

How new performance based contracts add value in maintenance contracts

J.D. van der Walt

Assistant Lecturer, University of Canterbury, New Zealand

Dr. E. Scheepbouwer

Director Construction Management Programme, University of Canterbury, New Zealand

ABSTRACT: Public agencies in charge of maintaining highways and bridges walk a fine line between cost and quality. They must answer to the public and create value, which has become an important political issue. For years traditional performance-based contracts have been used in New Zealand to maintain the highway network. These Performance-Specified Maintenance Contracts (PSMC) adopted a “best for asset” approach. Recently the New Zealand Transport Agency (NZTA) has adopted many changes in their procurement methods to obtain greater value for money. The new contracts see NZTA take a more hands on approach with respect to strategic asset management. The reasons for the changes are varied but an increase in the level of service in their assets allowed a move away from the prior methodology. The new Network Outcomes Contracts (NOC) have been set up to invest where needed and give more control to the agency. This research investigates how the use of the NOC contracts influenced the quality of the asset and whether this constituted value creation or not. It is the conclusion that NOC contracts take a more long-term vision approach. However, some assets were arguably kept at a too high a level of service; a situation that allows present diversion of investment. The ideal outcome is a balance between minimum investment in quality by the asset owners and minimum required repair needed by the maintaining party. In this paper, qualitative data from contractors and asset owners have been used to identify lessons learned till date. This can assist agencies and contractors in their continued drive to improve NOC contracts and creating value in the long term.

1 INTRODUCTION

As highway agencies are accountable to the public, delivering value has become an important issue politically. Maintenance regimes from highway agencies inevitably balances the cost of work against the level of service. After years of operating performance based arrangements, the agency has opted for a change towards Network Outcomes Contracts (NOCs). Both contracts are applicable for the maintenance of highway assets (Zietlow, 2005). The former Performance-Specified Maintenance Contracts (PSMC) used a, “best for asset” approach. Contractors were reimbursed for performed work, but carried the majority of the risk. Over the years this approach has led to an increase in level of service. Higher levels of service do not intrinsically translate to increased value, and recently the NZTA opted to change towards an arrangement that focused more on providing value. Its goal was to decrease the cost while maintaining the quality of their assets. This paper discusses the differences between both methods with regard to the strategic goals of NZTA, how these goals are achieved and what concerns have been raised. Both PSMC’s and NOC’s will be dis-

cussed after which details on the new approach will be provided.

1.1 Objective

Aim: Investigate how the use of the NOCs influence the quality of the asset and whether this constitutes value creation over previous methods.

Scope:

- This will be a qualitative study as there is limited long term data available due to the recent implementation of NOCs.
- The focus is on experts in the industry who have had first-hand experience with NOCs
- Ensure, that study includes expert parties from client(agency), consultant, contractors and sub-contractors.

This study has been conducted in New Zealand therefore is limited to the New Zealand context. However, the results can serve as indication to other nations with similar contractual arrangements.

1.2 Literature Review

There are several business models that have been used in the past. The traditional equipment-based service model is centered on reimbursement of work and materials to meet standards. Cost of labour, equipment, maintenance and consultation for activities on highways and bridges were traditionally billed lump sum after the fact once the activity is completed (Wheel, 2000).

Another approach is the cost-plus model. In this case a customer is provided with a detailed structure of prices for equipment, labour and consultation. Both parties agree on a fixed profit percentage to be added to the actual costs (Kim, Cohen, & Netessine, 2007).

Various types of performance-based contracts have been used for several decades in many European and Australasian countries (DeWitt et al., 2005). These contracts aim to refocus industry to measure performance instead of specification compliance (Mike Manion & Tighe, 2007).

Performance-specified maintenance contracting (PSMC) and its potential application to the international market has been extensively discussed by Gransberg et al. (Gransberg, Scheepbouwer, & Tighe, 2010). The traditional PSMC moves the focus from “minimize cost” to “maximize value”. The evolution of this produced the hybrid PSMC. This contract lets the owner hold control of the design contract however, allows the contractor to give significant input through Early Contractor Involvement (ECI) (Zietlow, 2004). This contract allows the contractor to offer alternatives that the design consultant can warrant (Porter, 2001).

Maintenance alliance contracts are normally reserved for the maintenance of assets of large public works or a way to share risks for major transport arteries on dedicated networks. Alliances have taken up many of the principals introduced by PSMC including working to deliver maximised value and ECI (Botha & Scheepbouwer, 2015; Scheepbouwer & Gransberg, 2014).

