Procurement Models for Road Maintenance

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Abstract

The author has been directly involved in the evolution of the maintenance of New Zealand's road network as it moved from the "one stop shop" approach of the New Zealand Ministry of Works in the early 1980's, through to the current position, which is based on complete funder/provider separation, with all services being provided by a fully contestable market. He has also had the opportunity to observe developing practices in a number of other countries including Australia, the United Kingdom and Canada. As Road Controlling Agencies gain confidence in the success of outsourced maintenance, the scope of the work being outsourced tends to be extended to encompass the full range of asset management activities. This has evolved to the point where contracts that entail the long term management of a road network have been let in a number of countries. The paper draws on the author's experiences to:

- Define the various roles in the management of a road network and how the procurement models impact on the road controlling authority's residual roles and responsibilities.
- Discuss the evolution of maintenance contracts as they have moved from initially being essentially "input" based, then to "output" based and now, increasingly, "performance" based contracts.
- Outline the predominant models now being used in New Zealand and the author's thoughts on their applicability.
- Illustrate some of the benefits contracting out has delivered and discuss some of the difficulties encountered along the way.

1. Introduction

There is an ongoing, world wide, trend towards outsourcing highway management and maintenance activities. The author has had the opportunity to observe trends in New Zealand, Australia, Malaysia, Britain, North America and more recently in developing countries. As the Road Agencies (Agencies) gain confidence in the success of outsourced maintenance, the scope of the work being outsourced is tending to be extended. This has now evolved to the point where some agencies are letting contracts that encompass all aspects of network management and maintenance for up to ten years. Contracts now typically encompass routine maintenance activities, both winter maintenance, management of emergencies (such as storm events), resurfacing and pavement rehabilitation, in addition to the development and implementation of the Asset Management Plans for all the assets in the road corridor. In addition to the road pavement the assets maintained within these contracts can include:

- Embankments
- Slopes
- Rest area facilities
- Emergency telephones
- Culverts & Bridges
- Guard-rails
- Tunnels
- Retaining structures
- Signs, including variable message signs
- Waterways
- Lighting
- Fences

As agencies draw these various components together into a single contract they are also tending to modify the way they are specifying the work. They are moving from the specification of the **required inputs** to specifications of the **desired outcomes**.

New Zealand has been at the forefront of these developments. Legislation was introduced into New Zealand in the late 1980s which stipulated that all work on the country's road assets was to be outsourced to independent contractors through a competitive tendering process. This legislation also encouraged (but did not require) agencies to outsource the day to day management of their assets to professional services providers (Consultants). Documentation and practices have been continually evolving since that time. This paper looks at the models currently being employed in New Zealand and how the various roles and responsibilities in the management of the asset are being assigned.

2. Characteristics of New Zealand's Road Network

New Zealand has 93,000 kms of public road network, of which 10,850 are State Highways. Forty percent of New Zealand's network is unpaved, with the majority of the unpaved lengths being lowly trafficked backcountry roads. The vast majority of the remaining pavements are constructed from granular materials (often water sensitive) and surfaced with chip seals. A limited amount of asphaltic concrete is used in the cities and in high demand areas.

The New Zealand network is characterised by its variability as it passes over a wide range of topography, climatic and geological conditions.

The relatively low cost nature of the construction of New Zealand's pavements creates a demand for sound intervention strategies and regular ongoing maintenance. The importance of

road maintenance is well recognised by New Zealand society and this has placed a high level of public expectation on our roading engineers.

3. The Asset Management Value Chain

As outlined above, documentation for contract maintenance is undergoing continual development. As Agencies have gained confidence in the local industry, documents have been evolving from "input-based" to "output-based" and now are increasingly moving to a focus on "outcome". To help understand the evolutionary process, the author has proposed [1] the value chain depicted in Figure 1, along with three generic forms of contract for undertaking the maintenance; "Input", "Output" and "Outcome" based contracts.

