical maintenance level and describes the maintenance concept, the maintenance plan, the work description

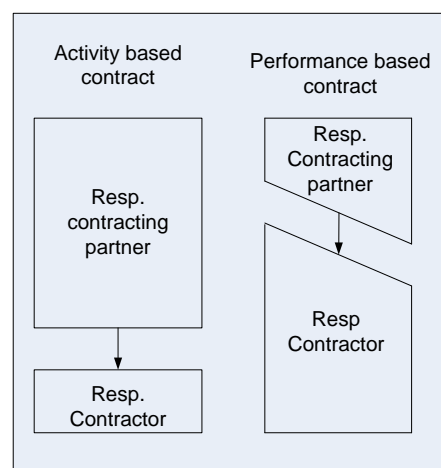
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and the quality of the work description. The contracting partner defines the functional requirements of the owner into the performance requirements. Then these will need to be specified into the maintenance activities;

- The contractor is responsible for the management tasks at an operational level and it is his task to execute the work description in the most efficient way. The contractor will be paid for the executed maintenance tasks.

In performance based contract management:

- The contracting partner is responsible for (a part of) the strategic maintenance level and formulates the requirements and limiting conditions for the maintenance.
- The contractor specifies the performance requirements in activities and formulates the maintenance concept and the maintenance plan. The contractor will be responsible for the tactical and a part of the strategic maintenance. This means that the contractor will not only be judged on how efficient the maintenance tasks are executed but as well on the effectiveness and integrity of the maintenance.
- The contractor will execute the maintenance activities that he formulated and he will show by means of reports to what extent the performance requirements were realized. To what extent the maintenance organization could realize the effectiveness depends on people, resources, the control over the process and the existing condition of the installation. A good control of the process will result in a continuing improvement of the maintenance concept and workflow.
- The contracting partner contracting partner restricts his supervision mainly to the process that the contractor adopts in order to achieve the end results and focuses less on the execution of the activities.
- There will be more alignment between contracting partner and contractor about the maintenance activities that will have to be executed and about the organization of their mutual alignment.



*Picture 1: An outline of the difference between activity based contract management and performance based contract management.*

Overview of the differences:

1. Transfer of the responsibility of the contracting partner to the contractor will be more upstream in the process;

2. Contracting partner has to formulate the functional requirements and also the boundary conditions in an explicit way, instead of in an implicit way as might happen in activity based contract management;
3. There will be an assessment on the performance of the infrastructure instead of on the activities;
4. The rules of the game in the relation between contracting partner and contractor are different because of the fact that the transfer of the responsibilities will be more upstream;
5. The processing and analysis of several infrastructure related data and maintenance data in a maintenance management system and the proactive supply and execution of improvement proposals.

### **Basic conditions for effective cooperation**

In the previous section the most important differences between the management of the maintenance by performance based contract management and by activity based contract management. In this research the focus is on the contract management of maintenance through performance based contract management..

Performance based contract management and thus performance based cooperation has many advantages for both contracting partner and contractor in a situation in which neither the contracting partner or the contractor dominates the relation. Both give equal importance to the relationship and both parties are motivated to maintain the relationship and develop it.

When parties have decided to outsource maintenance through a performance based management contract both the contracting partner and contractor will have to cooperate in a different way then when the maintenance is outsourced through activity based contract management. Contracting partner and Contractor will execute different tasks and treat each other in a different way. Different management tools, like organization structures and contract structures will make sure that both parties will do what they promised.

Because the contracting partner and the contractor have experience with management of activity based contracts the management tools these contracts are known (Swier 2002). Because contracting partner and contractor have limited experience with the performance based cooperation and execution of the maintenance this will results in some learning costs. Contracting partner and contractor should create a relationship in which they work together in an effective way. This will be called effective cooperation. Terms which are frequently used with effective cooperation are “mutual trust” and a “win-win situation”. A more concrete use of “trust” and “win-win” will be given by the basic conditions for effective cooperation like mentioned by Van Weele et al (2002). The basic conditions for effective cooperation are:

- Vision and strategy;
- Commercial organization;
- People;
- Knowledge and information;
- Relations Management.

