Pekka Pakkala

Innovative Project Delivery Methods for Infrastructure

An International Perspective

Finnish Road Enterprise

Helsinki 2002

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Executive Summary

Many countries around the world are attempting to answer the key challenges to the construction and maintenance of the infrastructure networks that are essential to the economic stability within their respective countries. Society is rapidly changing and public clients are trying to meet the critical needs of this fast-paced society. Aging infrastructures, cost escalation, limited resources, productivity, acute regional development, environmental issues, and sprawling growth are causing concern to the management and administration of infrastructure networks. These are strong incentives for seeking alternative and innovative means to procure the main foundations of society and maintain economic stability.

This study, called "Innovative Project Delivery Methods For Infrastructure - An International Perspective", attempts to demonstrate practices and methods that can be utilized by client organizations to more effectively secure products and services. The goal is to share some of the most innovative or at least the most progressive methods used in several countries. It is important to distinguish between the delivery methods used for *"Capital Projects"* and "*Maintenance Contracts*". The details contained in this report are from data and information gathered mostly from the road sector, but they have implications that can be utilized in other infrastructure sectors, as well. The countries included in this study are Australia, Canada (Alberta, British Columbia & Ontario), England, Finland, New Zealand, Sweden, and the USA.

Capital Projects

Most countries use traditional methods (Design-Bid-Build) to procure capital investment projects, and all countries seem to be continuing with this process, except for England, which uses alternative or innovative methods extensively. The innovative or progressive methods identified in this study are listed as follows:

- Design-Build (DB)
- Design-Build Operate Maintain (DBOM)
- Design-Build Finance Operate (DBFO)
- Full Delivery or Program Management

Figure 4 in the introduction section displays these methods quite well and indicates some of the attributes included in these methods. Other innovative aspects that could be used in conjunction with traditional and innovative procurement methods are as follows:

- Partnering
- Value Engineering
- Constructability Reviews
- Incentive and Disincentives
- Performance Specifications
- Multi-parameter Bidding (A+B+Quality)
- Lane Rental

More details on capital investment projects are discussed in the "*Capital Project Delivery Methods*" section.

Maintenance Contracts

Maintenance procurement is quite a different aspect because the infrastructure is already in place, but it needs to be maintained properly and rehabilitation and/or improvements need to be provided before any major deformation or deterioration occurs that effects safe usage. Previously, most organizations retained in-house staff for most maintenance activities, but now many client organizations must procure these services and products from the private sector.

Earlier practices for procurement of maintenance were via yearly or multi-year agreements, using separate contracts for each activity and with a labor rate or unit price. More recently, there are innovative methods of procuring maintenance activities for all products and services under one contract and for a long term. The more innovative types of contracts are also beginning to specify "outcome-based criteria", which provides the contractor with more flexibility, innovation potential, and cost savings measures for the client organization. The contract mechanism is via a "Lump Sum" contract for all these products and services over the duration of the contract period, and by using a "quality-based contractor selection method" to ensure the success of the project. More details can be found in the "Maintenance Procurement" section.

Innovative maintenance contracts can be categorized by the following:

- Traditional 3 – 5-year duration
- Hybrid type contracts (Combination of Lump Sum and Unit Price - Schedule of Rates)
- Longer term maintenance contracts (some are for 10 years)
- Performance Specified Maintenance Contracts (PSMC – Outcome-Based Criteria)

The advantages and disadvantages of using PSMC type contracts are summarized as follows:

ADVANTAGES	DISADVANTAGES
• Cost savings • Fully integrated client services • Transferring risks • Innovation • Better asset management • Better level of service • Partnering potential • Developing a new industry • Benefits of economy of scale	• Costly tendering for PSMC • Longer tendering period for PSMC • Reduction of competition (social justice), usually for large contractors • Uncertainty of long term relationships • Mobilization issues need to be addressed • Loss of control & flexibility

For the benefit of the Tekes INFRA National Technology Program, the maintenance sector could maximize the potential for innovation via:

- Long-term Agreements - longer than 7 years
- Partnering is essential (both Client & Sub-Contractors)
- Lump Sum Contracts
- Using quality-based Contractor selection methods
- Providing most of the Sub-Contractors with similar long-term agreements or at least sharing the risks/rewards (or forming alliances)
- Ability to use innovation throughout the length of the contract

Realistically, there are many aspects and details involved when considering a change to these more innovative methods, and it can be considered as a paradigm change. Change usually seems to be difficult, but sometimes it is a necessary part of keeping pace in today's society. The remainder of this report includes more details and hopefully describes the merits of these innovative practices.

FOREWORD

Tekes (National Technology Agency of Finland) initiated a new National Technology Program in January 2001, called INFRA. The INFRA program was created to assist in the development of a more sustainable, competitive, and innovative environment for the infrastructure sectors. These sectors, sometimes referred to as public works, consist mainly of transport, communications, utilities, and other physical networks. Some aspects of infrastructure includes design, construction, raw materials, production, maintenance and upkeep, improvements, and possibly removal after its life cycle is exhausted.

This project is mostly funded by Tekes, the Finnish Road Administration (Finnra) and the Finnish Road Enterprise, and partially by VR-Track Ltd., The Association of Finnish Local and Regional Authorities, and The Central Association of Earthmoving Contractors in Finland (SML). This specific project is managed by the Finnish Road Enterprise, and its content is mainly focused on project delivery processes for the road sector. Other sectors of infrastructure use these same traditional or innovative methods in their procurement of transportation networks and projects, and the project delivery methods discussed in this report can be utilized by most public infrastructure projects. However, it should be understood that most of the content in this report is focused on issues and studies from the road sector.

Part of the INFRA program's objective is to formulate and improve project delivery processes that are expected to create a more competitive setting, which leads to improved management, quality, innovative products and services, partnering initiatives, and a more sustainable environment. This lead to the development of the vision for this project. Global changes and previous studies have demonstrated that creating an innovative procurement delivery system leads to improvements. For example, the building technology sector has demonstrated improvements and innovation as a result of clients' innovative project delivery systems. These similar concepts could be adapted to the infrastructure sector.