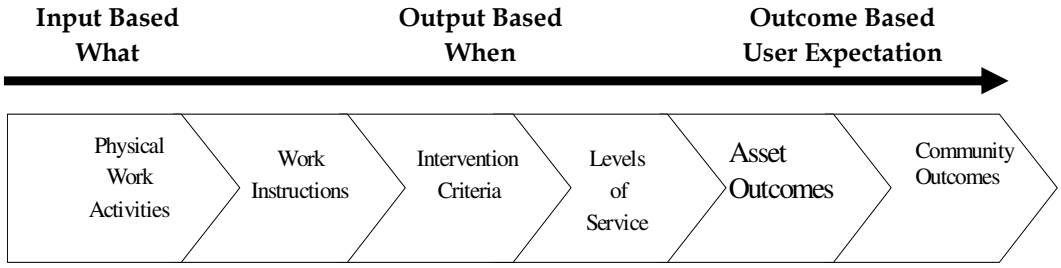


Figure 1: Asset Management Value Chain

Input-Driven Contracts

The first stage of outsourcing is usually based on "input-based" documents, which are focussed on prescribing exactly "what" is to be done by the Contractor. The Agency provides a detailed method-based specification (i.e. Work Instruction) and payment is for each individual input, i.e:

- Labour is paid for by the hour
- Plant is paid for by the hour
- Materials are paid for on the quantity delivered to site

These contracts are known variably around the world as "Direct Labour", "Plant Hire" or "Day Works" contracts. Typically separate contracts are let for each maintenance activity. At this stage of development of the procurement model the "Consultant" inputs are usually provided in-house by the Road Agency.

Output-Driven Contracts

As the agencies recognise the benefits of moving their activities into a competitive environment their documents tend to evolve and begin to seek to define the "Outputs" they require the contractor/consultant to provide. The procurement model changes and the focus of the documents is on specifying intervention criteria and defining performance standards for individual repairs. The best of these documents allow the contractor flexibility in the selection of the methodology, but in a number of cases an element of the Agency's method-based philosophy remains. Payment is based on a tendered schedule of rates. Under this model a range of separate activity-based contracts for the physical work is often found.

Outcome-Driven Contracts

In recent years a number of agencies have developed specifications that move further across the value chain and only specify the desired outcomes ("Performance Measures") and minimum "Levels of Service". The most advanced of these contracts do not include any method-based specifications and allow the Contractor complete freedom in the methodology chosen. Under this model payment is by equal monthly lump sums.

In order to allow the contractor full control over these outcomes the scope on most advanced procurement models is extended to include pavement rehabilitation, resurfacing and minor safety work in addition to the routine maintenance activities.

It is worth noting that as the model moves from left to right across the value chain, the contractor's focus moves from short term implementation considerations to a more "holistic" focus on the assets long-term performance needs. (e.g. roughness and rutting)

4. Roles in the Management of Road Assets

Further study of the author's value chain [2] reveals that it can also be used to identify the three distinct roles required for integrated highway management, "Implementation", "Management" and "Governance". These too can be plotted on the authorities asset management value chain (Figure 2).

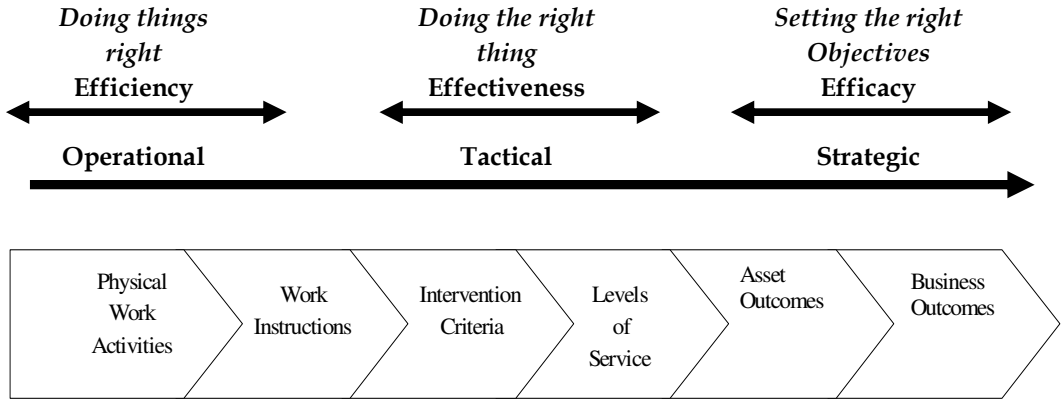


Figure 2 : Roles

Further the model defines where responsibilities for the "Three Es' of asset management, the efficiency, effectiveness and efficacy, lie (Figure 2). [Note: **Efficiency** is measured by a comparison of production with cost in energy, time and money. **Effectiveness** is the ability to produce a desired effect while **Efficacy** is the power to produce an effect.]

