A Guide to Delivering Good Asset Management in the Road Sector through Performance Based Contracting

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A GUIDE TO DELIVERING GOOD ASSET MANAGEMENT IN THE ROAD SECTOR THROUGH PERFORMANCE BASED CONTRACTING
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<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>AM</td>
<td>Asset Management</td>
</tr>
<tr>
<td>DBMOT</td>
<td>Design Build Maintain Operate Transfer</td>
</tr>
<tr>
<td>Improvements</td>
<td>New characteristics added to the road in response to new traffic, safety or other considerations. Items such as widening of roads, intersection upgrades etc. that primarily improve the functional performance of the asset. While often completed in conjunction with other works (when the existing infrastructure is due for resurfacing or renewal), they are not essential to the retention/reinstatement of the original level of service.</td>
</tr>
<tr>
<td>OPRC</td>
<td>Output and Performance-Based Road Contract</td>
</tr>
<tr>
<td>Opus</td>
<td>Opus International Consultants Limited (<a href="http://www.opus.co.nz">www.opus.co.nz</a>)</td>
</tr>
<tr>
<td>Outcome Contract</td>
<td>Where payment is made on the basis of the quality of the asset provided e.g. $ for having the road within a specific roughness limit. The Contractor takes the risk on the resources, quality and quantity of work.</td>
</tr>
<tr>
<td>Output Contract</td>
<td>Where payment is made on the basis of the outputs delivered e.g. $/km for resurfacing, $/sq-m of patch. The Contractor takes the risk on the resources involved and the quality of work, but not the quantity of work.</td>
</tr>
<tr>
<td>Pavement Renewals (Reconstruction or Rehabilitation)</td>
<td>The improvement (reinstatement) of the load carrying capacity of the pavement layers carried out in order to bring the roads up to pre-defined standards;</td>
</tr>
<tr>
<td>PBC</td>
<td>Performance Based Contracting, refer to Outcome Contract above</td>
</tr>
<tr>
<td>Periodic Maintenance</td>
<td>Refer Periodic Resurfacing</td>
</tr>
<tr>
<td>Periodic Resurfacing</td>
<td>The planned resurfacing of a road and for unpaved networks the scheduled placement of more gravel on the wearing course to account for that lost under vehicle usage. For asphalt surfaced pavements, overlays less than 50mm are considered as resurfacing</td>
</tr>
<tr>
<td>PMMR</td>
<td>Performance-Based Management and Maintenance of Roads</td>
</tr>
<tr>
<td>PPP or P3</td>
<td>Public-Private-Partnership</td>
</tr>
<tr>
<td>Reactive Maintenance</td>
<td>The routine, typically reactive, actions needed to restore network safety/serviceability. Involves items such as pothole repairs, vegetation control and drain clearing.</td>
</tr>
</tbody>
</table>
Performance-Based Contract (PBC) methods are widely used for road maintenance in developing countries. There are many reasons why road agencies have decided to introduce these methods, e.g., better transparency, increased focus on workmanship and reduced long term costs. The World Bank (the Bank) has supported and financed almost 50 PBC projects over the last 15 years. Currently, most PBC projects are developed on the basis of Sample Bidding Document for Output- and Performance-based Road Contracts (OPRCs).

This guide has been developed on the underlying presumption that good asset management is an essential goal of any Bank investment in the on-going management of a road network, and that PBC is a proven way (but not the only way) to drive the paradigm shift in all parties typically needed to achieve good asset management.

The term OPRC represents a spectrum of contract models, while the term PBC is the general term for all contracts using performance-based methods. Currently, in order to maximize value for money, OPRCs are dramatically evolving in line with road asset management principles. According to the results of the PBC review project (P118614), there are three principal scenarios where PBCs are applied:

I. unpaved roads PBC;

II. paved roads in a generally poor-fair condition (DBMOT PBC); and

III. paved roads in a generally good-excellent condition (Network Management PBCs).

This guide is intended to assist those new to the topic of PBCs to understand what they are, how they align with good asset management and what the key issues are to consider before (and during) implementation.

The guide commences with a discussion on what constitutes good asset management, before describing how PBCs assist in the delivery of good asset management. The guide then addresses the key issues associated with making an implementation successful, concluding with an overall PBC implementation decision tree and checklist.
2.1 AIMS OF THE GUIDE

The road sector represents a significant asset to any country – both in terms of the physical cost to build it, and the social and economic benefits that it facilitates. Good asset management in the road sector is about obtaining the desired benefits at the least whole-of-life cost, and it is therefore natural to seek to implement a robust asset management approach on what is typically a nation’s largest asset.

Implementation of performance based contracting (PBC) necessitates the identification of many of the cornerstones to asset management, such as knowing the asset, managing risks and determining the sustainable level of service for the funds available. Performance based contracting is a proven method to deliver a paradigm shift in all parties responsible for the management and preservation of the road infrastructure, including addressing construction quality issues, delivering consistent levels of service, improving transparency and stewardship and reducing the opportunities for corruption.

The aim of this guide is to help the reader understand:

1. What asset management is and why it is important;
2. How performance based contracting delivers good asset management; and
3. The issues and challenges associated with successful implementation of a performance based contract.

This guide is focused on PBCs with a significant contract term. This guide does not specifically cover performance based design-build contracts, although aspects of the guide are likely relevant to that contract delivery model as well. Similarly the guide does not address in any detail the funding options (road taxes, general taxes, external borrowing, tolls etc.) that may be used to fund the works and for this reason it does not address public-private-partnerships specifically noting, however, that a robust PBC underpins all successful PPP projects.

2.2 INTENDED AUDIENCE

This guide has been written with the following audiences in mind:

1. Those within international lending institutions;
2. The in-country road managers (often Public Works Departments or Ministry of Works) who are being offered funds on the proviso of implementing a performance based contract; and
3. The consulting and contracting industries that supports the process, both before and after letting of the contract.

2.3 BACKGROUND MATERIAL

This guide draws extensively on the following report which examined 35 projects across 27 countries, combined with the knowledge of an international project team.


Unless otherwise referenced, the above report and associated research is the basis for the guidance given here.
WHAT CONSTITUTES GOOD ASSET MANAGEMENT

3.1 WHAT IS ASSET MANAGEMENT

Good infrastructure asset management (AM) is defined in numerous guidelines and standards, with the common theme being the provision of the desired level of service in the most cost effective manner. The following definition is from AASHTO (2011):

“Transportation Asset Management is a strategic and systematic process of operating, maintaining, upgrading and expanding physical assets effectively throughout their lifecycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well defined objectives.”

For many infrastructure asset owning agencies, their traditional means of asset management better resembles a Facility Management approach, wherein the approach is to “find and fix as many faults as possible within the budget available”, with the level of service provided being an outcome of the works completed and with little thought about minimizing the whole of life costs.

3.2 WHY IS ASSET MANAGEMENT IMPORTANT

AM is important because infrastructure (and in particular road infrastructure) is so critical to the functioning of modern societies, and will typically constitute the largest constructed-asset of any country. Furthermore, every dollar spent on the physical infrastructure in excess of that necessary is one less dollar available to be spent on the social services of a country.

With good AM come benefits such as:

- Reduced Life-cycle Costs;
- Consistent Levels of Service;
- Ability to Monitor and Track Performance;
- Improved Transparency in Decision Making;
- Ability to Predict Consequences of Funding Decisions and future funding needs;
- Demonstrated asset custodianship; and
3.3 THE ESSENTIAL QUESTIONS OF ASSET MANAGEMENT

Experience has shown that with the implementation of asset management in any organization whether it is at a basic or advanced level, the asset manager has to understand the answers to the following fundamental questions:

- **What is the asset under consideration?** Basic inventory in sufficient detail to allow clear understanding of the scope of the contract and to enable definition of contract responsibilities.

- **What condition is it in?** Ideally this will include a timeline of condition and performance data so that the road controlling organization understands rates of deterioration and contractors can have an appreciation of their future financial exposure going forward.

- **What is it worth?** To justify the investment in the assets, and to ensure that the value is retained over time, it is necessary to have an estimate of the replacement (and depreciated replacement) value of the asset.

- **What is required of the asset?** What are the levels of service the organization wants to deliver to road users and what are the performance measures which define the condition that the assets should be in?

- **What do we need to do to it?** Are there any gaps between current and required service levels occurring now or at some time in the future as a result of growth? What is the forward works program required to close the service gaps?

- **How much will it cost?** Is the cost affordable, do the owners’ / users’ aspirations need to be revisited or will debt funding be required, by either the organization or the contractor?

- **How will it be delivered?** What are the delivery options (own forces, or outsourcing via input, output, or outcome/performance based contracts) and how do these align with the over-arching goals of the organization and needs of the network?

For mature AM organizations, the above questions are answered within the Asset Management Plan (AMP). The development of the AMP is a key part of AM, and as shown below that PBC is a proven way to deliver the plan.
4 HOW PERFORMANCE BASED CONTRACTING FACILITATES ASSET MANAGEMENT

4.1 WHAT IS PBC

Performance-based contracting (PBC) is defined as “a type of contract in which payment for the deliverable is explicitly linked to the contractor's successfully meeting or exceeding certain clearly defined performance indicators” (Stankevic, Qureshi and Queiroz, 2005) PBC involves a significant shift away from more traditional approaches to the delivery and maintenance of road infrastructure and associated services by a shift from the situation where the client has responsibility for the design and supervision of construction and maintenance activities, to a focus upon the key outcomes that the client wishes to achieve and incentivizing the achievement of those outcomes. Most PBCs consist of a subset of the following six components: design, build, finance, operate, maintain, and transfer.

The World Bank (hereafter, the Bank) has supported different types of PBCs in the road sector over the last 15 years. The Bank developed sample bidding documents for PBC in 2002 (Performance-Based Management and Maintenance of Roads – PMMR (World Bank 2002)), and again in 2006 (Output- and Performance-based Road Contracts – OPRC (World Bank 2006)) to secure minimum standards of quality for PBC implementation. Also, the Bank published Transport Note TN-27 (Stankevich et al. 2005) in 2005 and a supporting web-based Resource Guide¹ in 2006, to assist national and sub-national road agencies launching or enhancing PBC projects for construction, operation and maintenance of their road networks.

4.2 BANK SAMPLE BIDDING DOCUMENTS

The sample bidding documents (World Bank 2006) while often referred to as a single entity, are in effect three separate contractual sections:

- Part 1: Bidding procedures
- Part 2: Technical specifications
- Part 3: Conditions of contract

The Bank considers Parts 1 and 3 mandatory, with variation to account for the specific implementation provided for within Part 2. Within this guide, where

¹ http://www-esd.worldbank.org/pbc_resource_guide/resources.htm
reference is made to the need for specific bidding documents for various forms of OPRC, this in effect relates to the provision of different sample technical specifications.

4.3 WHY PBC FACILITATES GOOD AM

The process of implementing a PBC forces those responsible for the funding, governance and management (at all levels) of the asset to answer the questions that have the potential to drift on, lacking answers, without the contractual pressure of the PBC timeframe. Specifically, to successfully implement a PBC (refer to Section 3.3 below), answers are needed to questions such as:

- What assets does the client own and which of these are to be managed under this contract?
- What level of service is it desired to provide to the road user?
- What condition are they in?
- What is the forward works program required to deliver the least whole-of-life-cost solution?
- What risks exist in the delivery of the level of service, and how are those risks best managed?

PBCs also tend to:

- Provide a better focus by the road agency on governance as a result of the separation from the day-to-day operational activities;
- Deliver a more consistent (and better) service level;
- Reduce costs and/or set costs at a fixed level to enable long term fiscal planning by the road agency;
- Better allocate risk;
- Improve workmanship; and
- Address internal labor shortages wherein the authority may not have the internal resources/capacity to manage a network according to the traditional model.