There are several project delivery models utilized in transportation projects throughout the world, but the "traditional" project delivery model seems to be the most broadly accepted practice and most extensively used. The type of project delivery model used by the public entity can have a significant effect on the ability to adapt new, not fully-tested technologies, the degree of management burden, financing, and indirectly, the competitive market. As society has progressed, increased pressure and accountability have been placed on public administrations to provide a safe, reliable and functional transport infrastructure, while effectively maintaining budget and financial constrictions. This needs to be accomplished despite possible staffing reductions, an aging infrastructure, and the need to account for future technologies (such as Information Technology) that are not presently available, but may be available in the years ahead.

Hence, this project was developed in order to seek out and evaluate the most innovative project delivery systems in use by the most progressive countries, not only for new construction projects, but especially for

maintenance type contracts. The project duration is from January 1, 2001 through December 31, 2001. Considering the budget and time constraints, it is not practical nor possible to evaluate all countries, but rather to strategically incorporate and analyze the most progressive ones. That is the process and objectives that were adapted in this study.

The research approach to this project was to gather as much written details via reports, technical papers, conferences, internet searches, and contacts throughout the industry. It is important to understand that there is only a limited amount of information available through these sources, and it was necessary to hold informal interviews/meetings with the appropriate authorities in the progressive countries included in this study, which are Australia, Canada (Alberta, British Columbia & Ontario), England, Finland, New Zealand, Sweden, and the USA. The goal was to uncover innovative practices for both capital and maintenance contracts, evaluate the best practices, outline the lessons learned, and determine which methods might be appropriate as a model in Finland. As part of the Tekes project, the objective was to determine which delivery mechanisms would stimulate innovation in the infrastructure sector.

ACKNOWLEDGEMENTS

This project would not have been possible without the support of many Finnish organizations and especially Tekes, which launched the INFRA National Technology Program in January 2001. It is also necessary to express appreciation for the support provided by the Finnish Road Administration (Finnra) and the Finnish Road Enterprise, and also to VR-Track Ltd., The Association of Finnish Local and Regional Authorities, and The Central Association of Earthmoving Contractors in Finland (SML).

It is also appropriate and correct to provide recognition to my innovative and pro-active colleague, Mr. Markku Teppo, to whom I am personally grateful.

Not only is financial support needed, but also the cooperation of many organizations that participated throughout the world. I would personally like to express my warm thanks and appreciation to all the organizations (listed below) and people that participated and provided their valuable time and effort in order to share in the need to develop innovative practices and processes. It is so important to share views and opinions that would hopefully lead to better care and management of the infrastructure network. Thanks to all who provided their valuable input and expertise.

This report will be made available to all the organizations contributing to the "outcomes" of this report, and they are mentioned below:

Australia
Egis Consulting
New South Wales - Roads & Traffic Authority
Transfield Services
John Holland Pty. Ltd.
VIC Roads
ARRB Transport Research
Geopave (Vic Roads)
Sinclair Knight Merz Pty. Ltd.
Tasmania DIER
Stornoway Maintenance

Canada
Ministry of Transportation Ontario
IMOS Inc.
Alberta Transportation
Ledcor Industries Ltd.
Ministry of Transportation British Columbia
JJM Construction Ltd.
Emcon Services Inc.

England
Highways Agency
Ringway Highways Ltd.
Amey Highways Ltd.
Halcrow group
Carillion Highway Maintenance Ltd.
WS Atkins Consultants Ltd.
Hertfordshire County Council

New Zealand
Transit New Zealand
Transfund New Zealand
Opus International Consultants
United Contracting
Franklin District Council
Works Infrastructure
Fulton Hogan Auckland

Sweden
Swedish National Road Administration (SNRA)
SNRA Construction and Maintenance
Swedish Rail Administration (Banverket)
NCC AB
Skanska

USA
Federal Highway Administration (FHWA)
Flippo Construction
Massachusetts Institute of Technology (MIT)
Massachusetts Highway Department
Virginia Department of Transportation (VDOT)
VMS Inc.
Design Build Institute of America
District of Columbia Government DDOT
Shirley Contracting Corporation
Texas Department Of Transportation (TxDOT)
J. D. Abrams Inc.

TERMINOLOGY

Asset Management:

The OECD definition for asset management is defined as: A systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organized and flexible approach to making the decisions necessary to achieve the public's expectations.

Build Own Operate Transfer (BOOT):

Build Own Operate Transfer is a project delivery method similar to DBFO, except that there is an actual transfer of ownership. The Contractor is responsible for the design, construction, maintenance, operations, and financing of the project. The Contractor assumes the risks of financing until the end of the contract period. Subsequently, the Owner is then responsible for operations and maintenance of the asset.

Construction Management (CM - At Fee (Agency or Advisor):

This is a process similar to DBB, the traditional model, in which the Owner/Client is responsible for the Design, Bidding, and Construction of a project. However, the CM organization takes on the responsibility for administration & management, constructability issues, day-to-day activities, and assumes an advisory role to the Owner/ Client. The CM organization has no contractual obligation to the Design and Construction entities. Again, the Owner is responsible for operations and maintenance of the project as well as the financing aspects.

Construction Management - At Risk Advisor (CM - At Risk):

In this scenario the Owner/Client has one agreement with the Construction Manager, who then manages the contracts with the Design Consultant and the General Contractor. CM-At Risk assumes much of the risks of the project, which differentiates this model from CM-Agency and DBB, where the Owner maintains the risk. Again, the Owner is responsible for operations and maintenance of the project as well as the financing aspects.

Design-Bid-Build (DBB -Traditional Method):

This system was developed during the Industrial Revolution period, which resulted in the creation of specialized professional movements of Architects, Contractors, and Engineers. This approach has been the standard choice of project delivery systems for many years. In this model, an Owner/Client procures the services of a Design Consultant to develop the scope of the project and complete design documents, which are then considered as legal documents for use in selecting a contractor who builds according to the specifications developed by the Design Team. Typically, in a public organization the proposal is in an open competition for a "Low Price". The contractor that wins the award is legally bound to produce the project at a

certain price, schedule, and minimum level of standard care. After completion of the project, the Owner is then responsible for operations and maintenance of the project. The Owner is also responsible for all the financing aspects.