There are clearly zones of overlap in the roles. The overlap can only be managed by ensuring high levels of data and information flow between those undertaking the various roles. The needs of the various parties must be carefully considered when contract documents are being prepared, as poor documents can create hard boundaries that inhibit optimal management of the asset. The overlap in the roles also helps explain why a good, strong, partnering approach

between the parties to the Contract (and within the delivery team) is essential for the successful delivery of asset management contracts.

5. New Zealand Models

5.1 Background

Historically, New Zealand's State Highways were maintained by the Public Works Department (which later became the Ministry of Works) and Local Government Agencies managed and maintained their own local road networks. There was no separation of roles and in-house forces carried out the majority of work. The public demanded, and received, a relatively high level of maintenance intervention and service.

The process of reform that occurred the through 1990s saw the introduction of the procurement strategies that have lead to the models currently being employed in New Zealand.

While each agency has retained "ownership" of its network's assets, the technical inputs for the vast majority of functions, including asset management, maintenance management, project identification and contract supervision are obtained from the consulting industry using well defined competitive pricing procedures [3]. The contracting industry provides the technical expertise and resources to implement the work under the specifications prepared by the consulting industry. Thus typically, there are three parties engaged in the management of the network: The Road Agency (Client), the Consultant and the Contractor. However there are variations on this theme and these are discussed later in this paper.

Information and control needs vary significantly from those to which we were accustomed to in the old "one stop roading shop" days. Responsibilities (refer figure 2) can be assigned generally as follows:

Governance - Road Agency
- Audit
- Define Service Levels
- Agree investment needs
- Manage funding issues
- Allocate resources (as controlled by funding)
- Approve and own the asset management plan

Management - Consultant
- Develop network management strategies
- Draft asset management plans
- Check and approve contractors work programs
- Monitor field operations
- Audit field achievements

Implementation - Contractor
- Identify reactive maintenance needs
- Prioritise and program works
- Execute the works
- Claim for payment

Ensure work quality and satisfy defect liability requirements

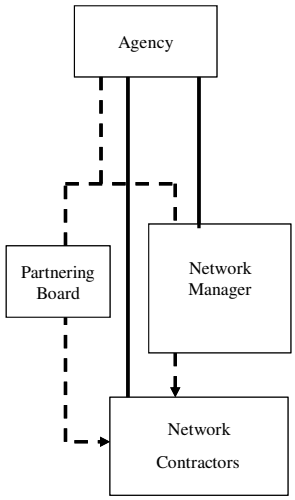
The creation of a competitive market in New Zealand for both network consultancy activities and maintenance work that followed the reforms has enhanced the level of engineering being applied to all aspects of highway maintenance and accelerated the introduction of new technology. The management of road assets has moved from being considered a "blue collar" profession, to being at the "leading edge" in a select number of consulting and contracting firms.

Critical to the success of this organisational structure is availability and use of robust information and communication systems. Alignment of expectations throughout the structure is of paramount importance.

There are essentially three contract models in use in New Zealand at present; The "Conventional" or 'Traditional" model, the PSMC [Performance Specified Maintenance Contract] model and the "Hybrid". Turning to each of these models in turn.

5.2 Conventional Model

The New Zealand "Conventional Model" aligns with the Output focussed model outlined above, with the road agency letting separate contracts for the "Management" or Consultancy role and for the "Implementation" or Contractors role. The Network Management contract includes all the contract management and the major asset management activities (The Agency always retains ownership of the Asset Management Plan and long term financial planning – albeit often relying heavily on the advice of their Network Manager).