While many of these desired outcomes might be achieved via alternative contracting means, it is the PBCs’ requirement to address all of these at once that is often perceived as the key benefit to the contract model as they force a paradigm shift along with consideration of all the principles of good asset management.
4.4 CONTRACT MODEL TYPES

4.4.1 INPUT-OUTPUT-OUTCOME MODELS

PBC is but one of a continuum of contract methodologies that are in use to maintain road networks around the world. As indicated within Table 1 the key changes in progressing from an Input-based contract through to a PBC (or Outcome-based) contract is the change in responsibility for efficiency and effectiveness of works, and the financial motivation of the contractor. Further details on each are provided below the table.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Input</th>
<th>Output</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Name</td>
<td>Force Account (Day Works)</td>
<td>Traditional</td>
<td>Performance Based</td>
</tr>
<tr>
<td>Payment</td>
<td>$/input</td>
<td>$/output</td>
<td>$/month subject to meeting performance standards</td>
</tr>
<tr>
<td>Sophistication Required from Contractor</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Contractors’ Motivation</td>
<td>As many inputs as possible, with no emphasis on efficiency.</td>
<td>As many outputs as possible as efficiently as possible – there is no driver for quality or for effectiveness of the interventions.</td>
<td>As little work as possible to deliver specified outcomes. Contractor seeks to be both effective and efficient.</td>
</tr>
<tr>
<td>Who carries efficiency risks</td>
<td>Client</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>Who carries quality and effectiveness risks</td>
<td>Client</td>
<td>Client</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

**Input Driven Contracts**

Historical practice in all the countries under study (and just about everywhere else!) centered on input driven contracts which typically employed direct labor organizations undertaking works which had been tightly specified. This left little or no room for contractor innovation or efficiency savings to be made. Management and governance of the works was typically carried out by Highway Authorities in-house design organizations with little or no thought to any holistic approach to asset management of the network as a whole. The contractor simply did what he was told
to do and received payment for labor and plant by the hour and for materials by quantity delivered. The focus was on getting the best service level one could for the available budget, often with unwritten secondary goal of employing as many people as possible.

As the benefits of outsourcing became apparent this model continued to find favor with the only change being the increasing use of contractors at the expense of in-house direct labor units. Experience from observing those managing this form of delivery model suggests a strong focus on the efficiency of the work force [as the contractor gets paid just for being on site, so the driver for those managing the contract is to make sure the resources are being used for the least time available] but rather neglected the effectiveness and efficacy issues that good asset management practices demand.

Output Based Contracts

Output based contracts were developed to encourage contractors to take responsibility for, and carry the risk of, the efficiency of their workforce. Under this model the contractor is paid for each of the completed outputs, rather than the resources used to deliver the outputs. Typically payment is for each completed unit of work (to accepted quality standards) in place or for larger works per cubic meter of material in place (the contractor carrying the risk of location). In more advanced models the contracting entity may be called on to take more of the risk so payment may be per square meter (with the contractor also carrying some of the design risk on depth).

While all the work on the network may be bundled up into one contract it is more common for the work to be broken down into a number of output based contracts such as routine maintenance, resurfacing, rehabilitation, and drainage improvements and let as separate contracts. The contractor should warrant their work so that the risk of rework is theirs as this helps to drive improvements in the
quality of workmanship. The duration of the warranty varies but is typically at least a year or the duration of the contract in term contracts.

Work is still tightly specified within this model form providing little room for contractor innovation. Historically consultation with the contractor rarely took place before tenders were invited meaning that construction techniques, health and safety issues or construction programs were not often adequately considered or the experience of buildability that a contractor could bring to the project taken on board. As this model has evolved the specifications have increasingly introduced performance based requirements and lump sum elements into their pricing.

Outcome Based Contracts

The move to Outcome, or fully performance specified contracts provided a step change in the procurement of highway asset maintenance contracts. Arrangements are such that the Asset Owner simply enters into a single contract with a combined contractor/consultant organization and only specifies the desired outcomes [service levels] for the road network, placing full responsibility for all interventions including resurfacing and pavement rehabilitation, along with all routine maintenance activities, on the contracting entity. Accordingly the entity assumes full responsibility for both the efficiency and the effectiveness of all interventions. In their purest form these contracts allow complete flexibility in the methodology adopted by the contractor organization. In developing countries, the use of an experienced monitoring consultant to support the road agency is considered essential. The monitoring consultant also provides the contractor with an element of protection from interference by the road agency with regard to the methods the contractor employs to achieve the outcomes required.

These contracts provide the Asset Owner with one point of contact rather than the two typically used in the output driven or conventional form of contract. Payment is, for the most part, achieved under lump sum arrangements that significantly reduce
The adversarial issues that can occur under the other forms of contract. Again, governance of the contract is the role of the client who is responsible for defining and ensuring compliance with the specified service levels.

The required service levels are specified in performance based contracts through a series of performance measures which cover asset and contract management requirements, road user service and comfort measures as well as the long term durability of the asset. It is the later requirements that are the most contentious as agencies are understandably concerned about the consumption of their asset during the term of their contract.

### 4.4.2 SCENARIOS WHERE PBCS ARE APPLIED

The term PBC itself represents a spectrum of contract models, with variations resulting from the scope of assets included, the nature/condition of the existing road network, and the payment mechanism amongst others. The key scenarios and intents of the resultant PBC are:

1. **PBC for unpaved roads**: Owing to their relatively fast deterioration the outcomes are generally easy to specify and are focused on the road user comfort measures. While there is an issue around the specification of appropriate durability measures for unpaved roads to account for gravel loss, they have been successfully implemented in a number of countries. Given the performance indicators change quite quickly on unpaved roads (both in terms of deterioration and rectification (via grading)), this has to be considered when evaluating the performance and contractual compliance.

2. **Paved roads in a generally poor-fair condition (DBMOT PBC)**: With these roads the focus within the PBC needs to move from the initial upgrading of the network, through to the maintenance of the network. The form of the payment mechanism needs careful examination to ensure that the
contractor is suitably incentivized to deliver on the maintenance portion of the contract. The focus on these contracts is often to get improved construction quality (in order to minimize the whole-of-life-cost\(^2\)), with a key requirement being a sufficient period of time post construction for any defects to be rectified by, and at the cost of the contractor.

For example, the CREMA (Contrato de REcuperación y MAntenaimiento translated to Rehabilitation and Maintenance Contracts) contracts used in Latin America include a heavy initial rehabilitation. These contracts are often referred to as Design-Build-Maintain-Operate-Transfer (DBMOT) methodology contracts. Design-Build only contracts, while performance based, are outside the scope of this report which is focused on models that include the ongoing maintenance of the network.

3. Paved roads in a generally good-excellent condition (Network Management PBC): These roads require a relatively small (if any) initial investment to bring the network into full compliance with the required service levels. The focus is to obtain the least whole-of-life costs (often akin to maximizing the asset life) from the assets under management whilst also ensuring an

\(^2\) Whole-of-life costing involves the minimization of the cost of ownership of the assets over the life of the asset. It includes for the analysis of investing more today, in order to deliver savings tomorrow, as well as extracting the full life from the asset. In many contracts where there is a history of poor construction the reconstruction/rehabilitation works programme is completed in the first 1-2 years of the contract (effectively discarding the remaining life of some assets that may have survived another 5 years), with the remaining period used as a maintenance period to drive better construction quality.
appropriate condition at the end of the contract term (i.e. ensuring the asset is not unduly consumed over the term of the contract). With these networks the payment is typically a uniform amount per month, and the focus is on long term sustainable service levels (both during and after the contract period) which typically demand a relatively uniform series of interventions.

It is under this scenario that the Bank sample OPRC documents were originally prepared, with a nominal upfront investment limit of 30% of the total contract value being placed on the applicability of the document\(^3\). These contracts are typically of a performance based Network Management Contract\(^4\) form, and a sound understanding of asset management is required by the contractor if he is to deliver the timely interventions and good workmanship needed to deliver the specified service level for the least cost.

\[\text{FIGURE 5: PHOTOGRAPH OF A ROAD IN GOOD CONDITION}\]

The primary financial difference between the DBMOT and Network Management contract formats described above, is the duration over which any debt is carried by the contractor were he paid on a uniform lump sum basis.

\(^3\) The limit of 30% of contract value being for initial works was subsequently removed to enable for the sample documents to be used on a wider range of networks, but with no specific changes made to the remainder of the document to address issues caused by a >30% initial works value.

\(^4\) These contracts recognize that at any point in time there are likely to be parts of the network with a range of ages and residual lives, and that the focus is on a consistent service level and minimizing the whole-of-life costs. This is distinct from the DBMOT approach that typically sets out to provide a step-change in service levels and mitigate the risks of poor construction quality via the extensive upfront work.
For the Network Management contract form, any debt is notionally “within year” with no substantial carry over from one year to the next, while for the DBMOT there may be debt from the initial upgrade that is repaid over the entire duration of the contract. More detailed guidance on the payment models is provided in Section 5.3.

In practice, all contractual models require partnerships to be successful and the learnings within this guide are, in most cases, applicable to all models. There is a strong tendency for the projects that are funded by the Bank and other lending institutions to fall into the DBMOT category. This is thought to be because those countries where investment is sought by way of Bank loans to improve the infrastructure typically have a poorer standard of road network (often owing to insufficient funds). This is in contrast to the OPRC sample bidding documents that were developed with a more balanced asset management approach in mind. In practice a single Sample Bidding Document should be able to cover all three scenarios above, but with different supporting Technical Specifications.

It is important to recognize that the progression from an Input to an Output on to a Design and Build, and subsequently to a Design, Build and Maintain contract model form is an important part of developing the skills necessary for a PBC within the local industry. Equally, where the desire is to make a step change in the way that AM is implemented, and PBC is the accepted way to facilitate the change, there is unlikely to be time to develop a local “skilled” industry. Instead the contract size and scope will need to be developed such that external (either national or international) contractors with suitable PBC experience are enticed to take the lead contractor role – ideally with local contractors supporting in the delivery of various functions such that local capacity is increased for subsequent contracts.

**Output Based Aid and Results Based Financing**

Output-Based Aid (OBA) is a results-based mechanism that is focused to deliver basic infrastructure and social services to the poor. The OBA concept and initiative is a derivative of the Result-Based Financing (RBF) process that is aimed at incentivizing governments and their providers to engage service providers to provide infrastructure that is paid for on completion. Unlike traditional approaches, OBA links the payment of aid to the delivery of specific services or “outputs.” For example, these can include acceptable distances from poor people’s households to an all-season road or regional trade facilitation links. PBC initiatives can be enhanced if incentives, subsidies or capacity building are needed using the OBA mechanism that can be effectively utilized to assist the successful completion of PBC projects.

PBC in the road sector is a good example of RBF, with payment related to successful accomplishment of the project objectives. PBC is also a good example of how a results-based system works to the advantage of providers and users. The OBA
approach can assist in facilitating the change of contracting methodology and building of confidence and knowledge for this more efficient way of procurement.

4.5 PBC IMPLEMENTATION STRATEGY

Unfortunately not all PBC initiatives end in the successful implementation of a contract. In many cases the time taken to move through the process of implementing a PBC is too great for momentum to be sustained, with the result being staff often moving on and the initiative halted. While in others the sole focus of implementing a PBC, at the expense of recognizing the benefits of implementing asset management (with PBC a way to support the AM approach), puts the project team at odds with the road agency involved. For an organization that has not adopted asset management as a way of working, to focus on PBC in itself, without a corresponding focus on implementing good asset management increases the risk that the organization involved will not support the initiative. It is essential that the organization firstly grasps the need for and benefit of asset management, before endeavoring to understand the benefits of PBC in delivering the asset management outcomes.

Although it is difficult to prioritize the importance of success factors for PBCs, it is well accepted that institutional issues are the foundation of any successful PBC process. This statement can even be taken as far as saying that PBC can only be successful if it is “driven from the top”. Furthermore, the organizations “culture” must be aligned with the desired outcomes e.g. preservation of the asset’s value, consistent level of service for road users, collaborative long-term relationships.

Having only top-level commitment may not be enough. The PBC contracting format has its origins from institutional or road sector reforms, and it is reasonable to assume that if the status quo in undertaking road maintenance was satisfactory, there would not be a need to adopt an alternative contracting format. Smith and Grinker (2004) include PBC on the continuum of public service improvements (refer to Figure 6). Their main point is also that PBC in itself is not sufficient to drive improvement in service delivery, but it should also be supported through improvements in performance measurement and management of the asset, and in some cases institutional restructuring. There is also a clear alignment between the benefits/enablers of PBC and those of asset management.