Design-Build (DB):

This system heritage is as old as the days during the construction of the pyramids, when it was referred to with the term Master Builder. Design-Build is simply a project delivery method in which the Owner/Client selects an organization that will complete both the design and construction under one agreement. Upon completion, the Owner is then responsible for operations and maintenance of the project. The Owner is also responsible for all the financing aspects.

Design-Build-Operate-Maintain (DBOM):

Design-Build-Operate-Maintain is a project delivery method in which the Owner/Client selects an organization that will complete the design, construction, maintenance and an agreed upon period of operational parameters under one agreement. Upon termination of the operational period, the Owner is then responsible for operations and maintenance of the project, unless the operations are continued under a separate procurement method.

Design-Build/Finance/Operate (DBFO):

Design-Build/Finance/Operate is a project delivery method similar to DBOM, except that the Contractor is also responsible for the financing of the project. The contractor assumes the risks of financing until the end of the contract period. The Owner is then responsible for operations and maintenance of the asset.

Fully Integrated Clients Services:

“Fully Integrated Clients Services” in this report refers to most, if not all maintenance activities, that are procured under one contract. In other words, one contract that includes all the maintenance products and services.

Lump Sum:

Lump Sum is considered as a fixed price agreement for the total work and products of a given project. Sometimes this is also referred to as a “Fixed Price” contract. Any changes to the contract must be agreed upon by both parties, and they are usually described under “Change Orders”.

Network Area:

A Network Area is defined as a certain geographical area that includes all the road assets, usually stated in terms of kilometers of roads. It also includes other assets such as signs, guard rails, etc.

Outcome Based Criteria:

This is defined as the desired end results or end product criteria. Usually, pavements outcomes are stated in terms of roughness, rutting, skid resistance, texture, and cracking, while signs can be stated in terms of illumination.

Output Based Criteria:

This is defined as the quantities of production, usually specified via a Unit Price. For example, the yield or cost for so many kilometers of resurfacing, or so many meters of guard rail, etc.

Program Management (Sometimes referred to as Project Management or Full Delivery):

"Program Management" is considered as a construction entity that provides a comprehensive list of services to an Owner/Client from the planning stage throughout the entire process. This can include maintenance and operations, also. This process requires a broad focus of expertise and knowledge, and certainly in today's market, requires partnering with many skilled service providers.
This may be considered as the best alternative when in-house expertise is lacking, staffing reductions are needed, and outsourcing issues are current.

Pure O & M (Operations & Maintenance):

This is a delivery method in which the Owner/Client secures both Operations and Maintenance for a project under one agreement from a single provider, usually called the "Contractor". The Owner is also responsible for all the financing aspects.

Quality Based Selection Method:

This refers to the process of evaluating and selecting the contract winner on the basis of other parameters/criteria besides price. Typically, quality-based criteria can include some of the following; technical skills, personal skills, management team, supply chain management, methodology, environmental criteria, relevant experience, and past performance.

Quality Price Trade Off:

This refers to the New Zealand Contractor Selection Method in which the contract winner is determined via a system that considers the price of quality in the tender offer.

Unit Price or Schedule of Rates:

This refers to price considerations for specific aspects of construction and materials. For example, the cost per unit for either physical work or products; the price base for so many meters of guard rail – FIM / meter or FIM / hour of labor.

TABLE OF CONTENTS

1 INTRODUCTION

The main purpose of this report is to evaluate existing and developing public project delivery methods in the infrastructure sector, which are able to enhance and encourage the use of innovation. The goal is for the infrastructure sector to be more advanced and to be perceived as a more high-tech type of environment. Both capital and especially maintenance type projects are addressed. The content of this report discusses these two processes in more detail and is mostly focused on issues in the road sector. However, it should be mentioned and emphasized that the same procurement methods are utilized in most of the infrastructure sectors such as rail, water works, local authorities, airports, and shipping/harbors. This report discusses:

- Background reasons for this study
- Client services
- Project delivery methods
- Methods that provide opportunities for innovation
- Types of contracts
- Contractor selection methods
- Quality issues
- Environmental situations
- Methods used in Finland
- Conclusions and recommendations
- Future developments to consider

Also, this study seeks an international perspective, since it is important to determine what innovative practices are utilized in other countries, what lessons can be learned, and what are the "***best practices*".** The countries included in this study are Australia, Canada (Alberta, British Columbia & Ontario), England, Finland, New Zealand, Sweden, and the USA. It is also important to note that this is a one-year study (January 1, 2001 through December 31, 2001), which is partially funded via Tekes (National Technology Agency of Finland) through the Infra National Technology Program.

The content of this report attempts to provide alternatives to present project delivery methods, especially maintenance contracts, since this is the sector that is changing the most, and where new project delivery practices are needed, especially in Finland. The industry is evolving, changing, and seeking more integration, innovation, and simply better schemes for providing public services and products.

The present delivery methods for capital construction projects are mainly traditional processes that have typically evolved from history and the industrial revolution, where specialization of professional organizations was the key trend. This means that various forms of architects, engineers, specialty contractors, and the industry have adopted a segmented rather than an integrated type of process. Subsequently, laws have sometimes been changed and adapted to reflect this movement. Not until recent years has there been interest in seeking alternative methods, even though these so-called "*alternative methods*" were utilized in the past procurement of

some public sector authorities. So, it can be considered a sort of "***re-procurement***" or newly discovered old processes, because these practices do not necessarily involve new methods. However, this so-called ***"re-procurement***" has not been widely placed into existing practice in significant numbers. Interest is being demonstrated, however, and it appears as if there is more enthusiasm and possibly a new movement into integrated processes. In some cases, laws may need to be changed to reflect these changes and to make the procurement more fluid, transparent, fair, and serving the best interest of the public that utilizes the infrastructure resources.