Under this model a range of separate activity-based contracts are let for the physical works. Typically they are shaped to meet the capacity of the local industry. As a minimum, separate contracts are let for:

- Pavement Maintenance and Emergency Work (including Winter Maintenance)
- "Corridor Maintenance" which includes vegetation control and maintaining, roadside furniture, signage and pavement marking
- "Capital Works" with separate contracts for re-surfacing, rehabilitation and safety improvements as requested.

The state highway contracts are each usually between 500 to 700 kilometres of contiguous network. The local authority networks, which are less heavily trafficked, have up to 2500 kilometres in a contract area.

Within the Network Management contract, there is an increasing emphasis on the development of robust, long-term (10year) asset management plans. In addition to developing pavement management strategies, consultants develop and implement strategies for:

- Road user safety
- Environmental management

- Public relations
- Financial management
- Congestion management

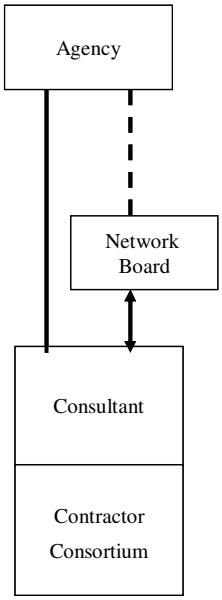
These strategies have resulted in a much wider management focus than had been historically applied to the road assets and resulted in a much more proactive stance than was evident in under former systems.

Most contracts are now for a period of 3 + 1 + 1 years, with the yearly extensions being subject to an assessment of the quality of the service being provided.

When the current regime was first introduced, the initial consultancies contracts had a strong focus on the supervision of the physical works contractors. However, current practice places a strong reliance on partnering and on the contractor's quality assurance programmes as well as their ability to identify and programme day-to-day reactive maintenance needs.

5.3 PSMC

These contracts, known as "Performance Specified Maintenance Contracts" (PSMC), combine both the consultancy and contractor functions and are for a period of 10 years. Tenderers are required to submit a lump sum price to cover all the network management and maintenance activities (including resurfacing and rehabilitation) required to maintain the network at the specified service levels. An excellent asset inventory database and detailed condition records are essential prerequisites for this type of contract to enable tenderers to prepare meaningful bids.



New Zealand introduced its first fully outcome based contracts in 1998 on a trial basis and now has four networks managed under this model. The first three are for the management of the state highway networks; however the latest "trial" has combined all the state highway network with all the local roads (including about 300 km of unpaved road) within the Western Bay of Plenty District Council's boundaries.

A feature of these contracts are that the Contractor is responsible for designing and carrying out the actions they believe is necessary in order to meet the specified service levels. If the service level is not achieved in any given month, the payment for that month may be reduced or even suspended.

Service levels are defined through performance measures. It is important that the performance criteria comprehensively cover all aspects of the management of the network, and account of the fact that different sub-areas often require different service levels. Criteria are defined at three levels, viz:

Long Term Asset Performance Measures which are expressed in like:

- Roughness profiles

- Rutting profiles
- Skid resistance profiles
- Strength profiles
- Residual Life Profiles
- Vegetation control envelope
- The retro-reflectivity of road signs and markings

Operational Performance Measures which are expressed in terms like:

- Response times to rectify defects that compromise the safety of road users
- The extent of repairs permissible before a more extensive periodic maintenance treatment is required
- Degree of sedimentation in drainage facilities

Management Performance Measures which define the information the Agency requires to govern the asset both during the term of the contract and to facilitate the next tender round. Requirements include:

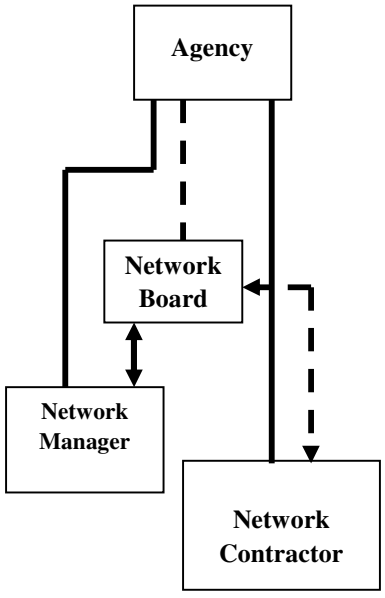
- Delivery of regular progress reports
- Inventory updates, as builts and other data sharing requirements
- Maintenance history (so subsequent tenderers can price the work)

The 10-year term of these contracts is selected on the basis that the successful contractor has responsibility for the pavement for a period that approaches the normal intervention cycle.