Outcome based contracts as a new business model has been increasingly discussed within the commercial and academic world (Ng, Ding, & Yip, 2013; Wirtz, Pistoia, Ullrich, & Göttel, 2016). The need for effective new business models are driven by three key components:

- 1) Value drivers are often an important factor for organizations. Therefore, when a change in value drivers is present, a need is created to change business model.
- 2) When value drivers are changed an organization's performance during this time is highly scrutinised to see if key outcomes are compromised.

- 3) Change in value drivers can result in partnerships changing requiring new innovative agreements to be reached.

Outcome base contracts have evolved from these principles to focus on the holistic outcomes of assets rather than the resources required for a single asset. (Lee & Barrett, 2003). Outcome Based contracts have the following goals:

- 1) Outcome based contracts align both parties to outcomes of a product or service.
- 2) Shifts shared risk back to the client, increasing responsibility of the client.
- 3) A party that can attain best outcome results from both interior and exterior connections and collaborations is more able to exceed expectations. (Ng et al., 2013)

Outcome based contracts draw from the classical approaches and trends seen in recent years. Moving the contractor closer to the client. Outcome based contracts also changes the focus from ‘*value of asset*’ to ‘*value of network*’ perspective.

1.3 Network Outcomes Contracts with Asset Management

The introduction of NOC's was the conclusion of a process that was born by the need to find ways to reduce cost. The New Zealand Transport Agency undertook three years of investigation to meet this demand. NZTA identified multiple opportunities. Firstly, the NZTA identified that more work needs to be conducted by the agency instead of handing this off to an external supplier. This is particularly important in the fields of decision making and customer service. Secondly, moving away from a risk adverse management culture, taking on more possible shared risk in the contract results in potentially reducing cost. Thirdly, introduce better methods to estimate Net Present Value as the current system is not applied consistently. Finally, investigate new methods to understand the risk of flat budgets limiting the amount of renewals undertaken. Following this investigation, the NZTA after considerable consultation introduced the Network Outcomes Contracts (NOC) system to implement these changes (M. Manion, nd).

1.4 Changes to Managing Assets

At its core, the NOC is an outcome based contract and pursues a quality outcome. The NOC does not specify the methods of how the outcome is achieved, but does specify the performance measures to show that a quality outcome has been reached. Outcome based contracts have drawn from traditional performance based, alliances and hybrid contracts with a

change of focus. The contractor retains the risk of the supply chain to build/maintain quality assets. The method of how the contractors establishes the cost for achieving a quality outcome is up to them (NZTA, 2015).

From the literature review and contract documents the following key elements will change in how assets are managed. Firstly, NOC's payment contains both measure and value and lump sum components. Secondly, the contractor is responsible for how the general condition of the asset is managed so that it remains serviceable and safe. The contractor must estimate the amount and type of repairs and approximate the cost of delivering them to the specified performance measures in the contract. Thirdly, the contractor must make provisions to achieve these performance measures in a lump sum component. Failing to provide the required level of performance will result in a financial penalty. However, suppliers who manage renewals investment below a target quantity are rewarded (M. Manion, nd; NZTA, 2015).

Like in previous methods, contactors are still able to seek variations to rates if quantities differ substantially from those listed in the schedule of prices. This is if they can sufficiently demonstrate a material effect from the quantity change. It is then up to the contractor to show that quantity has changed and that this has had a material effect, otherwise the rates as tendered remain for the increase of quantity (NZTA, 2015). In the US this is similar to a CM/GC contract with a follow-on maintenance period (Gransberg et al., 2010).

2 METHEDOLOGY

The methodology of this research has consisted of gathering and analysing literature on the challenges faced and decisions made by NZTA. As well as this, an in-depth document study on NOC has been completed to understand the methods and reasoning.

There is limited long-term maintenance data available on NOC contracts due to their recent introduction, therefore, this study instead will focus on a qualitative approach though structured interviews. Standardised questions were prepared which focused on the key aspects of NOC and the assessment of value. Interviews with representatives from the delivery teams, clients, contractors and other persons of interest were conducted. Results from these interviews have given insight on how industry perceive the value of NOCs as well as insight into the operational character of the procurement system. Their expert opinion will form the basis of results in this paper. This study surveyed from the following sub categories:

Table 1: Table showing subcategories of parties interviewed

	<i>Client (Agency)</i>	<i>Con- sultants</i>	<i>Con- tractor</i>	<i>Sub- contractor</i>
<i># of experts interviewed</i>	3	3	3	2

3 RESULTS AND ANALYSIS

In this section, the opinions of the different parties will be stated. Each section contains a table that captures the opinions of the consulted experts with a continued discussion of the points. At the end of this section results will be summarized.