From the maintenance perspective, there are newer forms of delivery of maintenance services and products, which are quite new and can be classified as innovative methods. These are addressed in more detail in the subsequent sections of this report.

1.1 Present Situation, Problems & Paradigm Changes in Finland

It is important to note that on January 1, 2001, the **Finnish Road Administration** (Finnra) recently entered into a new paradigm in which Finnra became more of a pure client organization responsible for tendering all phases of road construction and maintenance activities. Sometimes this process of moving from an in-house organization in all aspects to a client organization is referred to as the "***privatization process***" of a government agency, which separates the client aspects of an organization and the "production" or "works" portion of the organization. Finnra will enhance it's role of public procurement of the road infrastructure sector and be required to tender products and services under existing public procurement law. Also, the strategic role of the client organization is to insure the safety and effective movement of transport and people on the road network in Finland.

At the same time, the **Finnish Road Enterprise** (known as the production organization) became a state-owned enterprise and is totally distinct from the Finnish Road Administration (Finnra). The role of the Finnish Road Enterprise changed less, in that the organization still provides architectural & engineering support, as well as the actual physical works for projects. However, now and more so in the future, the Finnish Road Enterprise will have to compete for all projects in an open, competitive environment, and will be forced to compete with the private sector for road and maintenance contracts. Full and open competition is expected to occur in 2005, when there will no longer be any negotiated contracts with the Finnish Road Administration and everything must be competed in the open market according to Finnish rules and legal requirements. The Finnish Road Enterprise, on the other hand, must now learn to compete for projects, and more importantly, attempt to demonstrate a realistic profit margin in tendering for projects. This is a challenging paradigm change, and now it is necessary to demonstrate efficiency and effectiveness while meeting corporate targets. See Figure 1 for a pictorial representation of the possible phases of a changing road administration. From this figure you can follow the path and progression of Finnra & the Finnish Road Enterprise. The

present status of both organizations is in Phase 4 (Modified from original sources).

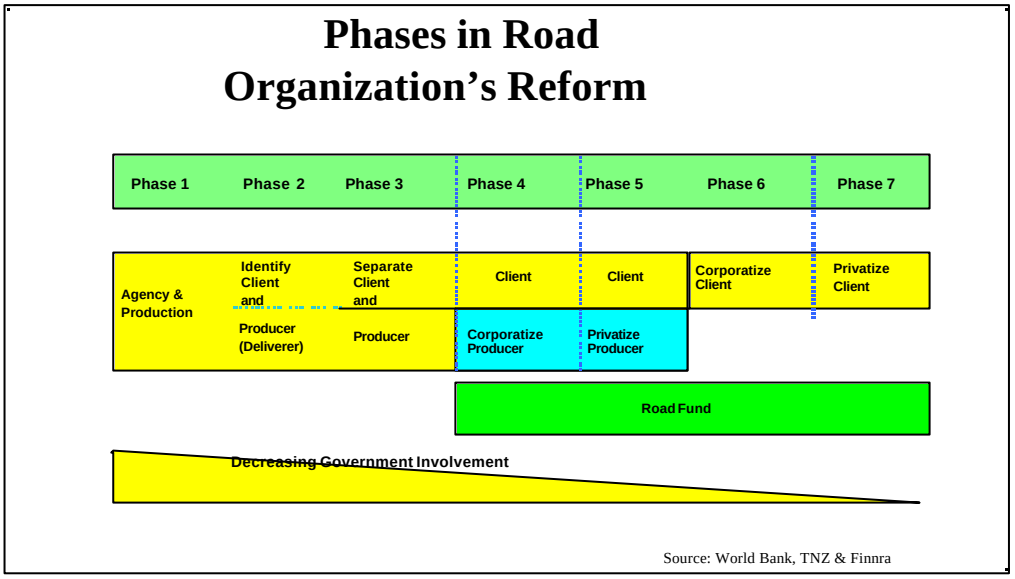


FIGURE 1 Road Organization Phases

During the present so-called transition phase, prior to fully open competition, there are restrictions placed upon the Finnish Road Enterprise and their options in competing with private and local community clients. Allowing the Finnish Road Enterprise to compete with the private sector is seen as a possible threat and a large competitor in non-traditional areas. This was one of the main reasons for the slow transition phase of the Finnish Road Enterprise, prior to open competition in 2005. Several restrictions were placed on the Finnish Road Enterprise during this transition period.

Despite advances in the road sector, there are several issues and so-called problematic areas that need development and more modern means to carry out and meet the needs of public road transportation systems. Some of these problematic areas that need more attention and are lacking modern ideas are as follows:

- Insufficient funds to meet/maintain satisfactory levels of road care (Global Problem)
- Very little or slow innovation
- Mostly based upon price
- No value-added services for the client
- Quality - subjective or lack of understanding
- Lack of integration
- Marketing has been seen as the client's responsibility
- Not enough real competition
- Infrastructure sector has a lower profit margin
- Poor image
- Future problems of making the infrastructure attractive to younger professionals
- Lack of real partnering & teaming

- No really good contracting methods for maintenance
- Procurement process is slow & bureaucratic
- Laws are inflexible, archaic, slow, administratively burdensome, & traditionally focused
- Lack of Trust

Several of these areas of concern have been noted, and the Infra National Technology Program was developed to resolve some of these issues. The intent is to develop this industry so that it can be more productive and become a modern profession and a worthy industry in the future. One of the goals of this study/project was to help develop the industry and create opportunities for innovation and advancement.

1.2 Existing Road Procurement in Finland

Capital Projects

The existing project delivery methods in Finland are quite traditionally focused. Only a minimum number of projects are using new or innovative methods, such as Design-Build (DB), Design-Build Finance Operate (DBFO), and Construction Management At-Fee and At-Risk (CM). These can be considered as recent modern type developments, and not those of normal procurement processes. The general contract has been the standard form of agreement used and it includes the general descriptive criteria, conditions, schedule, standard specifications, quality criteria, warranty considerations, and other miscellaneous criteria. This does not differ greatly from the methods used by other countries, but the ***Nordic*** environment has differing demands compared to warmer climates.