The points made by Smith and Grinker (2004) thus highlight a vital issue from an institutional perspective – that is the condition of having a strong desire from the agency to change practices in maintaining their roads. For example, sometimes adopting PBC may require high level changes such as alterations to legislation and bidding and/or contracting policies. These changes take time and energy and can only be driven by top management.
There should also be mechanisms to address or counter fears and insecurities from staff within the agency. For example, if by adopting PBC, a natural consequence may include some significant job losses (or often a transfer of staff from the agency to the PBC contractor) there will be a strong resistance from within the agency that may jeopardize the process of moving towards PBCs. For example with CREMA in Argentina (Silva, M.M. and Liautaud, G. 2011) the following is reported “with the adoption of CREMA as an asset management modality, DNV’s workforce has reduced at an average rate of about 4 percent per year, from 3700 in 1994 to about 2100 in 2010, while maintenance by force-account has also been reduced from over 50 percent to about 30 percent including unpaved roads”. It is often the case that a new contractual format faces reluctance from various levels of agency staff including:

- Lower level staff may perceive PBC contracts as a risk to their jobs, especially where maintenance work or supervision of maintenance is currently undertaken in-house;

- Managerial staff from agencies may be hesitant to move towards PBCs fearing its potential failure or unpopularity within the wider agency. This may be exacerbated if they perceive there will be a loss of control of asset management decisions as a result of transferring risk to the contractor; and,

- At governance level there may be stumbling block due to the resistance to change legislation or processes to allow for a PBC framework, including the locking in of maintenance budgets for the long term.
It has been observed in all cases where the above mentioned factors were present that the PBC process was significantly delayed to a point where it was often effectively cancelled.

There are seven steps (from the client having an idea, through to the PBC being delivered) where the PBC Implementation Chain can fail (refer to Figure 7). If the goal is to implement a PBC, then success at all 7 steps is required. It is noted that before Step A, there are also challenges in getting an organization to buy into the concept of asset management. Where an organization has not accepted good asset management as an end goal, then progress along the PBC Implementation Chain is unlikely.

Within Figure 7, seven distinct potential points of failure are identified (labeled A – G). Each of these seven points is discussed in Table 2 below including the nature of potential failure, and what might help alleviate the reason for failure (or increase the chances of successfully moving to the next link in the implementation chain).

While there are the specific steps (A, C, E and G) noted above, the implementation chain also addresses the links between these steps (e.g. how to move from concept successfully to engaging a consultant to support the process).
### TABLE 2: EXAMPLES OF FAILURES AT THE VARIOUS STEPS ALONG THE CHAIN INCLUDE

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<tr>
<th>LINK IN IMPLEMENTATION CHAIN</th>
<th>Discussion</th>
<th>Indicative Alleviation Measures</th>
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<tbody>
<tr>
<td><strong>A. Failure of Concept</strong></td>
<td>It is almost impossible to know how many transport agencies have considered implementing a PBC but have not progressed the concept any further. Whether this is because they did not understand the benefits of PBC in delivering AM, they did not believe in AM, or some other reason is equally difficult to identify.</td>
<td>Better Bank guidance on the meaning and benefits of the asset management approach and a full suite of PBC sample bidding documents available, including clear selection criteria for each model type and some factually based analyses of the value delivered by the PBC model. Help with the process of developing the objectives of the road agency, and then linking these to the most appropriate contract model form(s).</td>
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<tr>
<td>Notes:</td>
<td>i. PBC contracts are not always the best means of achieving different objectives targeted by the road agency. Therefore, there has to be a natural fit between the objectives of an agency and the PBC mechanisms. ii. There has to be a champion within the organization to drive the PBC concept internally. Someone has to take ownership of the transition into a different procurement process.</td>
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<td><strong>B. Failure to move from Concept to Consultant Support</strong></td>
<td>Practically this is almost indistinguishable from the failure at stage A, with the only notable difference being that the discussion on the concept has been made somewhat more public and/or discussed with lending institutions such as the Bank. Failures at this stage appear to relate to issues with procurement of the consultant support. For instance Thailand had terms of reference for the appointment of a consultant prepared in 2004, but have not yet initiated this. Similarly Punjab required two rounds of tendering to yield a result.</td>
<td>As above, plus: The availability of a sample Terms of Reference for the consultant support to suit the particular case.</td>
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<tr>
<td>Note:</td>
<td>i. The TOR should require the delivery of a draft Asset Management Plan that will provide a benchmark cost comparison for whatever form of PBC is subsequently decided upon.</td>
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## LINK IN IMPLEMENTATION CHAIN

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<th>C. Failure of the appointed Consultant</th>
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<th>Indicative Alleviation Measures</th>
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| At this stage in the process failure is a combined consultant/client affair wherein the consultant is unable to produce contract documents that are suitable in the eyes of the client/Bank for progressing to the bidding phase. The initial consultant support in Botswana was not successful in advancing the contract and a new tender process is under way to identify a replacement. | Either a two-stage evaluation process to shortlist only capable/experienced consultants, and/or placing a much higher weighting on non-price attributes would reduce the chances of this occurring. The availability of a suite of Bank sample bidding documents to address OPRC, DBMOT, PPP and Unpaved road networks reducing the burden on the consultant to develop one-off contract documents. | Notes:  
1. Reluctance to use a high selection weighting on non-price attributes means that in many cases the client may well be receiving advice from a consultant that has limited (if any) specialist knowledge in the field of PBC. The use of lowest cost evaluation methods tends to force the use of contract staff not necessarily skilled in OPRC/PBC. |

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<th>D. Failure to move to the Bidding Process</th>
<th>Discussion</th>
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<td>At this stage, failure is often caused by an inability to obtain the necessary funding commitment to deliver the physical works. In many cases it is thought that the apparent higher cost estimate of the PBC (compared to traditional contracting means) is as a result of the consultant proposing design/construction standards that will deliver least whole-of-life cost solutions. Where the work is potentially moving from in-sourced to outsourced, this issue is further exacerbated by few agencies recognizing the true cost of delivering the services (overheads etc.).</td>
<td>Bank to develop better support/guidance around the actual quantum of work and design/construction practices necessary to minimize the whole-of-life costs of ownership of the asset. [It is against this value that the PBC should be measured in terms of delivering value for money, and not the prior underfunded scenario that occurs in many jurisdictions.] Undertake industry consultation to determine the viability of the model and engage with industry. This is particularly important to help manage perceived risks such as historic construction quality and vehicle overloading.</td>
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### Performance Based Contracting

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<td><strong>E. Failure of the Bidding Process</strong></td>
<td>Very few PBCs have failed at this stage. Two notable exceptions are Egypt and Argentina. In Egypt the timing of the PBC coincided with a construction boom (and an associated capacity constrained market) that had ample work from construction contracts and little interest in pursuit of road maintenance contracts. Consequently only a single bidder was received (from the 10 invited). In Argentina, the financing cost to the contracting industry of the high quantum of upfront works versus the proposed uniform payment resulted in excessive prices. Argentina subsequently moved on to a successful PBC with the CREMA contract model.</td>
<td>Better support to help select the most appropriate contract model (PBC or otherwise) would reduce the chances of the bidder prices coming in well above client expectation. More industry involvement early in the process through briefings, seeking feedback and explanation of the benefits to their long-term sustainability as contractors that these types of contracts can offer. This could in turn help increase interest in, and knowledge of, the contract form and reduce cost bid as industry understands risks better.</td>
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<tr>
<td><strong>F. Failure to Sign the Contract</strong></td>
<td>We are not aware of any PBCs where the preferred contractor has not gone on to sign the contract.</td>
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<td><strong>G. Failure in the Delivery of the PBC</strong></td>
<td>At this stage, failure is either not achieving full compliance with the contract requirements, or as a result of financial difficulties on the part of the contractor owing to underpricing of the works (or risks). Where the contract has been underpriced (more likely based on lowest price bid selection criteria) the potential for major performance challenges and need for intervention by the agency is greatly increased. To help ensure compliance, it is essential that penalties are timely and comparative to the level of non-conformance. The concept of the “Non-Conformance Report (NCR) Bucket” as outlined in Opus (2009) is considered an approach that is readily understood and provides the appropriate level of tension on the contractor’s performance. Penalty regimes that work on a “three strikes and you’re out” principle have generally not worked in either the developed or developing world.</td>
<td>The selection of an experienced monitoring consultant (if in house skills don’t exist) to reduce the chances of failing to comply with the contractual requirements. Ideally the consultant selected to support the bidding process should be retained for the first 1-2 years (minimum) after contract award to ensuring continuity of service and maximize the chances of contract success. Making an effort through the whole procurement development process to keep industry informed, seek and provide feedback and educate them on the model form, such that expectations are known before the contract is commenced/bid. Ensure the NCR bucket, liquidated damages and performance guarantees are in place and utilized to give the agency (and by extension the monitoring consultant) the ability to “incentivize” and manage the contract at the appropriate level of detail.</td>
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### Discussion

#### Indicative Alleviation Measures

**Note:**

i. The chances of financial failure of the contractor can be reduced by recognizing the financial strength of the bidding party in the evaluation process, and by ensuring that the risk allocation table is equitable. While a low bid price may appear attractive at day-1 of a contract, an unsustainably low price often leads to dissatisfaction by all contracted parties. The use of a quality based selection process for the delivery of the physical works is also necessary to minimize the risk of financial default by the contractor.

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### Case Study: Controlling of Overloading in Indonesia

Indonesia, like many developing countries, has a significant issue with overloading of vehicles. The figure below indicates that some 50% of all trucks were overloaded by at least 50%, and 20% of vehicles were overloaded by more than 70%. With a change in enforcement practices and the establishment of quality weighing facilities, a trial was instigated to control the most severely overloaded vehicles on the road (those >60% overloaded).

Following the trial, the percentage of excessively overloaded vehicles dropped from 35% to around 5%. Such dramatic improvements illustrate that overloading can be substantially controlled with the right mix of infrastructure and enforcement. In the case of this trial, it was possible to place a cordon across the road network to avoid overloaded vehicles simply being driven around the weight stations.
Furthermore the penalties for overloading were such that both the driver and company were incentivized to conform, with the requirement to return to the place of loading the truck to off-load the excessive materials.

Additionally, the risk for overloading can be clearly allocated on the basis of the known level of overloading present on the network, with the PBC contractor able to design and construct pavements that reflect the least whole-of-contract costs for the risks they are being asked to carry.

Although Figure 7 shows multiple steps to be achieved before the PBC is in place, failing to implement the PBC should not be considered a failure if there has been a substantial shift in the practice of AM within the road agency. As indicated in Figure 8 substantial AM benefits can be realized prior to the bidding process (Step E above).
Literature has quoted very few PBC projects that have gone through to completion to be retrospectively labeled a failure or less successful than expected. In developing countries in particular, “failing PBCs” are normally those contracts that did not get off the ground at all. Most problems associated with implemented PBC contracts arise from either:

- relationship issues. These are often borne out of misunderstandings/poor definition of scope, intent, objectives or extent of risk transfer owing to a poor understanding of the issues by the agency and/or the consultant engaged to support the agency and reiterates the need to get sufficiently experienced advice; or

- institutional issues that result in a contract not proceeding as intended.

The one notable exception is that where price dominates the evaluation procedures, it is possible that the “successful” contractor will find the contract to be financially unsustainable if full compliance with the technical specification is enforced. Under such a scenario there is seldom a chance of the PBC delivering the full benefits anticipated, although the PBC itself may still run to the end of the contract period.

To assist in a greater number of projects making it to the delivery phase, it is concluded that the focus of the consultant support role should be on:

1. Making the client aware of the value of the assets they are the custodians of and their duty to future generations

2. Assisting in building understanding of asset management within the client organization;

3. Development of an asset management plan (AMP), to identify risks, level of service, long term demands, contracting options and other standard AMP topics. This should ideally be for the whole network, but can equally be just for the sub-network under examination for the PBC project; and

4. Preparation of a procurement plan for the physical delivery of the works necessary to meet the requirements outlined in the AMP. This should consider both OPRC and non-OPRC options, with the evaluation of each approach duly considered.

The focus should then move on to facilitating the implementation of a OPRC, should that be determined as the appropriate contracting model for the network in question.

Such a model is illustrated in Figure 6. The middle phase (“after Phase 1 of PBC Initiative”) reflects the timing within the PBC implementation process where the generic asset management activities are recommended for completion, and the decision on how to deliver the physical works is to be made.
It is considered appropriate not to pre-ordain the outcome of the entire process as a case where “PBC must occur”, but instead adopting the stance that “asset management must occur”. In this sense it is expected that were PBC positioned as a good support tool for AM that the level of apathy towards PBC could be greatly reduced, as asset management does not in its own right require PBC as the outcome.