3.1 Client's Point of View

The client's argument from the start has been around cost savings. From discussion with client representatives NOC contracts aim to force contractors to be more effective in their management programs as the new contract will significantly limit maintenance funds. The contractor must offset this change with a smarter strategic maintenance strategy. The focus has been to prove value as previous systems in place did not achieve the desired result. Before maintenance is allowed the contractor must comply with new more rigorous specifications to demonstrate value.

Table 2:Client, showing key factors that drive value and potential issues from the implementation of NOC in New Zealand.

<i>Factors driving value for the Client (NZTA)</i>	<i>Potential issues for the client (NZTA)</i>
<ul style="list-style-type: none"> •Reduce cost •Results are more in line with desired outcomes •Increased co-operation •Drive strategic forward work planning •Sustainably of the industry is increased •Better understanding of costumer behaviour •Performance measures drive quality •KPI and KRA show improvement •Up skill the industry •Industry adapting to holistic focus •Change in business model for the industry 	<ul style="list-style-type: none"> •Increased risk to the client •Require large increase in personnel •Potentially higher cost due to outsourcing and limited numbers of sub-contractors •Increased amount of dissatisfaction from the public. •Some performance measures are not realistic or effective in driving value requires further work. •Large amounts of resources required to implement NOCs •Communication with the public

The NZTA recognises that the implementation of the NOC will take time. Relevant staff and personal must be retrained to work effectively with the new

contract. Much effort has been put into establishing clarification of new terms in the contract.

An important part of the NOC is the inclusion of a clause specifying that a large proportion of work must be conducted by sub-contractors. This forces substantial amount of funds back into the community and stimulates small business growth.

Large contractors maybe using their learnings from earlier contracts to minimise first year difficulties with NOC contracts. This shows the industry adapting to the new environment.

NOCs in South Canterbury, New Zealand show great improvement. They have moved from poor to outstanding due to more rigorous reporting and communication. In general, the NZTA is reporting steady/ improvement in key areas.

NZTA reports that it has gained a better understanding of customer behaviour to enable efficacy gains. An example of this is where more regular litter collection has been implemented outside of fast food restaurants and cleaning graffiti of bridges. This resulting in visually cleaner assets.

Looking ahead, NZTA preservatives noted that the NZTA is moving focus from implementation to delivery and performance of the NOC contracts. This involved a large amount of auditing process that have not been put in place yet. Auditing this type of contract has presented several difficulties which they are working though currently.

3.2 Contractors' Point of View

Due to the decrease in spending on maintenance and lesser control by the contractor, speculation within the construction industry is that these changes in contracting will possibly result in lower level of service over time. Therefore, could cause inevitable rise in maintenance cost in the far future.

Severe weather events, can result in the contractor loosing significant amount of money due to unexpected maintenance. This has put pressure on an already streamlined lump sum budget. With extreme weather events set to increase in the coming years this may not be a once off issue. Meeting performance levels under extreme financial pressure is difficult. If contractors do not meet these levels of performance there are then also financially punished.

If certain assets are kept in high condition, it can result in NPV issues for the rest of the network. Contractors must be careful in spending available funds as they are required to prove a network performance outcome and not a care for a single asset.

Contractors speculated that some of the KPI & KRAs require a lot of man power which does not result in value for money. Contractors are eager NZTA has recognised this and are working on reforming the KRA & KPI framework.

Table 3: Contractor, showing key factors that drive value and potential issues from the implementation of NOC contracts in New Zealand.