The purpose of this research is to reduce the learning fees of the new contract management method by observing what contracting partner and contractors with experience in dealing with performance based cooperation consider attention points. In this research these attention points will be called contract management risks. In the next chapter these attention points will be determined.

The basic conditions for effective cooperation are used to structure the contract management risks which will be identified during the interviews. The mentioned differences between activity based contract management and performance based contract management are used as a check to see whether the identified risks could be explained by these differences. If this is not the case the events are considered out of the scope of this research.

## **DEVELOPMENT OF THE METHOD**

Based on interviews with experts, experienced in outsourcing (performance based) maintenance of objects and installations of civil infrastructure, risks and control measures, for the control of a performance based maintenance contract, are determined.

- The definition used for risk is:  
*(Chance on) an unwanted event that might occur –or not- with an impact for the objectives, in which these objectives could harm the objectives.*
- The definition used for control measure is:  
*A measure that is designed to eliminate or diminish the risk.*

### **Approach**

In this research is decided to hold semi-structured interviews in which the questions and the structure of the risk matrix are fixed and the answer possibilities are open. In this way the possibility is created that during the interview new questions could be added to get additional information about specific cases. The interviews were held with persons who had experience with the outsourcing process:

- Both contracting partners and contractors of the maintenance of infrastructure;
- Both proponents and opponents of outsourcing through a performance based contract;

The parties that were interviewed are active in the next sectors:

- The rail infrastructure sector: management & maintenance;
- The building sectors concerning ground, roads and water: management & maintenance;
- The rail vehicles: management & maintenance;
- IT infrastructure: management & maintenance.

### **Objectives of out sourcing based on performance requirements**

The definition of risk demonstrates that it is important to first define the objective. These objectives could be used to weigh identified events, so that these can become risks (the change on an event and its impact). The objectives at one hand relate to the company objectives and on the other hand relate to the strategic consideration to outsource through a performance based contract. These objectives must have:

- Influence on the company objectives on the short term: availability, safety, budget;
- Influence on the company objectives on the long term: sustainability. With sustainability is meant: the capacity of the infrastructure to fulfill its design requirements during its designed lifecycle.
- The objectives must be aligned: in order to be able to realize objectives like learning, improvement of effectiveness and improvement of efficiency.

These objectives should be determined for each case and depend of the objectives of the organization.

### Risk assessment

After the identification of the objectives a risk assessment should be done to determine which risks are urgent for the organization. For these urgent risks the organization might establish control measures. The risk that an event has one or more of the objectives must be determined by identifying the chance that an event will happen. After this the effect of the event on the objective will be estimated. Table 1 show how this will be done and with which units the risks will be estimated. The risk score (Risk = chance \* effect) gives the urgency for a control measure.

Table 1: Example risk score [source: Wijnants 2005b]

		Effect	Chance
		0 = not applicable	0 = occurs never
		1 = minor effect	1 = occurs sometimes
		2 = clear effect	2 = occurs regularly
		3 = acute effect	3 = occurs frequently

The method is designed by joining the risks and the control measures, both identified in the interviews, in a sheet. The next step was to analyze the control measures, make them more specific and if necessary divide them into two control measures.

It is important that the risks are determined per basic condition because otherwise certain aspects that are important for an effective cooperation could be overlooked. A number of risks are identified per basic condition for effective cooperation. These should be ranked on the determined objectives. By using weights an organization could give importance to an objective. Table 2 shows a part of a risk assessment.