The following are identified as critical success factors for PBC, without which the chances of there being a successful outcome are significantly reduced.

1. **Road Agency Institutional Buy-in**: There has to be a genuine institutional desire within the road agency and belief that PBC procurement options will offer significant achievements of given objectives for an agency. This buy-in should also be linked to specific individuals in an organization who will be prepared to champion the PBC process.

2. **Financial**: Two aspects were identified with regard to the financial aspect of a successful PBC:
   i. Assurance (Guarantee) of Funding: Where there is not clarity regarding the long-term availability of funding to support the contract (e.g., if World Bank loans don’t cover the entire PBC contract period), then the contracting industry will be concerned as to the prospect of being paid and may seek to “front load” bids to endeavor to recover as much of his costs as possible during the term of the loan.
ii. Financing Costs: There is a need to fully understand the payment model and how this imparts potentially significant financing costs on the contractor. While this may be entirely appropriate (and necessary) to meet agency financing constraints, it is essential that the impact be understood. Further guidance is provided in Section 5.3 on payment models.

3. Legal: The legal issues tend to be more of an enabler than an identifier of likely PBC success or failure. If the legal framework is not conducive to a PBC then either it will not be possible to implement at all, or the risk pricing will potentially be very high (making the PBC financially unattractive).

4. Institutional Knowledge in both the Transport Agencies and the Lending Institutions: While some shortcomings in institutional knowledge can be addressed via the use of consulting advisors, it is essential that the basics of asset management are soundly understood.

5. Bidding Process: Successful implementation of PBC (especially in the early years of implementation of PBC into a country/organization) requires the selection of a contractor with the right skill mix to deliver the project. If selected on a lowest price basis, there is a reduced chance of selecting a competent contractor who fully understands the principles and risks of a PBC. To mitigate this, one of two approaches is recommended:
   i. Include a significant non-price weighting into the contractor selection process, or
   ii. Implement a pre-qualification stage to the bidding process, where only those contractors that have clearly demonstrated their competency to do the work are invited to bid.

Either of these approaches should be considered alongside industry engagement to both gain knowledge on the perceptions of risk within industry, and ensure a correct understanding of expectations is in place.

6. Performance Measurement: Both the ability to measure performance and clear consequences of non-conformance are essential to PBC success. Management regimes that use a predominance of response time measures tend to be more cumbersome to enforce when compared to the “density of defect” type measures and this latter (density) approach should be encouraged (refer to Section 5.2).

7. Performance Payment: The consequences of non-conformance need to be graduated and equitable with the level of non-conformance. The traditional approach of “three strikes and you are out” has not worked to drive performance and should be discouraged from use. Approaches such as the “bucket of defects” (refer to Appendix A and Opus (2009)) have been found to be simple to implement and provide the contractor with an incentive to perform over the duration of the contract. Measures need to focus on the short, medium and long term needs of the asset to ensure a balance is maintained. Additionally there is the need for clear business improvement
measures to encourage innovation and optimize the chance of advancing asset management practice through the course of the contract.

8. **Risk Sharing:** The allocation of risk (except at the extremes such as force majeure) was not observed to be a major identifier of success or failure of a PBC. So long as risk was clearly apportioned and the contracting party was sufficiently experienced to manage (and price) the risk, then “inappropriate” risk allocation tended to result in higher bid prices. That being said, if the occurrence of a risk would render the contract financially non-viable (i.e. the risk would remove all profit from the contract), then there is an increased chance of default on the part of the contractor – a scenario under which neither party wins.

9. **Timing:** The process to implement a PBC in an agency which does not have experience will typically take 3-5 years, although there are examples (e.g. Serbia which took one year) where this is much less. This is a relatively long time to maintain momentum for an initiative, especially if considered against the duration of many international funding loans. There would appear to be some anecdotal evidence that compressing the timeframe would help build enthusiasm and enable a greater portion of PBCs to make it to the Delivery phase. The development of a full suite of sample Bank bidding documents, better support material and approval processes could significantly reduce the time to get from conception to implementation.

10. **Sufficient technical support during implementation:** There are examples of PBC implementation where neither the client, nor the contractor had prior experience of PBCs. In such cases the inclusion of an experienced third party consultant for assistance during the bidding and initial stage of the contract is essential.

11. **Control of underpricing** of bids through a mechanism to disqualify unsustainable low bid prices. No contractor can be successful on a contract without receiving sufficient compensation for work being undertaken. While the direct control of underpricing is difficult, a significant amount of risk can be mitigated by applying a conformance hurdle that requires demonstrable skills and capability in asset management (refer item 5 above) such that any low-pricing is a deliberate bidding tactic and not an inadvertent oversight of contractual costs.

12. **Control of the minimum level of improvement work** required to maintain Levels of Service in the long-term. Underpinned (contractual minimum) quantities, with an associated robust quality control program, can be used to ensure that no consumption of the network takes place during the contract term. Current technical measures to address residual life of pavement assets, such as FWD data, can have a high degree of variability with certain pavement/geology/weather combinations and if used, needs to be supported by other methods to avoid unintended consumption of the asset.
4.6 ADVANTAGES AND DISADVANTAGES OF A PBC

To have an informed discussion about the merits (or otherwise) of a PBC, those involved need to understand what the reported advantages and disadvantages are. It may be that for certain locales the choice of a PBC is not the correct one as the identified advantages may already have been obtained by another means, resulting in only the downside of a PBC implementation remaining.

**Potential advantages:**

- **Potential reduction in costs:** This is typically difficult to quantify as the same service levels are seldom retained after a PBC is implemented. The initial investment necessary to get a network up to standard is often significant and improvements to road safety and road carrying [width and strength] capacity are often included in the contract. Unless the costs and benefits of each element are clearly identified there is a danger the benefits of a PBC will not be understood because of the long term nature of the benefits being delivered by the investment.

- **Improved level of service** *(This could cost more):* DBMOT style contracts are typically implemented in order to raise the standard above that currently in existence.

- **The transfer of risk to the contractor** thereby providing certainty of costs to the agency (albeit at a potentially higher contract price).

- **Securing of an appropriate level of multi-year financing:** While this is an advantage for the road network within the PBC area, the contractual allocation of sufficient multi-year funds to one part of the network may result in a reduction of (typically already scarce) funding for the remainder of the network.

- **More innovation:** This can be expected as a result of the PBC contractor having a financial incentive to apply new tools and techniques to the management of the road network.

- **More integrated services:** This is dependent upon the scope of the services within the PBC.

- **Enhanced asset management on the part of both the PBC contractor and the Road Agency:** The Contractor benefits from understanding whole-of-contract costs and levels of service and the road agency benefits from the application of fundamental AM skills in the preparation of a PBC.

- **Ability to reap the benefits of partnering:** Benefits can be expected with the skill set of the road agency being supplemented by the contractor.
• **Industry Development**: Building a new industry and/or adding new skills to the existing contracting industry with regard to understanding AM.

• **Achievement of economies of scale**: Economies of scale enable the use of more efficient and effective means of delivering the required contractual outcomes.

• **Conscious focus of resources**: Gains are achieved through the contracts with stated objectives and focus on the long term needs of the asset.

• **Expedited implementation of works**: Works can be implemented more quickly, as with the DBMOT model. Only the conceptual design needs to be completed, not the full design with all the associated approvals required for a traditional contract model.

• **A reduction (or elimination) in the level of corruption**: Gains are a result of there being far fewer financial transactions meaning the audit is easier.

• **Reduced political intervention**: With the focus on delivering level of service outcomes rather than specific projects, political intervention is also greatly reduced.

**Potential disadvantages:**

• **A more costly procurement process for the bidders**: The costs to industry are much higher than standard procurement as a result of the need to more comprehensively understand the behavior of the asset and associated risks. Typically there is also a requirement to have a higher skilled contracting industry to undertake PBCs. Also as the PBC implementation is often a new concept, it is necessary to incorporate a significant quality aspect in the contractor selection process - via either a price-quality trade-off, or prequalification of contractors before issuing the invitation to bid.

• **Increased complexity**: The complexity of the bids also increases the evaluation time required by the road agency, which to ensure focus on the quality (non-price attributes) should include the use of a two-envelope assessment method, or prequalification. Unlike the “lowest price conforming” method of evaluation, where potentially only a single bid needs to be evaluated, under the two-envelope system all bids need to be evaluated.

• **Potentially a longer procurement process**: This may extend to a need to convince the client that PBC is a good idea, convincing the Bank procurement team and engineers that the modifications to the OPRC sample bidding documents are appropriate. There is also the risk that the process
could be curtailed as a consequence of institutional or industry resistance to change. This must be weighed against the time to complete detailed design and gain all necessary approvals before bids can be called under a conventional model. Once the PBC process is established the time from concept to implementation is typically significantly less than conventional measure and value contracts.

• **Increased Cost of Data:** The increased cost of having good data (including accurate inventory and historical condition and achievement data) on the asset in order to be able to bid accurately and be informed with regard to the risks. While this should happen with/without the PBC (i.e. this is really a cost of establishing and maintaining good asset management and should occur irrespective of the drive for PBC), the PBC often forces a higher level of investment in the data sets. If not done well, data issues can lead to poor outcomes / disputes once the actual extent of the asset or the actual condition is better understood (often after the contract has started).

• **A reduction in competition:** Where there is insufficient non-PBC work for a competitor to remain in the marketplace this can be an issue.

• **Uncertainty:** Uncertainty associated with long-term contracting relationships, especially where the term of the contract exceeds the term of any loan or external funding arrangements.

• **A potential loss of agency control and flexibility:** An example would be the reallocation of funds during times of fiscal constraint when the bulk of the expenditure is under fixed long-term contractual commitments. In both the developing and the developed world, the road sector is often seen as having a greater level of flexibility with budgets to both reduce expenditure without the immediate impact that a similar cut in health or education may have, and similarly to provide a stimulus via employment when additional funds can be leveraged. This reiterates the need for the Ministry of Finance as well as the road agency, to be committed to and supportive of the PBC initiative.

• **Shift in Control of Decisions:** Where the risks associated with the development of the works programme has been transferred to the contractor, the agency may lose control of asset management decisions and be less able to respond to political requests for works to be completed in certain areas. (This aspect may also be seen as an advantage)
5 ISSUES TO CONSIDER

In preparing, implementing and monitoring a PBC using the Sample Bidding Documents and associated Technical Specifications, a number of issues need to be addressed. These are discussed below.

5.1 ROAD SAFETY

PBCs – especially the DBMoT option – have the potential to significantly impact on road safety, and it is essential that the impacts (both positive and negative) are duly considered when defining the works to be completed, and the performance indicators and targets that are set. The provision of often wider roads, in better condition, will typically increase travel speeds, which if not appropriately managed will lead to a higher severity (and possibly number) of accidents. It is equally important though that the potentially significant cost of making roads safe to a “western standard” not be given undue priority over the wider demands of improved accessibility for communities, and other associated benefits of a better road network. Road safety, as with other targets within the PBC, should be considered in terms of the best means to deliver the appropriate safety outcomes.

Two opportunities are present within the PBC environment to improve safety outcomes:

- Routine maintenance: The focus of the PBC on delivering all activities to an acceptable standard will typically result in an improvement to the maintenance of basic safety systems such as signage, line-marking, shoulder maintenance and sight lines past vegetation. Similarly the focus on pavement maintenance around aspects such as pothole repairs, rutting (to avoid ponding of water) and surface measures such as texture, all help to ensure the network is managed in a way that enhances safety outcomes; and

- Safety Enhancements: During pavement rehabilitation/reconstruction projects, it is often possible to include safety improvements at marginal cost (over the basic works). Such opportunities should be considered on a case-by-case basis, and typically include widening the carriageway (additional shoulders or lanes), local intersection improvements, additional road side safety barriers, and general geometric improvements.

5.2 PERFORMANCE INDICATORS AND BASELINE SURVEYS

For PBCs, the primary (and often only) way of directing the contractor to deliver what is desired is through the appropriate use of a range of performance indicators and associated targets linked to payment. Good practice results in indicators covering the three elements of:
• Management performance measures (MPMs): which address the delivery of reports and information on the network.

• Durability performance measures (DPMs): which address the long term sustainable management of the asset (e.g. roughness, rutting)

• Operational performance measures (OPMs): which address the day-to-day routine maintenance activities (e.g. potholes, litter)

All operational measures (and others where suitable) should focus on the frequency of defects, rather than the historic approach of time-bound rectification of defects. The frequency approach is a much easier and cheaper method to manage and enforce, although it is noted that a combination of the two will likely be needed to cover all eventualities.