<i>Factors driving value for the primary Contractor</i>	<i>Potential issues for the primary Contractor</i>
<ul style="list-style-type: none"> • <i>Decreased maintenance cost.</i> • <i>Longer contact period roughly 7 years. Allows for forward work planning and investment.</i> • <i>Increased in quality of work delivered</i> • <i>Requires the contractor to innovate to remain competitive.</i> • <i>Potential gain if performance criteria are reached.</i> • <i>Multiple parties are available from the NZTA when problem arise</i> • <i>Drives the industry forward where everyone is working for outcomes.</i> • <i>Driver collaboration between client, consultant, contractor and sub-contractor.</i> • <i>Drives sustainability of the industry</i> • <i>Drives better educational resources to train external industry</i> 	<ul style="list-style-type: none"> • <i>Reduced monetary value can be seen as a potential loss of profit</i> • <i>Anxiety that less spending and less control by the contractor will results in potential decrease level of service.</i> • <i>Scope creep can become a real issue</i> • <i>Financial penalties if the contractor does not meet criteria.</i> • <i>Events outside of the contractors control could significantly influence losses and gains.</i> • <i>Lump sum portion of the bid requires extreme foresight, this can result in cost overruns and low margins.</i> • <i>More communication is needed with different parties in the NZTA slowing progress hindering performance.</i> • <i>Contractors can be punished for keeping the asset in elevated condition. The rest of the network may be neglected.</i> • <i>This might not be the best model for the public.</i> • <i>Sub-contractors are, "hit and miss" in terms of quality and performance</i> • <i>Increased risk when using sub-contractors.</i> • <i>Uncertainty of how handover will occur after the end date of the contract.</i>

All contracts agree that the NOC has put substantially more pressure on their forward work program. They have been forced to innovate, especially in order to justify in terms of value. Contractors are forced to operate a much leaner program only conducting work that is absolutely necessary. An example of this is the heavy reliance in the ratio of defects over area to justify NPV.

To implement the new framework, the contract requires multiple parties to communicate from the NZTA. Previously contractors generally have had to deal with one point of call, instead now with the NOC framework, contractor are required to communicate with four and above personnel from the agency. Some contractors have indicated that this

communication process is slowing performance and is not driving value.

Contractors must revolutionize the systems they use. Large effort and resources are being invested into further development of techniques to preserve asset life for a low cost. An example of this is the 1st Signs approach to maintenance (M. Manion, nd).

Cooperation between the agency, contractor and subcontractor has become vital to success under the NOC contracts. The inclusion of a high proportion of subcontractor's in the NOC has forced the principle contractor to increase H&S and environmental training in order to minimise risk.

3.3 Consultants' Point of View

Some consultants are expecting reduce quantity of work as NZTA is conducting much of the decision making and consumer service in house. NZTA has recently hired a large number of new staff to support these contracts. Contractors have also taken a large proportion of the responsibility from the consultants. Consultants, have been asked by contractors to develop methods and systems to support these new contracts.

There was a push from contractors to allow them to exclude consultants and allow much of the work to be completed in house. The NZTA disagreed as this would not be value in terms of sustainability of the industry. Therefore consultant-contractor partnerships are still present, preserving some work for the consultant. The consultant has now moved to a supportive role to the primary contractor.

Table 4:Consultant, showing key factors that drive value and potential issues from the implementation of NOC in New Zealand.

Factors driving value for the Consultant	Potential issues for the Consultant
<ul style="list-style-type: none">•Consultant – Contractor partnerships are still maintained•Higher standards of H&S, auditing and reporting•New need for engineering development and re-search•Quality work	<ul style="list-style-type: none">•Reduced decision-making work for the consultant•Loss of Capability of the industry though Consolidation.•Increase of quality of work but a potential decrease of level of service.

Consultants believe that there has been a loss of capability of the industry though consolidation caused by the formation of NOCs.

3.4 Sub-contractors' Point of View

The requirement of high proportion of sub-contracted work in the NOC has led to the general unavailability of sub-contractors. This is particularly the case for local councils as the larger contracts of-

fered by the primary contractor of the NOC are more appealing. This has led to the councils struggling to find suitable sub-contractors to complete work. There has also been an increase the average bid price due to the lack of competition in some cases. This could be a possible temporally side effect as more sub-contractors move into this space and restore competition. The Sub-contractor reported that the method of work has not changed for them under the new NOC contract, 'business as usual'.

Sub-contractors have reported that much more rigorous training is available in order to conduct work, especially in the areas of health and safety, environmental impact and forward work programming.

Table 5: Sub-contractors, showing key factors that drive value and potential issues from the implementation of NOC in New Zealand.