Risk associated with extreme weather events is assigned to the party best able to manage the risk.

5.4 Hybrid

The third model in use is known as the "Hybrid" as it enjoys some of the characteristics of both the previous models whilst maintaining a strong focus on outcomes. Under this model the agency lets two separate contracts, one for the Network Management role and the other for all the physical work activities including pavement rehabilitation, resurfacing and winter maintenance. Both the successful tenderers are expected to work with the agencies representative as a unified team and to deliver the best possible outcomes for network and as well as meeting the specified service levels. While the contractor has responsible for many of the operational performance measures, the Network Manager is responsible for the medium to long term management of the asset, information/data management, and safety auditing.



A fundamental difference to the PSMC model is that underlying quantities for periodic maintenance are provided to the contractors for pricing purposes, thus significantly reducing the demands during tendering. The location of the work is not defined, as this is decided during the term of the contract, but the expected quantum is.

To encourage the parties to work together as a team 30% of each parties track record is based on the performance of the other team members. This is used in the evaluation of subsequent contracts.

The term of Hybrid contracts is the same as that of the conventional model, i.e. 3 + 1 + 1 years.

6. Benefits of outsourcing

In the authors' opinion, historical delivery mechanisms have tended to over emphasis the importance of the "efficiency" of maintenance activities to the detriment of the other two "Es": effectiveness and efficacy. However outsourcing has led to the separation of the roles and has produced a strong focus on the principles of asset management and its associated "least cost of ownership" philosophy. This in turn is driving far more awareness of the wider issues. There is no doubt the emphasis on early intervention and proactive preventive maintenance programmes has a much bigger impact on the overall cost of maintaining a network than selecting the "right size of shovel for the job".

There is no doubt that out-sourcing has resulted in a far stronger emphasis on maintenance than existed under the old in-house model. New methodologies have evolved that are delivering cost savings of at least 17% on the cost of the physical works and 30% on consultancy inputs. In addition, the agencies are no longer captive to a sole supplier. This has resulted in a much stronger focus on quality outputs and the level of service provided by the industry.

The strategic benefits of the new methodologies are hard to quantify explicitly but are obvious to those involved in the management of the maintenance effort. Positive trends in the following areas have been noted.

Reduced reactive maintenance needs: There are fewer priority maintenance requirements apparent than in the past. For example the following graph shows the results that have been achieved in the Hawke's Bay area under the conventional model. Similar reductions have been experienced on other networks under the different models.

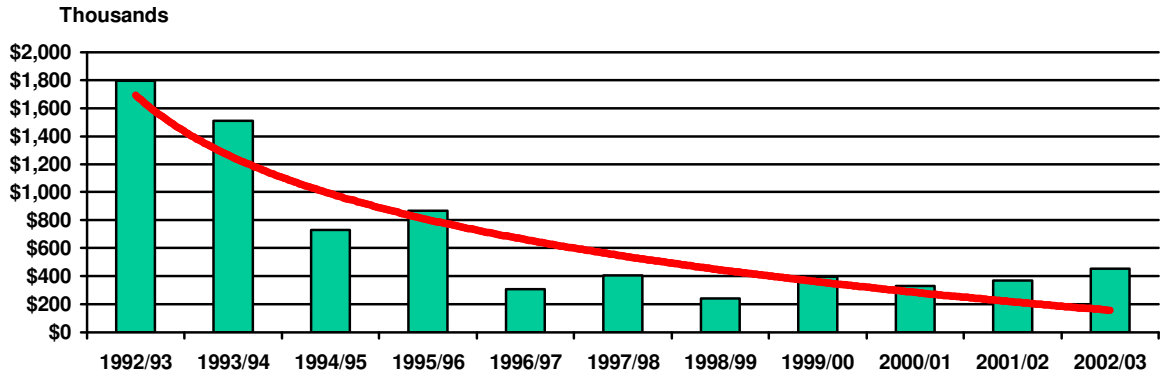


Figure 3: Reduced reactive maintenance costs achieved in Hawke's Bay

More success with preventative maintenance. The preventative maintenance strategies applied are better organised and positively controlled. Successful implementation in a structured manner is apparent, together with the benefits of a better standard of maintenance**.**