1 Example of Time Bound versus Frequency Measures

2 Considering potholes a time-bound performance measure format would be as follows:

   • Time from identification to repair if diameter 100-300mm in diameter 7 days
   • Time from identification to repair if diameter >300mm in diameter 1 day

3 Converting to a frequency-based performance measure, potholes would be controlled by the following format:

   • Number of potholes per km with diameter 100-300mm 2
   • Number of potholes per km with diameter >300mm 0

4 In both scenarios, the presence of smaller potholes is controlled and the presence of large potholes is effectively eliminated. The difference with the frequency approach is that it can be enforced by a single drive through of the road, without having to consider how long the pothole had been in existence. This not only makes for easier monitoring by the road agency and monitoring consultant, but also makes the measures more “auditable” by the general road user.

For the durability measures, the primary concern is the way to manage the residual life of the pavements. This is addressed further in Section 5.12.

For unpaved networks, the operational performance measures work well as a consequence of the relatively rapid change in the network condition (both in terms of deterioration and remediation). Performance measures relating to dust
mitigation through sensitive areas (towns/villages and certain crops) have proved
difficult, as has durability measures on the depth of gravel on the road. Both of
these issues require some form of minimum quantities of materials (dust
suppressant or m³ of gravel) to ensure the client’s desired outcomes are met.

To ensure that contract standards are not just complied with immediately prior to
monthly inspections, a rigorous inspection (including random inspections) regime is
likely to be needed. However this is secondary to the way in which the measures
are set.

5.3 PAYMENT MODELS

The payment model is a success factor of the PBC, with careful consideration
required with regard to each of the following aspects:

- Timing of contractors costs versus timing of payment. If there is a significant
deferral in payment (for instance if the network requires significant upfront
investment, yet the road agency can only afford uniform payment) then the
contractor will incur (and pass on) interest costs for the borrowing of monies.
The ability to borrow money may in its own right preclude many smaller
contractors from bidding as the head contractor.

- Output versus outcome payment. While payment on output tends to reduce the
cash flow issues (and the need to borrow heavily by the contractor), the PBC is
best able to be incentivized to perform where the maximum use is made of
outcome based payments.

- Advance payment. What (if any) payment might be appropriate prior to works
being commenced to ensure the successful commencement of the contract.
Often a small advance payment can have a significant impact on the borrowing
throughout the contract period.
Example: Impact of Payment Model on Contractor and Agency Costs

Consider a road network with the following investment profile required over a 10 year period.

<table>
<thead>
<tr>
<th>Year</th>
<th>In Year Costs (excl interest)</th>
<th>Cumulative Costs (excl interest)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
<td>24,374</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>42,686</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>52,505</td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>52,734</td>
</tr>
<tr>
<td></td>
<td>2014</td>
<td>54,812</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>63,239</td>
</tr>
<tr>
<td></td>
<td>2016</td>
<td>72,709</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>75,906</td>
</tr>
<tr>
<td></td>
<td>2018</td>
<td>83,808</td>
</tr>
<tr>
<td></td>
<td>2019</td>
<td>90,809</td>
</tr>
</tbody>
</table>

The figure above shows that the costs to the contractor will be very high in the early years (typical of a DBMOT type contract). In order to reimburse the contractor for his/her costs (including interest), a variety of financial models can be used. Each will have a differing impact on the timing when the road agency must access funds, the amount of interest paid, and the amount of debt that the contractor must carry.

<table>
<thead>
<tr>
<th>Financial Model</th>
<th>Description</th>
<th>Total Payments (incl interest)</th>
<th>Total Interest</th>
<th>Interest as %</th>
<th>Max Advance to Contractor</th>
<th>PV to Road Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Model 1</td>
<td>Uniform annual payments</td>
<td>108,467.43</td>
<td>17,658.13</td>
<td>16.3%</td>
<td>0.00</td>
<td>28,779.32</td>
</tr>
<tr>
<td>Financial Model 2</td>
<td>Double payment in final year</td>
<td>113,528.71</td>
<td>22,719.42</td>
<td>20.0%</td>
<td>0.00</td>
<td>30,853.04</td>
</tr>
<tr>
<td>Financial Model 3</td>
<td>Decreasing payments</td>
<td>100,607.38</td>
<td>9,798.09</td>
<td>9.7%</td>
<td>-418.69</td>
<td>21,370.31</td>
</tr>
<tr>
<td>Financial Model 4</td>
<td>Increasing Payments</td>
<td>113,567.40</td>
<td>22,758.11</td>
<td>20.0%</td>
<td>0.00</td>
<td>33,586.64</td>
</tr>
<tr>
<td>Financial Model 5</td>
<td>Match to Work</td>
<td>90,809.29</td>
<td>0.00</td>
<td>0.0%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Financial Model 6</td>
<td>7.5% yrs 1-8, then 20%</td>
<td>122,352.75</td>
<td>31,543.46</td>
<td>25.8%</td>
<td>0.00</td>
<td>35,364.57</td>
</tr>
<tr>
<td>Financial Model 7</td>
<td>Upg, Rehab at time (less perf bond)</td>
<td>91,178.21</td>
<td>368.92</td>
<td>0.4%</td>
<td>-2,053.38</td>
<td>1,657.69</td>
</tr>
<tr>
<td>Financial Model 8</td>
<td>Initial Payment, then Uniform</td>
<td>91,297.56</td>
<td>488.27</td>
<td>0.5%</td>
<td>-4,305.13</td>
<td>6,326.88</td>
</tr>
</tbody>
</table>

Depending upon a number of factors, the appropriate financial model would be selected. If there is a risk that the contractor will not maintain focus on the maintenance portion of the work and may default, models that have large "advance" payments to the contractor will not be favoured. Similarly where the level of funds that the road agency can access are notionally uniform then financial models that match the work flow will not be suitable.

5.4 PREPARATION OF THE RELEVANT DOCUMENTS

In the preparation of the current Sample Bidding Documents, the significant use of the DBMOT model was not envisaged. This resulted in the cash flow/payment clauses of the Sample Bidding Documents not being considered for the DBMOT model. Specific consideration is required to address outcomes that would result in
excessive cost of finance charges and/or that would result in the loss of retention of the contractor’s interest in the Maintenance and Operation phase of the work.

A key consideration that the Sample Bidding Documents and associated specifications need to address for both the Network Management and the Unpaved Roads situations is that of the quality of works completed near the end of the contract period. Under these contracts, there is no inherent protection provided by the maintenance period for the completed works towards the end of the contract period. This compares to the DBMOT situation, wherein the majority (if not all) the renewals works are completed in the first 1-2 years of the contract period, and the remainder of the contract period (typically in the range of 5-10 years) ensures that the contractor is incentivized to focus on the quality of the renewal works.

5.5  BIDDING AND NEGOTIATING OF PBC

To successfully conclude the award of a PBC requires the contracting industry to gain confidence in both the approach and the road controlling authority itself. To this end, a series of interactive meetings is strongly encouraged. These meetings should:

- Provide early identification of issues that are of concern to industry (some of which may be mitigated in the contract documents);
- Inform and both the client and the contractors on the process and the requirements on each of them and reinforce their understanding;
- Assist in the avoidance of over-pricing risks by explaining the risk allocation process; and
- Give confidence to all parties that the process will be open, fair and equitable.

In the developed world, good practice is for 1-on-1 discussions with each of the contracting parties during the bidding period. While the opportunity for such meetings should be considered for all contracts, where there are concerns regarding corruption, and probity cannot be assured to the satisfaction of all bidders, it would be unwise to subject the process to potential claims of bias/corruption.

5.6  IMPLEMENTATION

During the implementation phase there are two aspects that need to be carefully managed:

1. The cultural shift required by the client, the contractor and the consultant.
The time necessary to get the network into an acceptable condition and address any backlog of works that may exist. This may be achieved by either providing a “holiday” from the enforcement of certain performance measures for a period of 1-2 years while works are undertaken (typical of a DBMOT approach) or through the gradual increase of performance expectations. This is more appropriate for a Network Management or Unpaved Roads approach where only a small backlog of works may exist.

5.7 MONITORING AND EVALUATION

The long term success of the PBC in delivering the value outcomes anticipated is ensured by the way the contract is written, monitored and evaluated. It is practically impossible to write a contract that would appropriately address every possible scenario that could ever arise. Furthermore, with the evaluation of performance directly impacting on the profit of the contractor (and costs to the agency) the integrity of the monitoring and evaluation of performance is critical. For these reasons the following three mitigation measures are recommended:

- Have in place a Contract Management Board with senior representatives of both the client and the contractor, who are removed from the day-to-day management of the PBC, plus the Monitoring Consultant (refer next bullet point). The Contract Management Board is there to provide impartial review and guidance to the Project Managers as to avenues to review and resolve issues prior to any matters being introduced into the formal dispute process; plus to review and approve any changes to the contract requirements;

- Engage an independent monitoring consultant who has expertise in PBCs. The independent monitoring consultant’s role is to provide an impartial assessment of the performance of the contractor; and

- Use a methodology for the reduction in payment as a result of any non-performance that is fair and equitable (i.e. not an all-or-nothing type approach). One method that has proven to be successful in this regard is the “Bucket of
Defects” approach (refer to Appendix A for more details) which has been found to focus the attention of the contractor on the appropriate level of detail.

5.8 RENEGOTIATION AND TERMINATION

Any renegotiation of an existing contract (to revise performance requirements for instance) should occur firstly at the Contract Management Board level, with the client retaining the right of veto. Ideally the PBC contract mechanism and the legal framework of the country would facilitate performance based time extensions to provide further incentive for the contractor to perform throughout the contract period.

As the contractor is generally free to adopt new technologies and methodologies during the term of the contract, there is not a need under the PBC to specifically renegotiate the contract for this purpose. While some clients may wish to share in the cost savings offered by new technologies, such processes typically generate more antagonism than returns of profit and guidance is given against this approach. Instead the client should benefit by implementing new technologies elsewhere on the network (outside the PBC area), during renegotiation of any time extensions for the current PBC, or during the next round of bids for the network.

Where the contractor (or client) identifies works that have a positive benefit to the client, but which are not viable within the term of the contract (e.g. implementing a long term solution in the latter years of the contract period when only 1 or 2 years of benefit may result to the contractor), then the client should consider these as a variation on a case-by-case basis.

Termination of a PBC is no more/less simple than any other form of contract. The use of small payment adjustments to incentivize performance at all times, rather than the sole use of the threat of contractual termination further reduces the chances of needing to terminate a contract. For the DBMOT model in particular, the termination of the contract after the initial works are completed is likely to void any implicit warranty on the completed works.

5.9 LOCAL COMPETENCY (CAPACITY) LEVEL

Capacity is one of the most important success factors and one of the issues to be assessed most carefully. The necessary management skills for the road agencies, contractors and consultants under PBC are completely different from those under traditional input or output contracting mechanisms – even though the physical work activities are often identical. Ironically, it is often those organizations that have the least existing capacity that are more open to the dual concepts of asset management and PBC as they have less “invested interest” in defending their current ways of managing the road network.
It is noted that many smaller contractors are against PBCs as the cost to participate is often prohibitively high meaning that they cannot take on a lead role. While this is an important aspect to consider, one of the keys to a successful PBC implementation is to ensure that the lead contractor has sufficient financial strength, resources and capability to undertake the works.

For large PBCs, the local contracting industry is less critical to the success of the PBC as an experienced national or international contractor will likely lead a team (using local smaller contractors to deliver much of the service). Where there is a desire to ensure a portion of the work is undertaken by local firms, then this can be included as a contractual requirement and subject to monitoring throughout the term of the contract. While it may appear desirable from a local or national viewpoint to restrict the size and/or scope of the PBC to align with the capacity and capability of the domestic contracting industry, such an approach should be avoided.

Many pilot PBC schemes are smaller in size and consequently less able to attract an experienced national or international contractor to lead the team of smaller local contractors. Under such a scenario, it is important that the scope of works within the contract is reviewed following an assessment of local contractor capability. For example, if there is no (or very limited) local contractor capability for managing street lighting, then it may be appropriate to exclude such assets from the PBC contract. Similarly, it may be possible to commence building understanding of the PBC concept through the application to non-pavement assets in the first instance, thereby minimizing the risks to contractor and road agency alike.