Factors driving value for the sub-contractor	Potential issues for the sub-contractor
<ul style="list-style-type: none">•Increased sub-contractor involvement.•Increased amount of work given to sub-contractors.•Increase training of Sub-contractor staff•Possible gap in the industry for the formation of smaller contracting businesses.•Higher standards of sub-contractor training.•Taking on more diverse tasks.	<ul style="list-style-type: none">•Sub-contractor's quality and standards and training differ greatly.•Speciality sub-contractors could see number of jobs decrease.•Lack of sub-contractor competition therefor increasing bid price for client.

3.5 Comparison and Discussion

The introduction of the NOC contracts has been relatively well received by contractors, consultants and sub-contractors. It became clear that the previous contracting methods were not achieving the desired outcome for the NZTA and the Ministry of Transportation. This need was driven originally by the financial crisis to reduce costs but has developed into a change that the industry needed. Over multiple year of consultation the NOC contract was introduced. Contractors and consultants felt that this contract has been long in the pipeline and they have had sufficient time to be consulted.

Table 6: Comparison of opinions from the four affected parties: client, contractor, consultant and sub-contractor

NOC Driver (Client)	Principal Contractor	Consultant	Sub-contractor
Pervious method not producing ideal outcome	<i>Agree</i>	<i>Agree</i>	<i>Indifferent</i>
Need for change to NOC	<i>Agree</i>	<i>Agree</i>	<i>Agree</i>
Enhanced communication requirements drive value	<i>Does not agree, can slow down processes</i>	<i>Agree</i>	<i>Can slow down progress</i>
Performance measures leads to improved procedures and quality work	<i>Mostly</i>	<i>Mostly</i>	<i>Agree</i>
Reduce cost while maintaining current LoS	<i>Does not agree</i>	<i>Does not agree</i>	<i>Indifferent</i>
Enhance sustainability of the construction industry	<i>Agree, More training</i>	<i>Agree,</i>	<i>Increase in the number of jobs</i>
Communicated changes with the public	<i>Does not agree, improvement needed</i>	<i>Does not agree, could have been improved</i>	<i>Indifferent</i>
Impact to business	<i>Large impact to procedures and business model</i>	<i>Loss of work</i>	<i>Increase of work</i>
NOC is an enhanced contracting method for the foreseeable future to boost value	<i>Agree, requires further review from Agency</i>	<i>Agree, requires further review from Agency</i>	<i>Agree</i>

From the results, it was evident that that NOC has clearly driven the industry to in the direction the agency wanted. This is particularly evident by contractors reporting a significant pressure on managing their forward work program with large oversight from the agency. Contractors have also felt the impact from the new value calculations. They have reported that it has become much more difficult to justify maintenance, driving value.

The NOC has introduced significant changes in communication and reporting. Results have shown that communication and report has driven value from the agency's point of view. However, contractors have insisted that communicating with multiple agency representatives have slowed down process and is hindering value creation.

Consultants view is that the primary contractor was previously not exposed to the agencies de-

mands. Previously it was the consultant's job to act as an intermediary. With the NOC, the link between contractor and client has been narrowed exposing the contractor to more agency points of call.

The NOC has had the largest impact on the client and contractor, whereas the consultant and sub-contractor has felt less of its effects. The contractor has had to invest large amounts of resources into training and personnel in order to deal with the new terms of the NOC contact. This has also been the case for the agency. The consultant had moved to more of a supporting role to the principle contractor and the sub-contractor have seen a significant increase in the amount of work as a direct result of the implemented NOCs.

The intention of the NOC to up skill and grow the larger construction industry appears to be working. The results from this paper suggests that the primary contractor is investing significant amount of resources into training of sub-contractors. The sub-contractors have reported that this training was improving their performance in key areas.

Some contractors are apprehensive that less spending and reduced control by the contractor will results in a decrease of level of service compared to previous methods. It is the contractor's impression that NZTA has recognized this and is accepting that this could be the case. Some contractors believe that better communication with the public as to the changes that were being implemented should have been done.

The intention of the agency was to decrease cost while maintain quality. The implantation of strict performance measures was intended to achieve this. Some contractors and clients argue that this has resulted in an increase quality of work done. However reduced funding could result in a decrease in the level of service provided to the public. There is speculation within the industry as to whether the current form of the NOC is value for the public.

Although the results of the paper show many potential issues, most parties interviewed agree that these factors can be mitigated or resolved with further implementation changes. NZTA has shown they are willing to listen to criticism and make changes. An example of this is where contractors criticised the current KPI and KRA framework. NZTA has responded and is currently re-evaluating the framework considering these criticisms.