Less "fire fighting", more prevention. A greater portion of the maintenance allocation is being directed towards preventative maintenance. Typically this is less expensive and more cost effective.

Improved Condition. An Hawke's Bay example, a proportion of the money saved by reducing the level of reactive maintenance has been reinvested in proactive interventions such as resurfacing and drainage improvements. However total expenditure has been reduced significantly reduced and all condition indices are continuing to trend in a positive direction. This success is illustrated in the following graphs.

Other benefits gained from the control now being applied include:

Conflict reduction. Conflicts between maintenance programs and area treatment programs are now rare. For example, significant routine maintenance is no longer inadvertently applied in the lead up to rehabilitation works.

Balanced programme. The programme for future rehabilitation is now better balanced with no "surprises" in terms of extraordinary peaks creating funding problems.

Better management vision. Agencies asset managers now have a more comprehensive knowledge of rehabilitation and maintenance needs into the future.

In our experience, outsourcing both the management and implementation elements of asset management to a competitive market leads to the early adoption of "state of the art" technology and management practices, allowing agencies to benefit both financially and practically from innovative practices.

7. Lessons

The primary lesson that New Zealand has delivered is that outsourcing works and that a competitive industry can deliver the expected service levels. When outsourcing was first promoted concerns were expressed about the industry's ability to respond during emergencies particularly in extreme weather events. These concerns have not materialised. While there were a few initial teething problems in the very early days, our road network has now weathered numerous major events and complaints are extremely rare. Other issues to be aware of include:

(a) Contract areas should be sized on the quantum of work available, not just on length. Competitive rates are dependent on there being enough work in front of the work force to keep them gainfully employed. For example as the quantum of work is reduced in Hawke's Bay through better maintenance intervention strategies and preventive maintenance practices it was necessary to double the initial contract areas to maintain competitive rates.

(b) All models can deliver successful outcomes with the right people. Network management remains very much a people business and good people deliver good results. The rigors of a competitive market ensure a continuous improvement. The author understands that Transit New Zealand intends to continue to employ a mixture of models into the future and to continue to refine their documentation in the light of the experiences gained.

(c) Cost comparisons across the models, and particularly with the traditional (in-house) delivery model are difficult because of service level creep. Outsourcing forces Agencies to document service levels in a formal manner and there is a strong tendency to specify the desired service level, not the one actually being delivered by the existing work force. Response times in particular suffer from this phenomenon with average times often becoming specified maximums. As the model moves up the value chain the level of detail required increases and with it the potential for service level creep.

(d) The more advanced outsourcing models are dependent on well developed asset management practices. The PSMC model is reliant on:

- Robust inventories
- Detailed conciliation assessments, preferably over a number of years
- Agreed service levels, that are robust enough to meet road users expectation for the foreseeable future

(e) The best outsourcing outcomes are achieved thorough equitable sharing of risk. This has been a feature of New Zealand practice, with road agencies retaining the risks when appropriate, particularly during extreme weather events.

8. Conclusion

The outsourcing of the network management and maintenance activities has produced significant benefits to New Zealand's economy and road users. Less money is being spent on reactive repairs, users enjoy a higher level of service, and there is a far greater understanding of the asset's future needs. The benefits to be gained from these initiatives are not unique to New Zealand and could be introduced into other economies. Indeed there is a strong move world wide to introduce similar reforms. In my view the greatest benefits are to be enjoyed when the reforms are introduced in an incremental fashion that allows the local industry to develop in phase with the new drivers

9. References

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