5.10 LEGAL AND FINANCING FRAMEWORK

The success of the PBC is partially built on the confidence that the contracting industry has in the clients’ ability to deliver on long term contractual commitments. In many countries, there is limited ability to commit expenditure several years in advance (as is necessary if a 10 year contract is signed) and even less ability to commit expenditure across government election cycles.

As part of the early work in establishing a PBC, a review of the financial and legal framework specific to the country of interest will be needed.

5.11 RISK MANAGEMENT AND PBC

Risk management has traditionally not been a well-understood and applied concept in the management of road infrastructure. Despite this, it is believed that contractors understand risk better than many road agencies and as a consequence are also willing to take on risks in relation to network management as they offer revenue and profit opportunities. As illustrated in Figure 10, the portion of the risk that the agency carries decreases (and conversely the risk that the contractor
carries increases) as the contracting model moves from fully in-house through to the long term road concession (DBMOT) type contracts.

![Risk Sharing by Contract Model](image)

**FIGURE 10: RISK SHARING BY CONTRACT MODEL (OPUS 2006 ADAPTED FROM ZIETLOW, 2004)**

Considering the above, risk sharing aspects represent a tremendous opportunity offered through PBC, if it is applied appropriately and equitably. There are risks that may be categorized “outside of anybody's control” such as natural disasters and then there are risks that are simply unacceptable, such as following unsafe work practices. Likewise, there is also in the issue of the various types of risk being shared appropriately between the contractor and the client body. A general rule in this regard is that the entity best able to manage / mitigate a particular risk will also be the appropriate entity to carry that particular risk. A sample risk allocation table is included as Appendix B.

The longer a PBC term, the higher the probability that high consequence risks will be faced by the contractor. Generally, of greatest concern to the contractor are those risks where the cost of mitigation/correction is a significant portion of the base payment, and for which there is a relatively low likelihood of occurrence. This is because when a risk becomes highly likely (i.e. as a consequence of the longer term of the contract) all contractors will price the risk into the contract. It is the risks that are less likely to occur (but of high consequence), where the contractor may gamble on the risk not eventuating to provide a winning bid cost, and be forced into financial failure if it does occur.
5.12 LIMITING ASSET CONSUMPTION

Road network owners realize that it is possible to maintain certain performance standards such as roughness without necessarily adopting appropriate investment levels for rehabilitation works. For example one can follow a regime of intensive pre-resal repairs prior to resurfacing in lieu of rehabilitating sections. This approach needs careful consideration as although it may seem superficially that the network is performing well – there may in fact be no significant increase in the remaining life of the pavement. This is particularly of concern in the latter years of a contract, wherein the period to obtain a financial return from a higher level of investment is too short5, placing the financial incentive of the contractor at odds with that of the client (and the asset).

There are two theoretical ways of ensuring the delivery of the desired residual life (to limit asset consumption) of a network during a PBC contract. The first method is to measure the actual strength of the roads according to Falling Weight Deflectometer (FWD) or Benkelman Beam measurements. The second method is to specify a minimum level of rehabilitation work that needs to be completed on a network, along with a strong quality control requirement on the materials used and the construction results to be achieved.

The former method (usage of deflection testing) is better aligned to the PBC ethos as it leaves the response at the sole discretion of the contractor. Relying on strength measurements such as the FWD on their own has proven to be inappropriate at present, as these measurements have been found to be highly variable in practice. A cautionary approach is therefore recommended, using the combined FWD and underpinned (contractual minimum) quantities, in association with the use of approved materials and design procedures, along with quality control testing.

The latter method of minimum rehabilitation works (underpinned quantities) is often used to provide an assurance such that even if the outcome measure is not driving the right investment decisions, the asset is still being maintained. However, even this latter method requires the minimum quantity of works to be constructed to an acceptable quality, which will typically involve some form of deflection testing.

The intent of such minimum quantity clauses is to signal to the contractor that the owner believes that there is a minimum quantity of resurfacing and renewal/rehabilitation work necessary to deliver the performance requirements. This is also one way of countering the risk of underpricing of the PBC in situations where the contracting industry is not experienced in the production of forward works programs.

5 While the road agency will be focusing on minimizing the whole-of-life costs, the contractor is incentivized to minimize the whole-of-contract costs. In the latter years of the contract, there is simply not sufficient contract period remaining to justify higher intervention cost treatments.
5.13 AVOIDING THE NEED TO ACCEPT UNREALISTIC LOW PRICE BIDS

There are significant risks in adopting the lowest price conforming bid as a basis for awarding contracts under performance based contracting. Given the relatively long term of PBCs, low prices are typically unsustainable and are often received from contractors who do not have the ability to undertake contracts of a large scale and nature.

Although increased guarantees go some way towards addressing this risk, it is still unlikely to go far enough in protecting the client. In addition there is a need for the contract documents to make it clear that there are strong financial impacts for non-conformance with the performance criteria, and that the quality assurance testing and other monitoring will be rigorously enforced. Combined, these financial incentives should provide strong encouragement for the contractor to ensure suitably skilled AM personnel are retained within the team.

5.12 CHANGE MANAGEMENT

With the substantial change in road agency roles that comes with moving from an input/output contract model to a PBC, it is human nature that there will be a level of anxiety from staff based on a fear of the unknown and issues around job security. This applies equally to both those staff undertaking the physical works (potentially force account workers transferring to a private contracting firm) and the staff remaining with the road agency who must change from a “directing” role to a “management by outcomes” approach.

Needless to say, if not appropriately managed, such wide spread concerns at all levels can substantially undermine any PBC initiatives. It is beyond the scope of this guide to advise on change management techniques, other than to say that open communication about the need for better asset management outcomes is essential and that a plan for working with staff to alleviate their concerns should be developed and implemented in parallel with the overall PBC initiative.
Figure 11 provides a basic overview of the decisions and processes that need to be made to support the PBC Implementation Chain. A key decision to be made early on is whether or not there is sufficient institutional support for a PBC. If this does not currently exist, or cannot be readily gained, then the chances of progressing through the full implementation chain are very remote.

Table 3 contains a basic checklist for items that are either prerequisites for the implementation of a PBC, or for which significantly increase the chance of failure if present. There is no specific “score” above which a PBC should not be attempted, but rather the presence of a number of known risk factors would necessitate the application of a greater level of support and experience to minimize the risk of failure.
<table>
<thead>
<tr>
<th>Item</th>
<th>Prerequisite or Risk</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal framework enables for desired duration of PBC (5-10 years)</td>
<td>Prerequisite</td>
<td>Pertains to the ability to let a long term contract. In some jurisdictions it is not routinely possible to award a contract beyond the term of the elected officials.</td>
</tr>
<tr>
<td>Financial framework enables for desired duration of PBC (5-10 years)</td>
<td>Prerequisite</td>
<td>In some jurisdictions it is not possible to commit funds for more than 1-2 years in advance.</td>
</tr>
<tr>
<td>Knowledgeable road agency and/or experienced support consultant</td>
<td>Prerequisite</td>
<td></td>
</tr>
<tr>
<td>Strong executive support for PBC</td>
<td>Risk if not present</td>
<td></td>
</tr>
<tr>
<td>Comprehensive data set on current assets and past performance</td>
<td>Risk if not present</td>
<td></td>
</tr>
<tr>
<td>Equitable risk allocation framework</td>
<td>Risk if inequitable</td>
<td></td>
</tr>
<tr>
<td>Sound understanding of AM</td>
<td>Risk if not present</td>
<td></td>
</tr>
<tr>
<td>Local capability and capacity</td>
<td>Risk if not present</td>
<td></td>
</tr>
<tr>
<td>Experienced contractors (local, national or international)</td>
<td>Risk if not present</td>
<td></td>
</tr>
<tr>
<td>Change Management Program in place to address potential road agency staff concerns of redundancy or redeployment</td>
<td>Risk if not present</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


Opus (2009). Punjab State Road Sector Project, Loan # 4843-IN. Consultancy Services and Project Preparatory Studies for Package II (Phase II) for Preparation of Base design and Pilot Contracts Based on The Output and Performance Based Road Contracts (OPRC) for Approximately 600 Km of Roads in Punjab. Final Report.


Abstract

The hybrid model for State Highway maintenance has been in existence in New Zealand for over 10 years. These are performance based Lump Sum (LS) contracts typically for a five year duration involving a physical works contractor and a professional services consultant working in close collaboration. The contract specifies service levels and a range of related performance measures. The Contractor’s own auditing team are required to measure the extent of compliance being achieved against the specified service levels within randomly selected audit lengths each month.

It is acknowledged that it is not possible to have a fully complying network at all times as many of the defects recorded during audits have to manifest themselves before a remedy can be programmed. Consequently there will always be some work out there waiting to be done. This is why it is necessary to have a tolerance level of Non-Compliance before the Contractor suffers any financial penalty.

This paper outlines the development of the compliance mechanism that is now being adopted for the next generation of these hybrid contracts and how this is used to ensure the specified service levels are maintained. The adoption of this mechanism has resulted in service level compliance being achieved within the allowable tolerances and the Contractor remaining focused on ensuring non-conformances are identified and corrected within the specified timeframes. This very flexible approach to service level compliance is now being applied for other LS performance based road maintenance contracts in New Zealand and internationally.

Introduction

A review of the hybrid maintenance contracts that have been operating in the Christchurch and Dunedin State Highway Regions was held in late 2008. The organizations represented included Downers, Fulton Hogan, MWH, Opus and NZTA. NZTA staff included representatives from National Office, Wellington, Christchurch and Dunedin Regions.

A key issue discussed was how to better incentivize the Contractor to achieve the service level targets every month. The Contractors openly stated at the workshop that “financial incentives would drive performance”. Under previous contract hybrid proforma, the only consequence for non-performance was contract termination which was recognized as a draconian measure that was unlikely to ever be implemented. In effect there was no consequence for Non-Compliance by the Contractor and no mechanism to withhold payment for Non-Compliance.
The “Bucket” concept was first developed and introduced in the RTA (New South Wales, Australia) M1 PSMC Specification in 2008. The model has been introduced and adopted in the two North Canterbury maintenance contracts bid in 2009 in an attempt to incentivize the Contractor to deliver the specified performance levels.

1. What is the Bucket?
In recognition that we operate in an imperfect world and that it is almost impossible to have a conforming network 100% of the time, a small number of non-conformances will be allowed and will be managed through a “Non-Compliance Bucket”. The model recognizes that:

a) Identification of Non-Compliance, potential Non-Compliances and associated rectification is an important part of the Contractor's management and improvement process.

b) The Contractor should be encouraged to identify Non-Compliance and potential Non-Compliance and implement improvements.

c) Some Non-Compliances are more significant than others.

d) The Network will never be perfect and there will always be a certain number of Non-Compliances, but these still need to be managed.

The “Non-Compliance Bucket” can be likened to a bucket partially fill of water. Non-Compliances can be represented by solid balls of different sizes (weightings) according to the outcome/severity they represent. During the time period of any “Non-Compliance” ball is added to the bucket. If at the end of the prescribed time period [monthly in this instance] the level of the water in the bucket has not overtopped then no penalty is applied. However if at the end of the time period the bucket overtops because of the Non-Compliances that have been added then a penalty is progressively deducted in accordance with the volume overflowing. In essence the volume of water in the bucket represents the value of the bonus payment which is available to the Contractor. The volume of water that spills out of the bucket represents the amount of this bonus that is no longer available to be paid for that month.

At the end of the time period the Non-Compliance balls in the bucket are either partially or completely removed. Those remaining in the bucket represent Non-Compliances which have not been rectified during the period.

The ball will remain in the bucket for the next month if there is a consecutive repeat Non-Compliance for the same service level, and the ball “swells” in relation to the length of time they have been in the bucket (i.e. 2 months equals a weighting of 2, 3 months in the bucket equals a weighting of 3). Any residual water left in the bucket represents the value of the payment still available for payment to the Contractor. If all the water is displaced then the entire value of the bonus is lost.
This concept is illustrated below:

**FIGURE 12: BUCKET CAPACITY**

**FIGURE 13: BUCKET CAPACITY EXCEEDED – LOSS OF PERFORMANCE PAYMENT**

2. **The Mechanics of the Bucket**
The mechanics of operation of the bucket model are summarized below from the Hybrid Contract proforma as used in New Zealand's North Canterbury contract. The administration of the process is largely automated to minimize the cost of performance management:

2.1. **Self-Audit Process**
The Contractor must undertake a monthly compliance audit:

- The auditor must be a nominated person who is independent to the project team and is approved by the Network Consultant.
Audit sections will generally be of five road kilometers in length. A minimum of 10% of the network must be audited monthly by the Contractors Auditor. The audit sections will be nominated by the Principal. Results from independent audits will be used to determine the Monthly Network Compliance Score.