From the discussion with all parties the desired outcome of more efficient management of assets has been achieved. The need to reduce cost while still maintaining high performance as to the contract has been the main catalyst for change in their business model. All seem to agree that this change in focus is better and will drive value for the client.

4 CONCLUSIONS

DOTs are under increasing pressure to reduce cost and provide value for the taxpayer. In New Zealand, NZTA is under pressure from the Ministry of Transportation to reduce maintenance cost. However, maintaining assets is a balance of cost and quality. NZTA must find methods to retain quality in the face of cost savings. NZTA has introduced Network Outcome Contracts in a response to this pressure. These contracts fundamentally change how maintenance is done on New Zealand assets. They are taking on board much of the decision-making process previously outsourced to consultants. Industry is optimistic about the implantation of the NOCs. Overall effected parties agree that NOCs are the way forward for the industry. However, Industry is anxious that less spending and less control by the contractor will result in reduced level of service over time. Industry also fear possible short-term cost savings could result in long term cost. However, industry agree that with continued review the NOC will be a very successful framework for value driven maintenance compared to the previous method. This is echoed by the NZTA, where continuous auditing is now the main driver to improve the performance of these newly introduced contracts. As time goes on, an increasing amount of quantitative data will become available. Further research is required to ensure that value is continuously improved for the client and the taxpayer.

5 REFERENCES

- Botha, P. S., & Scheepbouwer, E. (2015). Christchurch rebuild, New Zealand: Alliancing with a difference. *Proceedings of the Institution of Civil Engineers-Management, Procurement and Law*, 168(3), 121-129.
- DeWitt, S., Yakowenko, G., Bohuslav, T., Ferguson, T., Hoelker, E., Molenaar, K., . . . Wagman, R. (2005). *Construction management practices in Canada and Europe*. Retrieved from
- Gransberg, D. D., Scheepbouwer, E., & Tighe, S. L. (2010). *Performance-Specified Maintenance Contracting—The New Zealand Approach to Pavement Preservation*. Paper presented at the First International Conference on Pavement Preservation, Newport Beach, California.
- Kim, S.-H., Cohen, M. A., & Netessine, S. (2007). Performance contracting in after-sales service supply chains. *Management science*, 53(12), 1843-1858.
- Lee, A., & Barrett, P. (2003). *Performance Based Building: first international state-of-the-art report*.
- Manion, M. (nd). *1st Signs Approach to Maintenance Management* Paper presented at the Institute of Public Works Engineering Australia, IPWEA. <https://www.ipwea.org/HigherLogic/System/DownloadadDocumentFile.ashx?DocumentFileKey=8c302cdb-9166-4c6e-9a54-c394d9a3b6d6&forceDialog=0>
- Manion, M., & Tighe, S. (2007). Performance-specified maintenance contracts: adding value through improved safety performance. *Transportation Research Record: Journal of the Transportation Research Board*(1990), 72-79.
- Ng, I. C., Ding, D. X., & Yip, N. (2013). Outcome-based contracts as new business model: The role of partnership and value-driven relational assets. *Industrial Marketing Management*, 42(5), 730-743.
- NZTA. (2015). NOC Contract Clarifications. Retrieved from <https://nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Network-outcome-contracts/Clarifications>
- Porter, T. M. (2001). *Trends in the Procurement Models for Highway Maintenance*. Paper presented at the 80th Transportation Research Board Annual Meeting, Washington, DC.
- Scheepbouwer, E., & Gransberg, D. D. (2014). *Comparative Analysis of New Zealand Alliance Contracting and US Project Delivery Models*. Paper presented at the Transportation Research Board 93rd Annual Meeting.
- Wheel, A. (2000). *Purchasing and supply chain management analysis, planning and practice*: Thomson learning business press.
- Wirtz, B. W., Pistoia, A., Ullrich, S., & Göttel, V. (2016). Business models: Origin, development and future research perspectives. *Long Range Planning*, 49(1), 36-54.
- Zietlow, G. (2004). Implementing performance-based road management and maintenance contracts in developing countries-an instrument of German technical cooperation. *German Development Cooperation (GTZ), Eschborn, Germany*.
- Zietlow, G. (2005). Cutting costs and improving quality through performance-based road management and maintenance contracts-the Latin American and OECD experiences. *Senior Road Executives Programme, Restructuring Road Management, German Development Cooperation, Birmingham*.