Traditional projects are typically Design-Bid-Build (D-B-B), and the tendering aspects typically use a weighted average (75% Price - 25% Other criteria) for contractor selection criteria, with a fixed price contract. As a general rule, there are three basic types of project delivery methods for capital type projects:

- Design-Bid-Build (Traditional Model)
- Design-Build
- Construction Management (At-Fee and At-Risk)

It should be noted that resurfacing and rehabilitation are presently procured as a capital project item and are usually traditionally procured.

The Design-Build model has demonstrated promising results and is considered a viable delivery method. Of course there have been objections and problems with the Design-Build models. Some criticism concerns the high tendering costs, use with only large projects, only for large companies, and limiting of competition. (These seem to be the same objections as noted in some countries). Also, the problem of overly strict end product definitions and having too much designing prior to tendering also hinders the advantages of the Design-Build model.

A few years ago, Finland used the Design-Build Finance Operate (DBFO) delivery method for a two-lane highway from Järvenpää to Lahti. Because of the public opposition against a toll type collection road, this is a shadow toll type road. To date, no other roads have been constructed using this model, but there might be potential for using it again if the political climate is favorable.

Maintenance Contracts

Maintenance type projects typically have been procured under yearly or multi-year agreements for maintenance activities via negotiated contracts with the old "*production organization*" (Finnish Road Enterprise). However, this year the market was opened to the private sector and a new procurement practice for periodic/routine maintenance was tendered for a period of 3 years under a "*Lump Sum*" contract. The first phase of competition, included 23 network areas with a total of 16570 kilometers, and the second phase of competition will tender 26 network areas in the year 2002. The third phase with 28 network areas will be tendered in 2003, and the remaining network areas are planned for 2004. The total number of network areas is presently 99. Other maintenance activities, such as line marking, traffic signs and signals, resurfacing, rehabilitation, and lighting are typically procured separately via unit prices (Schedule of Rates) and sometimes via Lump Sum (fixed price) contracts.

Finland presently has 99 network areas. This is perceived as too many areas, and longer lengths should be introduced into the contracts. There is some discussion and debate, but making longer, more effective road lengths by combining the most appropriate areas should be considered. Table 1 summarizes the present maintenance contract system used in Finland.

Delivery Activities	Routine/Periodic Maintenance
Duration	3 Years
Contract Type	Lump Sum
Contractor Selection Criteria	75% Price & 25% Technical Criteria

Source: Pekka Pakkala (Finnra)

TABLE 1 Present Maintenance Contract Model in Finland

1.3 Other Countries' Road Procurement

Capital Projects

In a global perspective, delivery of infrastructure services and products for capital investment projects varies in practice from country to country. All the countries evaluated in this study use a common general practice for the main project delivery model, known as the traditional model, or Design-Bid-Build. This means Design/Engineering services are procured first, and then

another procurement contract is tendered for the actual construction or physical works, based upon the Design/Engineering portion of the contract. Also, there are variations and differing combinations of the traditional process, such as parallel prime contracting, but they are not very common practices in this modern high-technology age. England is one country that deviates substantially from this practice and utilizes the Design-Build (DB) models and Design-Build Finance Operate (DBFO) model, which incorporates the philosophy of integration and external financing for these processes.

It is interesting to note that the Design-Build model is beginning to be used more frequently for many types of infrastructure projects. The Design-Build model is simply defined as a process in which an organization agrees to perform both the design and construction under one agreement. There has been a recent expansion in the use of Design-Build, especially noted in power plants, water works, bridges, airport expansion, rail, road, and also in some local authority infrastructure projects. The number of such projects compared to the traditional model are quite few, but more significant when compared to the total percentage of expenses.

An even more innovative model is “Full Delivery”, sometimes known as “Program Management”, when seeking a complete level of services and products from project conception to its usable life condition. This is under investigation in some of the more innovative countries and has good potential in theory, but it must be demonstrated that this can be a realistic model for extensive use. Transit New Zealand is supposed to start a so-called pilot project using this type of delivery method, and it will be interesting to investigate the outcome and results.

It should also be noted that some countries consider upkeep/improvements (resurfacing and rehabilitation) as a capital expenditure, and they are commonly procured under capital projects.

Maintenance Contracts

Maintenance and operations are more often considered as a service, but they do include some products such as signs, signals, line markings, and pavement type materials. In the past, many countries have managed the maintenance aspects with their own work force (in-house), sometimes referred to as a Direct Labor Organization (DLO).

Maintenance activities typically include periodic/routine aspects such as winter and summer maintenance, minor bridge repair/maintenance, drainage systems, vegetation control, gravel road conditioning, and other country-specific activities. However, a few countries have totally outsourced maintenance, which means that they have no work force of their own and are required to tender for these services and products. Usually these are all public organizations and they must tender or purchase these activities via the existing procurement laws of the land. Usually this means there is competition in purchasing these items and services in an open and fair environment.

The most common procurement method is a yearly or multi-year contract based on "***unit prices***", sometimes referred to as a "***schedule of rates***". This type of procurement practice is sometimes referred to as "maintenance by contract" or other terminology. As mentioned earlier, the activities included in these maintenance contracts vary and depend upon territorial conditions and cultural practices. As a common practice, each country, state, territory or province has regional offices that manage daily aspects and usually include a certain area of roads. The roads managed under certain contracts are typically referred to as the network area, contract area, managed area, or other terminology.

New and innovative practices including almost all maintenance activities are herein referred to as "**Fully Integrated Client Services**". Sometimes these services are procured over a long term period, while some countries include resurfacing and rehabilitation. They are typically referred to as long-term maintenance contracts, with some known as Performance Specified Maintenance Contracts (PSMC). PSMC contracts use outcome-based criteria or performance specifications, where the client specifies the desired outcomes and the performing contractor utilizes a specialized plan to make certain that the desired outcomes are met or achieved. The maintenance program and decisions are made by the contractor, which can be thought of as having "***ownership*"** of the road for the duration of the contract term. The PSMC outcome-based criteria for pavement aspects are usually described in terms of roughness, rutting, skid resistance, deflection, cracking and texture.