### 2.2. Monthly Network Non-Compliance Score

The Monthly Network Compliance Score (MNCS) is calculated using the following equation:

\[
MNCS = \sum \left( \text{number of occurrence} \times \text{weighting} \times \text{subweighting} \right)
\]

Where:

- **Number of occurrences** = Number relating to Non-Compliance category.
- **Weighting** = The severity weighting applied
- **Sub weighting** = The sub-weighting (e.g. time) applied

Table 1 details examples of the Non-Compliance weightings for the purpose of calculating the Monthly Network Non-Compliance Score.

<table>
<thead>
<tr>
<th>Non-Compliance Relating to</th>
<th>Number of occurrences of Non-Compliance</th>
<th>Multiplication Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Success Factors</td>
<td>#</td>
<td>4</td>
</tr>
<tr>
<td>All other Management Performance Measures (MPM's)</td>
<td>#</td>
<td>1</td>
</tr>
<tr>
<td>Safety related Operational Performance Measures (OPM's)</td>
<td>#</td>
<td>2</td>
</tr>
<tr>
<td>All other OPM's</td>
<td>#</td>
<td>1</td>
</tr>
<tr>
<td>All other Network Performance Measure's (NPM's)</td>
<td>#</td>
<td>2</td>
</tr>
</tbody>
</table>
Once a corrective action has been implemented which results in an individual Non-Compliance being rectified then it is removed from the Monthly Network Compliance Score.

### 2.3. Monthly Network Compliance Score Worked Example

A worked example of the Monthly Network Compliance Score is provided in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Non-Compliance</th>
<th>Number of Occurrences</th>
<th>Multiplication Factor</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>MPM 8 Information Management</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b</td>
<td>MPM 6 Traffic Management</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>OPM 10 Ponding</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>OPM 12 Culverts</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>e</td>
<td>Non-Compliance identified by Network Consultant</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

**Monthly Network Compliance Score:** 25

| TABLE 5: WORKED EXAMPLE MONTHLY NETWORK NON-COMPLIANCE SCORE |

a. **MPM8 Information management Non-Compliance for second consecutive month**

b. **Two occurrences of MPM6 Traffic Management Non-Compliances in single month (Key Success Factor)**

c. **OPM10 Ponding – single Non-Compliance (safety related OPM)**

d. **OPM12 Culverts – two occurrences of Non-Compliance, for fourth consecutive month**

e. **One OPM Non-Compliance identified by the Network Consultant which was not identified by the Contractor.**
2.4. **Impact of Repeat Non-Compliances for the Same Service Level.**

Item d. in the above worked example illustrates an important aspect when applying the “bucket” concept. The auditing and reporting process is focused on measuring service level compliance and not tracking the correction of the individual defects that have been identified in past audits. The recording of repeat Non-Compliance for the same service level, in this case OPM 12 – Culverts, will have a sub-weighting applied equal to the number of consecutive months that Non-Compliances have been recorded for this OPM. These may be different culverts that have been picked up in subsequent audits.

This approach removes the onus on the Network Consultant or Principal to track or monitor response times related to individual defects but over time the pressure will increase for the Contractor to correct these, and other defects related to the same service level on the network as the overall audit score increases.

2.5. **Payment of Performance Bonus**

100% of the Performance Bonus will be paid to the Contractor in each month the Monthly Network Compliance Score, as measured according to the Project Specification is less than or equal to 50.

Should the Monthly Network Compliance Score exceed 50; the Performance Bonus will be reduced on a sliding scale with reductions increasing as the score increases. 0% of the bonus will be paid if the Monthly Network Compliance Score exceeds 70.

The proportion of the Performance Bonus to be paid for scores between 51 and 70 will be based on the following equation:

Proportion of bonus to be paid = \(-0.235x^2 + 23.7x – 498\)

Where \(x\) = Monthly Network Compliance Score between 51 and 70

The following plot indicates how the bonus payment is typically calculated based upon the monthly audit score.
### 2.6. Annual Appraisal

The Annual Appraisal Score (AAS) will be determined by summing the monthly network compliance scores for the preceding 12 months.

The decision as to whether or not Separable Portion 2 (Year 3) will form part of the Contract Works depends on the Performance Appraisal Score (PAS) for Separable Portion 1 (years 1-2).

The Performance Appraisal Score for Separable Portion 1 is calculated as follows:

\[
PAS = 0.4 \times \text{Year 1 AAS} + 0.6 \times \text{Year 2 AAS}
\]

(i.e. more weight is given to the latest year, so that rollover cannot be achieved by only a good performance in the first year).

The PAS must exceed a preset level for the rollover to be awarded. A similar calculation is carried out for the subsequent rollovers.

### 2.7. Size of the Bucket and the Bonus

The size of the "bucket" will be specific to the contract area and will depend on a number of factors such as the size of the network, (i.e. the number of audit sections...
inspected each month), the proportion of urban and rural highways, and the density of assets such as signs or culverts, and the existing network condition. The two hybrid contracts in North Canterbury which currently apply the “bucket” compliance system have very different sized buckets. It is recommended that once the service level performance measures and their associated weightings have been confirmed, a series of audits be undertaken across the network by both the Principal and Network Consultant to check on the bucket “size” and determine the acceptable level of Non-Compliance before this written into the contract.

If desired, the size of the bucket could be varied with time. For example, if you have a network which is going to require some time to bring up to the contract standard, or for a network where a gradual improvement in the level of service is desired, the bucket could be reduced in size as the contract progresses.

It is also recommended that a mechanism be established for varying the bucket size or providing some other relaxation in the situation of large scale weather or other events adversely impacting upon the condition of the network and which are outside of the contract risk profile.

The size of the bonus payment will be specific to each contract. In setting the size of the bucket for each contract in North Canterbury, it was recognized that the bonus payment must be big enough to encourage compliance. The bonus payment per month represents approximately 10% of the monthly lump sum payment. This amount is seen by the Contractors as their margin and profit which they are very reluctant to put at risk.

When the process in the documents was first written, the bonus payment was an “all or nothing” payment – i.e. once the bucket overtopped there was no payment. After discussion with the Contractors, it was agreed that the bonus payment reduction should be graded, and the payment reduces as the bucket overflows. In North Canterbury, an exponential payment reduction formula has been adopted (i.e. the rate the bucket overflows increases as more balls are added). The bonus payment reduction is small initially, but increases exponentially as more Non-Compliances are recorded. The philosophy here is to have a progressive series of “warnings” to the Contractor by way of small losses in payment thereby providing an incentive for Non-Compliances to be addressed. However if the Contractor is persistent in failing to respond then the rate of payment loss will rapidly increase as the end of the tolerance range is reached.

3. **Bonus or Penalty?**

There has been discussion as to whether the bonus is in fact a bonus, or a penalty. As 100% of the bonus payment is paid if the specified standard is achieved, it is strictly not a bonus as the Contractor is getting paid “extra” to deliver what has been contracted. If Contractors price the project on the assumption that they will be receive the bonus every month, the non-payment of the bonus for failing to meet the specified standard is seen as a penalty.
Consideration is now being given to renaming the bonus payment as an “At Risk Performance Payment”.

4. Non-Compliances Identified by the Client or Network Consultant

Questions have been raised about the fairness of the Client or Network Consultant being able to identify Non-Compliances, and how this aligns with the random audit process as the Client or Consultant has the ability to inspect 100% of the network. Also, it is not clear whether the Client can identify Non-Compliance of an OPM if the Contractor has already identified a Non-Compliance within another audit length.

The intent was that the ability for the Client to issue Non-Compliances was reserved for serious or repeated Non-Compliance, or where the Contractors Auditor has failed to identify faults. However a Client with the wrong intent could easily fill the bucket given the weighting applied to Non-Compliances identified by the Client.

The following words have therefore been added to the pro-forma document to clarify the ability of the Client or Consultant to identify Non-Compliance:

Non-Compliances identified by the Client or Consultant shall be limited to:

- Non-Compliance not identified by the Contractor, within the audit lengths; or
- Non-Compliance anywhere on the network which in the opinion of the Client or Consultant represents an immediate safety hazard; or
- Non-Compliance anywhere on the network which in the opinion of the Client or Consultant will cause immediate damage to vehicles; or
- Non-Compliances which have not been addressed within a timeframe previously agreed with the Contractor; or
- Non-Compliance of MPM’s or NPM’s which the Contractor has failed to identify.

With NZTA’s objective of enjoyable journeys it may also be desirable that in the future specific Non-Compliances which impact on this aspect would be identified and included in the list of items that could be placed in the bucket by the Consultant or the Client, albeit with a response time for correction before the sub-weighting is applied.

5. Success of the Bucket Model to Date

The non-conformance “bucket” model has been in effect in two maintenance contracts in North Canterbury for the last two years and the mechanism is operating successfully with the desired outcomes.

The Contractors are now much more focused on delivering their contractual commitments as there are now financial consequences for failure to comply with the Contract. In the past there has been no consequence for non-conformance and no mechanism to withhold payment for non-conformance.
An example of the Monthly Non-conformance score and overall contract compliance is illustrated in the following figure:

![Monthly Non-Compliance Monitoring Score](image)

**FIGURE 14: EXAMPLE OF THE MONTHLY NON-COMPLIANCE SCORE**

In this figure the Contractor has lost some portion of his bonus payment twice and his entire bonus payment value once over the first 12 months of the contract. This financial penalty has been sufficient for the recorded Non-Compliances to be rectified before the next monthly audit.

A prudent Contractor will endeavor to manage the level of Non-Compliance so that it is just below the threshold for payment deduction to occur but will need to be mindful to leave sufficient buffer to enable the impact of inclement weather or other unforeseen events pushing the monthly audit score above this threshold.

In practice the Contractor may also choose to accumulate some Non-Compliance unaddressed for longer periods so that he can undertake more cost effective sequencing of their repair. So long as this accumulation does not trigger a payment deduction then this approach is quite legitimate and fits with the philosophy of allowing the Contractor flexibility in his work programming so long as the overall service level on the network remains within acceptable limits.

We have seen an increased focus given to reporting procedures which in the past were brushed over (e.g. crash reporting), and deliverables are being received in a far more timely fashion as late delivery now has consequences. The Contractor's personnel at all levels (Contract Managers to Site Personnel) now understand the process and the financial
implications and they strive to achieve the bonus through good management of the Non-Compliances every month.

6. **Summary and Recommendations**

The “Bucket” concept has been successfully introduced into the North Canterbury State Highway hybrid maintenance contracts. This compliance mechanism has enabled:

- A much higher level of network compliance with the specified service levels
- A higher level of incentivization of the maintenance Contractor to address defects on the network in a timely manner
- A reduction in the potential for disputes over service compliance due to the progressive level of payment reduction
- Sufficient flexibility to enable the Contractor to programme and manage the correction of non-conformances in an efficient manner
- The ability for the Principal and the Network Consultant to still identify a limited but fair range of non-conformances that can be added to the bucket where these should have been identified by the Contractor.
- A reduction in the time and effort required by the Principal and the Network Consultant that was previously associated with response time measurement necessary to check on whether the Contractor had repaired previously identified Non-Compliance defects.

The simplicity and flexibility associated with this compliance mechanism has seen it adopted in other performance based lump sum maintenance contracts both within New Zealand and internationally. It is recommended that future physical works hybrid road maintenance contracts adopt this approach in.