*Table 2: Part of the table for the risk assessment*

effects vs contract form	weighting factor									Risk score
	Company objective short term			Company objective long term			Goal alignment			
	1	1	1	1	1	1	1	1	1	
Vision & Strategy	K	E	T	K	E	T	K	E	T	Priority
Lack of a clear scope concerning the installation condition	3	1	3	3	3	9	3	3	9	21
Lack of a clear vision and strategy concerning performance based control of maintenance	3	3	9	0	0	0	3	3	9	18
Organisation structure & culture			0			0			0	0

### Choice of control measures

After the identification of the main risks has been executed, the appropriate control measures, to deal with these risks should be selected. Based on the concept of the 'scorecard-method', multi-criteria method, a method is composed [Bots, 1999]. Six points will be divided between the control measures, depending to what extend the control measure covers the risk.

- 6 covers the risk completely;
- 1 covers the risk a little bit.

The next step is to formulate the scores of the control measures and after that the control measures could be prioritized. Table 3 show a part of the determination of the control measures.

*Table 3: A part of the table for control measures*

	Vision & Strategy	Create clearness in the objectives	Create clearness in the intentions and expectations	Having informal evaluation conversations	Knowledge infrastructure	Having a initial measurement of the infrastructure and tuning about the condition of the infrastructure	Determine the desired end condition of the infrastructure	Discuss on a regular basis the list of less or extra costs
<b>Vision &amp; Strategy</b>								
Lack of a clear scope concerning the installation condition						3	2	
Lack of a clear vision and strategy concerning performance based control of maintenance		2	2	1				1

### USING THE METHOD: CASE MAINTENANCE RANDSTADRAIL

The objective of the case study is to determine the risks and the control measures for HTM Infra and to validate the developed method. By using this method we can establish whether the risks and the control measures that were determined in the expert interviews, are indeed recognized as risks and control measures by the experts in the case.

In the end of 2006 HTM planned to start Light Rail operations on 55 kilometer of rail infrastructure of the RandstadRail. HTM Infra will manage and maintain the rail infrastructure of the metropolitan area Haaglanden. Due to operational reasons HTM Infra has decided to outsource the regular maintenance of 28 kilometers of the rail infrastructure that is situated outside the municipal area of The Hague.

### **Objectives of HTM Infra Maintenance Management department with the outsourcing**

The RandstadRail project is a complex project. A lot of new techniques will be used by different parties that never cooperated before. Because of all the new technical interactions and the new ways of cooperation the execution of the maintenance also will be complex. HTM Infra and especially the department of maintenance management had made the choice to outsource the maintenance. The choice to do this was in consequence of the following motives: capacity problems caused by a growth of 30%, the maintenance of the RandstadRail is complex; Benchmark the maintenance services executed by HTM Infra (process, quality and costs).

The choice to outsource the maintenance based on performance, thus by a performance based contract is based on the following motives:

- To get to know and learn an effective method for the execution of the maintenance for Light Rail infrastructure;
- To learn from the efficiency of the contractor.

### **Starting points to determine the risks**

For an estimation of the management risks with professional maintenance the next estimations are made:

The maintenance process is complex because:

- Use of new infrastructure and new techniques (railway security systems);
- New vehicle and thus a different wheel-rail interaction;
- A new environment;
- Cooperation between a lot of stakeholders, resulting in new relations;
  - HTM- RET;
  - HTM- municipality Zoetermeer;
  - HTM- contractor.

As far as it concerns the cooperation between contracting partner and contractor there has been an extensive selection procedure that resulted in a mutual understanding between the management of both the contracting partner and the contractor. Moreover an organization structure has been chosen that creates a good environment for an effective cooperation.

At the start of the cooperation the attitude within the organization of the contracting partner was as follows:

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- The contracting partner has a good insight in the necessity and opportunities of the new cooperation, but this is not communicated well within the own organization;
- The contracting partner has good insight in processes, but these are elaborated in a limited way;
- The contracting partner understands the necessity of data storage, but data storage has not yet been implemented;
- The contracting partner has limited insight in the physical condition of neither the infrastructure nor an idea about a method to come to a compromise with the contracting party about the state of the physical condition.
- The contracting partner has limited coordination with supporting departments.

### **Method to determine risks and control measures**

In order to determine the risks for the RandstadRail Case the method is executed by people with a lot of experience in managing the maintenance of infrastructure. During the execution of the case the choice has been made, after an estimation of the risks and the differences between them, to select only the risks that are urgent in this case and should be managed.