Several countries use long-term maintenance contracts, but each country approaches the contract differently and it depends on what aspects of maintenance are included, and what types of specifications are required in the contract. Australia's, New Zealand's and England's processes are quite similar and include resurfacing and rehabilitation/reconstruction in the contract, while other countries do not include rehabilitation/reconstruction aspects and others, such as Canada, do not include resurfacing. The duration of the contract also varies between 5-10 years, and most countries have recently increased the length of the contract to 7-8 years. The USA differs in this approach in that the contract duration is 5 years with a possible 5 year extension for long-term maintenance contracts.

1.4 Other Infra Sectors

It is interesting to note that the procurement methods of other infrastructure sectors do not vary a great deal, but are more dependent upon the client's roles, objectives, and the sector of infrastructure that is involved. All the capital projects methods discussed in this report are appropriate project delivery methods for other disciplines. A few main issues are the client's expertise with the delivery methods and what level of management they maintain internally.

For example, the Finnish Rail Administration has very little staff to manage and administer delivery and contract agreements, and they are utilizing the Construction Management (CM) method exclusively. County and city-type

governments typically utilize the traditional process, because they have heavy administrative staffs and self-perform many aspects.

Forms of Design-Build (DB), Design-Build-Operate-Maintain (DBOM), and Design-Build Finance Operate (DBFO) have been used in many areas of infrastructure, such as:

- Water & Wastewater
- Airports
- Postal Facilities
- Rail
- Energy/Power

In the past history of the USA, many so-called innovative or alternative project delivery methods have been used in the late 1790s and until the first half of the 1930s. Most all of the infrastructure projects in the USA were completed using the Design-Build Operate Maintain (DBOM) and the Design-Build Finance Operate (DBFO) methods. Many of these projects were at the heart of the US transportation infrastructure. Some examples of these projects and other infrastructure areas are shown in Table 2. This table demonstrates several recent and older infrastructure projects used in various sectors.

PROJECT	PROJECT DATE	METHODS USED	INFRA SECTOR
Tolt Water Treatment Plant Seattle, Washington - USA	Present	DBOM	Water & Wastewater
El Paso, Texas	1998	DB	Mail Processing Center
JFK International Arrivals Building, New York – USA	1994	DB & DBFO	Airport
Franklin Ohio Wastewater Treatment, Ohio – USA	1997	DBOM	Water & Wastewater
Eastern Harbor Crossing Hong Kong	1990	DBFO	Rail & Road Joint Project
Chek Lap Kok Airport Hong Kong	1997	DB, DBFO & BOT	Rail, Road & Airport
Erie Canal, New York & Ontario – USA	1825	DB	Shipping
Illinois Central Railroad USA	1856	DBFO	Rail
New York Subway Contract #1 – USA	1904	DBFO	Rail
Keokuk Power Plant & Dam – Ds Moines, Iowa – USA	1914	DBFO	Energy/Power Plant

Source: Principles of Public & Private Infrastructure Delivery - Prof. John B. Miller (MIT)

TABLE 2 Other Infra Sector Project Delivery Examples

There are many examples of recent and past projects that encompass the entire collection of project delivery methods. However, these innovative or so-called alternative delivery methods have not been frequently used in great quantities in infrastructure projects. Some countries such as England and Australia incorporate these on a regular basis. Other countries not included in this study, such as Hong Kong, have invested in several projects using the Design-Build Operate Maintain (DBOM) and the Design-Build Finance Operate (DBFO) delivery methods.

Essentially, the key to these delivery methods is to know which method provides the best value for a particular project. In other words, the client should be able to discern which method will provide not only the end result, but financially better value in the long term perspective.

1.5 Client Services

Previously there were relatively very few client-oriented services offered by the private sector other than Design/Engineering services, construction services, and raw materials and products. Over the years of progress, many client services were transferred to the private sector as the road administrations progressed, and as more services and products became available. Some of the present day services that are available are as follows:

Capital Projects:

- Design/Engineering
- Construction & Construction Management
- Supplies & end products for the road assets (Lighting, guard rails, line marking, etc)
- Design, Construction, & Maintenance & Finance

Other Miscellaneous Services:

- Asset Management
- Research & Development
- Administration Services
- Road Management Services
- Ferry Operations
- Traffic Services
- Computer and Data Systems & Services
- Customer Service

Maintenance Contracts:

- Winter maintenance
- Summer maintenance
- Maintenance products & services
- Road Weather Information Systems (RWIS)
- Pavement Management Systems (PMS)
- Information Technology (IT) applications

- Future - Fully integrated client services

Fully integrated client services for long-term maintenance contracts can include the following:

- Routine pavement maintenance
- Asset/corridor management
- Vegetation control & mowing
- Signs & traffic signals
- Resurfacing
- Rehabilitation/reconstruction
- Emergency response
- Drying & drainage control
- Traffic services
- Guard rail repair/replacement
- Lighting
- Seal widening & repair
- Winter maintenance
- Summer maintenance

"**Fully Integrated Client Services**" for maintenance contracts are attracting the interest of client organizations, as all these services become available in one contract for a specified length of time. Also, client organizations are beginning to concentrate on their core goals for providing a safe and reliable road network, and this may provide additional opportunities for future development of specialty services from the private sector. This seems to be a general trend for procuring more and more services from the party best available to manage and provide "***best value***" for these services.

1.6 Partnering

The formal definition of partnering is a long term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. For most road administrations, this is not possible or it may even be considered illegal to make long-term partnering arrangements. But, project partnering can be utilized and it is a very beneficial tool for capital and ever so important with long-term maintenance contracts.