7. **References:**

1. **SMO32 - State Highway Maintenance Contract Proforma B2/B3 Hybrid Appendices; New Zealand Transport Agency; March 2010**
2. **SMO30 – State Highway Professional Services Proforma; New Zealand Transport Agency, March 2011**

This case study formed the basis of a presentation to the NZTA / NZIHT conference, with the presentation available at the following link:

### 8.2 APPENDIX B: SAMPLE RISK ALLOCATION TABLE

<table>
<thead>
<tr>
<th>Risk Description</th>
<th>Contractor Risk</th>
<th>Employer's Risk</th>
<th>Risk Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Legislative changes during contract period</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price, Resource or Time Implications</td>
</tr>
<tr>
<td>2) Government of Punjab policy changes</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price, Resource or Time Implications</td>
</tr>
<tr>
<td>3) Changes to Network size, except as provided for in the contract documents</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price, Resource or Time Implications</td>
</tr>
<tr>
<td>4) Maintaining private access-ways and pedestrian facilities located outside the</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price, Resource or Time Implications</td>
</tr>
<tr>
<td>kerb line and/or edge of seal in defined Built-up areas.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Stockpile and Disposal Sites</td>
<td>✓</td>
<td></td>
<td>Intractable Landowner Issues</td>
</tr>
<tr>
<td>6) Land Entry Agreements</td>
<td></td>
<td>✓</td>
<td>Intractable Landowner Issues</td>
</tr>
<tr>
<td>7) Identification and reporting to the Employer of the need for forestry</td>
<td></td>
<td>✓</td>
<td>Provision of an unencumbered RoW</td>
</tr>
<tr>
<td>clearances required for Improvement and/or Safety Works</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) Seeking and obtaining approval for forestry clearances</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price Resource or Time Implications</td>
</tr>
<tr>
<td>9) Land acquisition or other clearances required for Improvement Works</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price Resource or Time Implications</td>
</tr>
<tr>
<td>10) Changes to Contract Performance Measures (MPM’s, RUS&amp;CPM’s, and RDPM’s), see</td>
<td></td>
<td></td>
<td>Verified adverse Price Resource or Time Implications</td>
</tr>
<tr>
<td>Maintenance Specification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk Description</td>
<td>Contractor Risk</td>
<td>Employer's Risk</td>
<td>Risk Boundary</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11) Changes to annual surfacing renewal and pavement rehabilitation quantities, see Maintenance Specification, Section 5</td>
<td>✓</td>
<td></td>
<td>Employer instructed changes beyond annual preservation quantities</td>
</tr>
<tr>
<td>12) Changes to the Five Year Programme</td>
<td>✓</td>
<td></td>
<td>Employer instructed changes beyond annual preservation quantities</td>
</tr>
<tr>
<td>13) The identification and pricing of previously unidentified drainage improvements within both rural and built-up zones within the right of way.</td>
<td>✓</td>
<td></td>
<td>Employer instructed pricing of additional works</td>
</tr>
<tr>
<td>14) The construction of drainage renewals or other improvement works including safety improvements not identified on the conceptual designs.</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price Resource or Time Implications</td>
</tr>
<tr>
<td>Risk Description</td>
<td>Contractor Risk</td>
<td>Employer’s Risk</td>
<td>Risk Boundary</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>15) Where the recorded and verified Increase in cumulative Annual Traffic growth for the defined road section exceeds the annual threshold of 9% (arithmetic) for Cars, Buses or Trucks, and the Contractor is able to clearly demonstrate that this increase in traffic growth above the threshold value will result in an increase in the costs to the Contractor for either routine maintenance works or the cost of pavement rehabilitation, surfacing renewal or improvement works, and the OPRC has met all quality and LOS requirements that could reasonably impact on the area of claimed additional cost.</td>
<td></td>
<td>✓</td>
<td>Verified adverse Price Resource or Time Implications</td>
</tr>
<tr>
<td>16) The impact of all identified traffic overloading on existing pavements and in the design for all new or rehabilitated pavements and surfacing renewals</td>
<td>✓</td>
<td></td>
<td>Limit of ESA growth as specified in the contract document</td>
</tr>
<tr>
<td>17) Surfacing Renewal programmed in the FWP on Capital works Contracts completed by other contractors.</td>
<td>✓</td>
<td></td>
<td>Employer instructed changes beyond annual preservation quantities</td>
</tr>
<tr>
<td>18) The design, construction and post construction performance of all surfacing, surfacing renewal, pavement rehabilitation and improvement works completed by the contractor until the end of the maintenance defects period.</td>
<td>✓</td>
<td></td>
<td>Traffic loading thresholds, unforeseen natural phenomenon, Emergency Works</td>
</tr>
<tr>
<td>Risk Description</td>
<td>Contractor Risk</td>
<td>Employer’s Risk</td>
<td>Risk Boundary</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>19) Accuracy and completeness of information provided in Asset Inventories from</td>
<td>✓</td>
<td></td>
<td>Registers provided or available at the time of bidding</td>
</tr>
<tr>
<td>the Government of Punjab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20) Additional/reduced maintenance requirements including road marking associated with work undertaken by other contractors on the network. The Contractor will be given the opportunity to jointly inspect physical works completed by other contractors prior to accepting the subsequent maintenance responsibility.</td>
<td>✓</td>
<td></td>
<td>Traffic loading thresholds, unforeseen natural phenomenon, Emergency Works</td>
</tr>
<tr>
<td>21) Work required to address vibration and road noise complaints as a result of work completed by the Contractor.</td>
<td>✓</td>
<td></td>
<td>Agreed environmental threshold limits</td>
</tr>
<tr>
<td>22) Reinstatement of all utility services as a result of work completed by the Contractor under this contract.</td>
<td>✓</td>
<td></td>
<td>Trenches and installations completed by others</td>
</tr>
<tr>
<td>23) Monitoring of observed utility maintenance and installation activities and the reporting of inadequate pavement, surfacing or road shoulder formation reconstruction following the installation or maintenance of utility services by other contractors to the Employer.</td>
<td>✓</td>
<td></td>
<td>Non-notification by the Employer to the Contractor of work by other contractors within the RoW</td>
</tr>
<tr>
<td>24) All required consents and approvals for all work completed under this contract</td>
<td>✓</td>
<td></td>
<td>Additional Works ordered by the Employer</td>
</tr>
<tr>
<td>Risk Description</td>
<td>Contractor Risk</td>
<td>Employer’s Risk</td>
<td>Risk Boundary</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>25) Renewal of culverts less than 600mm internal diameter or equivalent</td>
<td>✓</td>
<td></td>
<td>Remaining functional and structural capacity &gt;50%</td>
</tr>
<tr>
<td>26) All structural bridge repairs</td>
<td></td>
<td>✓</td>
<td>Specified Routine Maintenance Requirements</td>
</tr>
<tr>
<td>27) Provision of Bailey or other temporary bridge stock or construction</td>
<td></td>
<td>✓</td>
<td>Loss, damage or closure of existing structures or road sections</td>
</tr>
<tr>
<td>28) Routine Superficial Bridge Inspection and Reporting</td>
<td>✓</td>
<td></td>
<td>Employer ordered special inspection</td>
</tr>
<tr>
<td>29) Routine Superficial Inspection and Reporting after a flood (or similar) event</td>
<td>✓</td>
<td></td>
<td>Employer ordered special inspection</td>
</tr>
<tr>
<td>30) Bridge and Other Structure Cleaning</td>
<td>✓</td>
<td></td>
<td>Existing assets</td>
</tr>
<tr>
<td>31) Bridge and Other Structure Detritus Clearing</td>
<td>✓</td>
<td></td>
<td>Existing assets</td>
</tr>
<tr>
<td>32) Bridge and Other Structure Protective Coated Surfaces Maintenance (Components Above Deck Surface Level)</td>
<td></td>
<td>✓</td>
<td>Maintenance of existing protective coatings required greater than 5% of the total coated area.</td>
</tr>
<tr>
<td>33) Bridge and Other Structure Timber Component Maintenance; with the exception of any: • sightrails • handrails</td>
<td></td>
<td>✓</td>
<td>Maintenance of existing structural components required beyond routine maintenance needs</td>
</tr>
<tr>
<td>Risk Description</td>
<td>Contractor Risk</td>
<td>Employer’s Risk</td>
<td>Risk Boundary</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>34) Maintenance (cleaning, painting, repair, or replacement) of timber sight rails and timber handrails on and approaching bridges.</td>
<td>✓</td>
<td></td>
<td>Unforeseen natural phenomenon, Emergency Works</td>
</tr>
<tr>
<td>35) Bridge and Other Structure Debris Clearing</td>
<td>✓</td>
<td></td>
<td>Existing assets</td>
</tr>
<tr>
<td>36) Bailey Bridge or other temporary bridge Inspection and Maintenance</td>
<td>✓</td>
<td></td>
<td>Existing assets</td>
</tr>
<tr>
<td>37) Specific Maintenance</td>
<td>✓</td>
<td></td>
<td>Existing assets</td>
</tr>
<tr>
<td>38) Maintaining privately owned signs and signs owned by other authorities within the RoW</td>
<td></td>
<td>✓</td>
<td>Work under Agreed Variation</td>
</tr>
<tr>
<td>39) Maintenance of all standard and non-standard signs and supports with a sign area less than or equal to 5.0 m² area.</td>
<td>✓</td>
<td></td>
<td>Unforeseen natural phenomenon, Emergency Works</td>
</tr>
<tr>
<td>40) Maintenance of heavy vehicle rest areas or any associated facilities.</td>
<td></td>
<td>✓</td>
<td>Work under Agreed Variation</td>
</tr>
<tr>
<td>41) Reinstatement work funded as agreed Emergency Works.</td>
<td></td>
<td>✓</td>
<td>Work under Agreed Variation</td>
</tr>
<tr>
<td>42) Existing subsidence sites and new sites where the depth of subsidence is 100mm or less in a single event.</td>
<td>✓</td>
<td></td>
<td>Up to the extent defined</td>
</tr>
<tr>
<td>43) Accuracy of inventory and previous maintenance activity information provided to contractor</td>
<td>✓</td>
<td></td>
<td>Information and data relating to completed works at the time of bidding.</td>
</tr>
<tr>
<td>Risk Description</td>
<td>Contractor Risk</td>
<td>Employer's Risk</td>
<td>Risk Boundary</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>44) A. Completing all asset inventory updates for physical work completed under this contract. Updates shall be completed in accordance with the Employer’s Database Operations Requirements B. Insufficient, inaccurate or inadequate quality assurance data or inventory data collected during or after the OPRC.</td>
<td>✓</td>
<td></td>
<td>Assets within the RoW</td>
</tr>
<tr>
<td>45) Liability for damages to services caused by the Contractor's operation</td>
<td>✓</td>
<td></td>
<td>The value of the Contracting Entity's Insurance Cover</td>
</tr>
<tr>
<td>46) A. Incident Response to make the site safe and secure. B. Attendance and work at the site beyond making the site safe and secure.</td>
<td>✓</td>
<td>✓</td>
<td>Provision of a safe, secure site</td>
</tr>
<tr>
<td>47) Routine maintenance and repair of crash and other damage, including graffiti, vandalism, theft etc. by third parties as well as all damage resulting from the contractor’s operation; with the exception of any: (i) crash damage to: □ the concrete components of bridges □ specific crash protection devices e.g. cushions (ii) vandalism (other than graffiti), theft etc. by third parties and crash damage to: □ all standard and non-standard signs and supports with a sign area greater than 5.0 m² area</td>
<td>✓</td>
<td></td>
<td>Assets maintained under the OPRC within the RoW</td>
</tr>
<tr>
<td>Risk Description</td>
<td>Contractor Risk</td>
<td>Employer’s Risk</td>
<td>Risk Boundary</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>48) All additional work required to achieve the required level of service for signs and pavement marking for each respective road category from that existing at the time of contract award</td>
<td>✓</td>
<td></td>
<td>Appropriate standard for the road classification</td>
</tr>
<tr>
<td>49) Management of RoW encroachments impacting upon the contractor's ability to satisfactorily complete Routine Maintenance Works or the construction of Pavement Rehabilitation, Surfacing Renewal or Improvement Works.</td>
<td>✓</td>
<td>✓</td>
<td>Contracting Entity's Reporting Obligations</td>
</tr>
<tr>
<td>50) Waterlogged pavements – Maintenance prior to identification and reporting by the Contractor</td>
<td>✓</td>
<td></td>
<td>Until definitive evidence provided to the Employer on waterlogging impact</td>
</tr>
<tr>
<td>51) Waterlogged pavements – Maintenance post construction of Contractor designed pavement treatments</td>
<td>✓</td>
<td></td>
<td>Unforeseen natural phenomenon, Emergency Works</td>
</tr>
<tr>
<td>52) Resources for the control of traffic and assistance with planned events and festivals within or adjacent to the RoW</td>
<td></td>
<td>✓</td>
<td>Work under Agreed Variation</td>
</tr>
</tbody>
</table>