It is recommended to take the next steps to really implement the control measures:

- Organize a Kick-off session in which at least persons responsible for the installations and higher staff of both contracting partner and contractor are present and where the next points will be established:
  - Intentions and expectations;
  - A good division of the tasks, **liabilities** and responsibilities done by scenario analysis;
  - A method that rewards pro-active behavior: as well for the organization as for individuals (assessment method and reward);
- Agree over the infrastructure condition through execution of an initial measurement.
- During the execution of the contract the following points should be filled in:
  - Critically monitoring on management level of the cooperation by a system of checks & balances.
  - Keep the official list of unforeseen activities up to date.
  - Have performance conversations and informal evaluation on a regular basis.
  - Set up a practical system of data storage.

### **Recommendations HTM Infra**

- If the choice is made to really implement the method, it is recommended to the management of HTM Infra to formulate their objectives with the performance based cooperation and communicate these within the organization.
- Implement the method, and take account of the fact that risks and risk analysis have a negative sound and that this method intensively deals with the negative side of the management of maintenance. In this way, it could seem that management on performance only has negative aspects.
- It is recommended to monitor the use of the method and adjust the risks and control measures on a regular basis. The advantage of the method is that the organization of the maintenance is being evaluated explicitly. Updating could enrich the method and then could be established in which situation a risk appears and when not and what control measure should be taken.

- Let the contractor also go through the method and maybe even the owner of the infrastructure. By going through the method mutual understanding is created and different interests will be recognized and acknowledged.
- In this research the focus is on management by performance in the exploitation phase of the life cycle of the infrastructure to improve the effectiveness of the maintenance tasks. If an organization really wants to make a step forward it is necessary to involve also the design department because only then it will be really possible to make return on infrastructure investment.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

In this conclusion it is indicated that the objectives are achieved.

The theoretical objective is: *“Designing of a method to determine the risks and control measures for the management of a performance based contract for regular maintenance of rail infrastructure”*.

Based on the results of the case study it could be concluded that the method is useful:

- The risks that are involved in the method, cover, according to the interviewed experts, for a great part the problems.
- Although it seems that the risk categories used in this research -that structure the risks- do have overlap, it was found that the individual risks could easily be attributed to one category. So there is only a limited overlap between the risk categories.
- The risks depend of the objectives of the organization and the way individuals interpret these risks on the objectives. So the results from the method will vary per user. But this method stimulates every individual user to think in a structured way about the possible risks and the control measures to take.
- It is determined that the extra value of the method comes from collectively using and considering the risks. The structured process stimulates that the available knowledge and experience of the staff (tacit knowledge) are made explicit and made ready for use in information that can be shared.
- The execution of the method makes that the staff will be more aware of the organizational risks. So the alertness is increased and thus, by executing this method, already one control measure has been taken.
- The established control measures complete each other and are therefore not completely excluding.

The cooperation within the performance based contract for maintenance shows a lot of similarities with a marriage. Both preparations for the wedding ceremony as the preparations for the ceremony to sign the contract require a lot of efforts and during the festivities both parties speak out their good intentions for a long and successful cooperation. However after this joyful moment the real work starts, since the road to success is not written in the stars and depends on creativity and commitment of both parties.

### Recommendations Scientific Research

During the research the next points were determined that could be interesting for further research:

- As in this research is determined the execution of performance based maintenance in the railway sector is still in the pampers. That is why there are a lot of opportunities for further research. For example the influence of the operations on the wear of the infrastructure and thus the consequences on the maintenance.
- Observe to what extend this method could be used in other sectors, like the sector of traffic management.
- During this research it became clear that the outsourcing of IT infrastructure is already executed through the use of performance based contracts and the monitoring of the performance is being realized by using Service Level Agreements. It is recommended to do more research to what extend methods, techniques and models that are used for the purchase processes used for IT are also useful for civil rail infrastructure.

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