Some of the goals or reasons for partnering in capital projects are listed below:

- Resolve differences
- Remove roadblocks
- Build & develop ***trust*** and commitment
- A common mission statement
- Opportunities to Innovate
- Shared goals
- Create win-win thinking

- Accountability among members
- Problem solving skills
- Reduce claims and litigation

Some of the reasons for partnering in long-term maintenance contracts are:

- Success throughout the length of the contract
- Develop trust and commitment
- Innovation potential
- Resolve differences and poor performance
- No one organization can provide all the client services
- Mutual understanding of methodology and scope
- Share the benefits

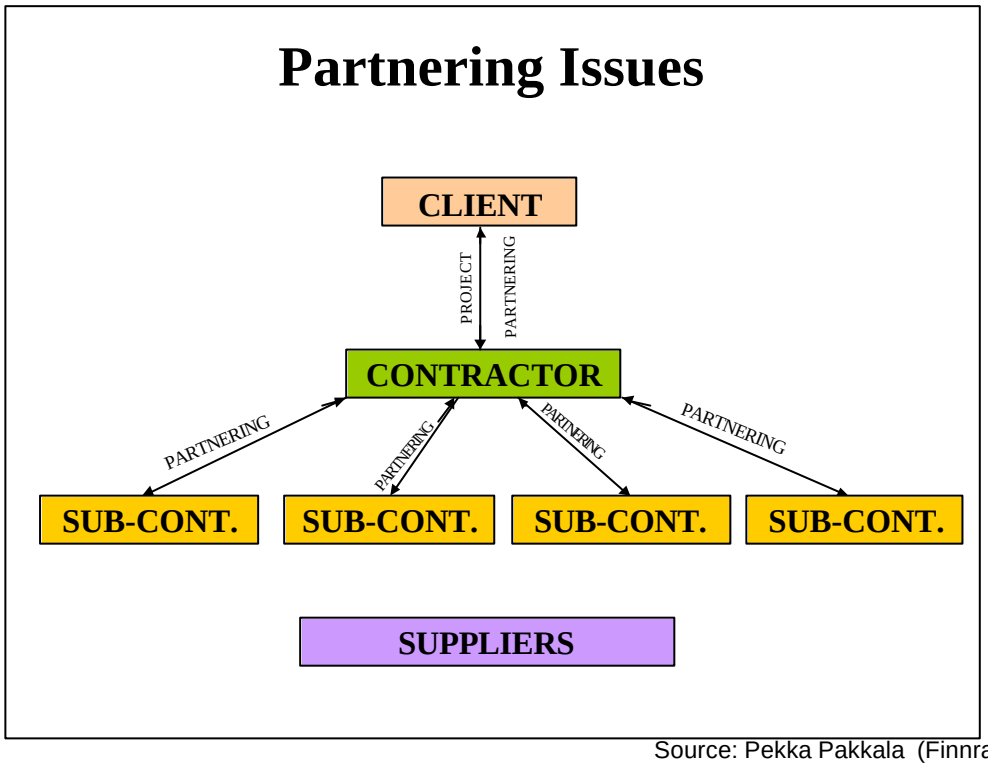
Whether partnering has been used formally or informally, the results have been very positive and even more ***essential*** in long-term maintenance contracts. This is especially important when long-term maintenance contracts are used for the first time, so that any differences, expectations, biases, and quality issues can be mutually discussed in an open forum.

Also, partnering would be ideal if the same duration of the contract is passed down to the sub-contractors to increase their potential use of innovation, savings, efficiencies, and ability to purchase new equipment and Information Technology (IT) during the length of the contract. Purchasing these items over a long period is sometimes referred to as depreciation of capital equipment/costs. Also, this provides the opportunity to acquire new equipment which can be more efficient and effective for various applications. Since the client pays for the equipment anyway, it provides an added incentive. Figure 2 shows the potential for partnering and how it can be used in supply chain management. It should be realized that innovation typically comes from the “bottom up”, or through the contractor and supplier network. The R&D budgets of most client organizations are more focused on safety and traffic issues than on material, product and IT developments. Therefore, partnering and a shared length of contract could provide the potential to maximize innovation. Or at the minimum, the risks/rewards should be shared to stimulate innovation

In long-term maintenance contracts, partnering is mostly needed between the contractor and sub-contractor groups. This allows for joint sharing of risks, benefits, coordination of effort, and as an end result, better products and services for the road user, who is typically not included in this process. Once the contractors become efficient and knowledgeable in the process, the long-term maintenance contracts should become an efficient process for maintenance contracts.

A recent report published in the USA by the National Cooperative Highway Research Program (NCHRP), called “Guidebook to Highway Contracting for Innovation: The Role of Procurement and Contracting Approaches in Facilitating the Implementation of Research Findings” (NCHRP Report 428), shared the results of a survey and revealed that “***Partnering***” was the number one approach to creating innovation. This report was based on a research study on capital investment projects.

It was interesting to note that "***Partnering***" was a key and major reason for the success in maintenance type contracts. Results from most countries indicated that the client organizations had more difficulty in understanding and practicing the partnering concept. This is probably due to the dramatic change from the role of decision maker to a negotiating type of role.



Source: Pekka Pakkala (Finnra)

FIGURE 2 Partnering Issues

1.7 Performance Specifications & Outcome-Based Criteria in Maintenance

The subject of performance specifications and outcome-based criteria is quite a recent development, especially in capital and maintenance contracts for the road sector. Performance criteria have been practiced in several infrastructure sectors in capital projects, and they have often been utilized in the building technology sector. The performance criteria for capital projects can be quite easily adapted to Design-Build delivery methods or their related Design-Build models (Design-Build Operate Maintain and Design-Build Finance Operate). Some examples might be for pavements that will meet certain criteria and may even include warranty issues, prior to resurfacing and replacement. Sometimes these performance specifications have been developed from other industries that have successfully implemented them. Among the reasons for the progression to performance specifications are the potential for cost savings, risk transfer, and providing the contractor with more flexibility to utilize innovative and more efficient means of producing the desired performance results.

If a client uses "***Outcome-Based Criteria***" in maintenance contracts, the process is somewhat different, as the client specifies the desired "**outcomes**" and the contractor needs to provide the proper strategy to meet these stipulated levels. It should be noted that all parties, including the client, contractors, and sub-contractors, need to understand the measurement implications of these "***Outcome-Based Criteria***". Otherwise, it could lead to misunderstandings, potential deviations, and if incorrect levels are not achieved, possible undesired client expectations. It is also possible to confuse the outcomes due to a lack of know-how or reverting back to the traditional methods. A significant failure or risk would be to apply inappropriate "***Outcome-Based Criteria***" which could result in poor or failed roads, or even the reverse scenario for better quality roads.

Some countries are beginning to understand and utilize these outcome-based criteria in actual maintenance contracts. Care must be taken in determining the satisfactory or desired levels so that there is neither a large increase (extra costs) or a large decrease (poor road conditions) in the quality performance of the roads. Some examples of outcome-based pavement criteria are:

- Roughness (IRI)
- Rutting
- Skid resistance
- Deflection
- Cracking
- Texture

Other non-pavement outcome-based criteria can be explained in terms of:

- Signs - visibility & structural fastening
- Road markings - visibility & skid resistance
- Lighting - % in working order & no two consecutive not working
- Vegetation (grass) - None greater than prescribed height
- Bridges
- Guard rails
- Sound barriers
- Drainage systems

As road authorities practice and become interactively involved in the process, the criteria can be refined and optimum levels determined for satisfactory performance. The client needs to define the outcome-based criteria that meet or exceed the quality requirements in the contract. Also, the contractor is then responsible for performing the work and activities that meet these requirements. It is very important that there is a mutual understanding between the industry and the client organization on what repercussions or end results might occur.

2 CAPITAL PROJECT DELIVERY METHODS

2.1 Introduction & Overview of Capital Project Delivery Methods

Outsourcing of capital investment projects to the private sector is not a new or recent practice in infrastructure projects. Results from the study indicate that there are no significantly new project delivery methods, but merely modifications or slight variations of existing or past methods. The most common practice is the traditional method of Design-Bid-Build (D-B-B), procurement of Design/Engineering services and a separate contract for physical works/construction. Based on the results in this survey, the Design-Bid-Build (D-B-B) method for the road sector is practiced in all countries except England. Design-Bid-Build also appears to be the most widely used delivery method quantitatively. England uses the Design-Build (DB) and Design-Build-Finance-Operate (DBFO) delivery methods, sometimes referred as Public Private Partnerships (PPP). The main project delivery methods are summarized and described as follows:

- Design-Bid-Build (D-B-B)
- Design-Build (DB)
- Construction Management (CM At-Fee (Agency or Advisor))
- Construction Management (CM At-Risk)
- Design-Build-Operate (DBO)
- Design-Build-Operate-Maintain (DBOM)
- Design-Build-Finance-Operate (DBFO)
- Full Delivery or Program Management
- Build Own Operate (BOT) & Build Own Operate Transfer (BOOT)

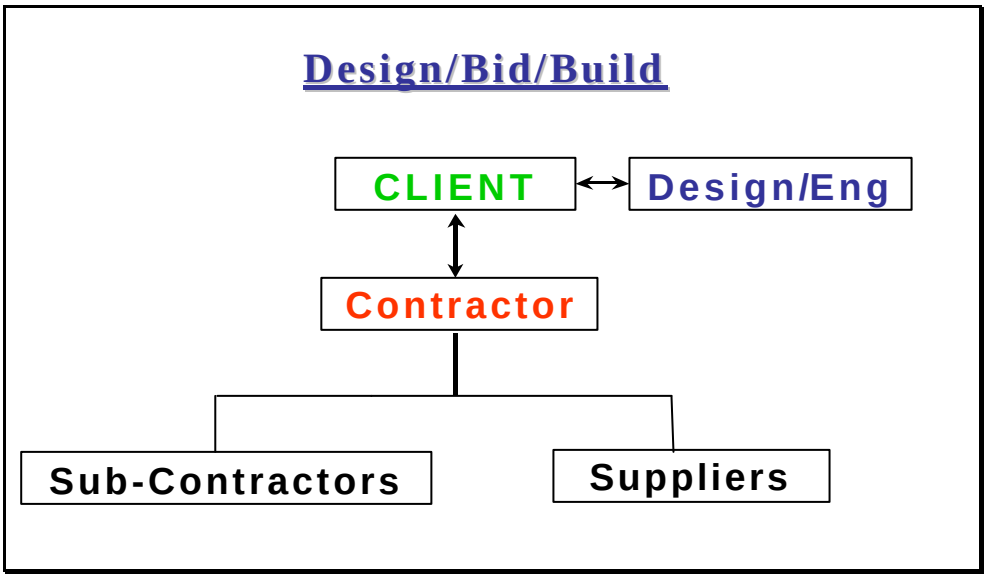
In the delivery of capital projects consideration should be given to some fundamental elements and the type of environment that exists when infrastructure projects are secured. An example for consideration is shown in Table 3, Fundamental Elements For Public Infrastructure Procurement, which prescribe 10 essential aspects needed for healthy procurement practice for infrastructure.

FUNDAMENTAL ELEMENTS FOR PUBLIC INFRASTRUCTURE PROCUREMENT	
1.	CLIENT-defined scope.
2.	Head-to-head competition among PRODUCERS.
3.	Fair treatment of actual competitors.
4.	Transparency - Signaling fair treatment to potential competitors.
5.	Safety confirmed - An independent engineering check on the efficacy of the PRODUCER'S design.
6.	Competitions open to technological change.
7.	Sound financial analysis by CLIENTS and PRODUCERS over the project life cycle.
8.	Re-establishing the dual track procurement strategy of Quadrants IV, 1, and II. (This refers to using a proper mix of DB, D-B-B, DBOM, DBFO & BOOT models)
9.	CLIENT decision-making at the portfolio level with the assistance of scenarios
10.	Re-establishing pace (or level) of infrastructure investment as a variable in public and private sectors)

Source: Professor John B. Miller - MIT

TABLE 3 Fundamental Elements For Public Infrastructure Procurement

Pictured below in Figure 3 are the main models utilized and the different structural and relationships between organizations.



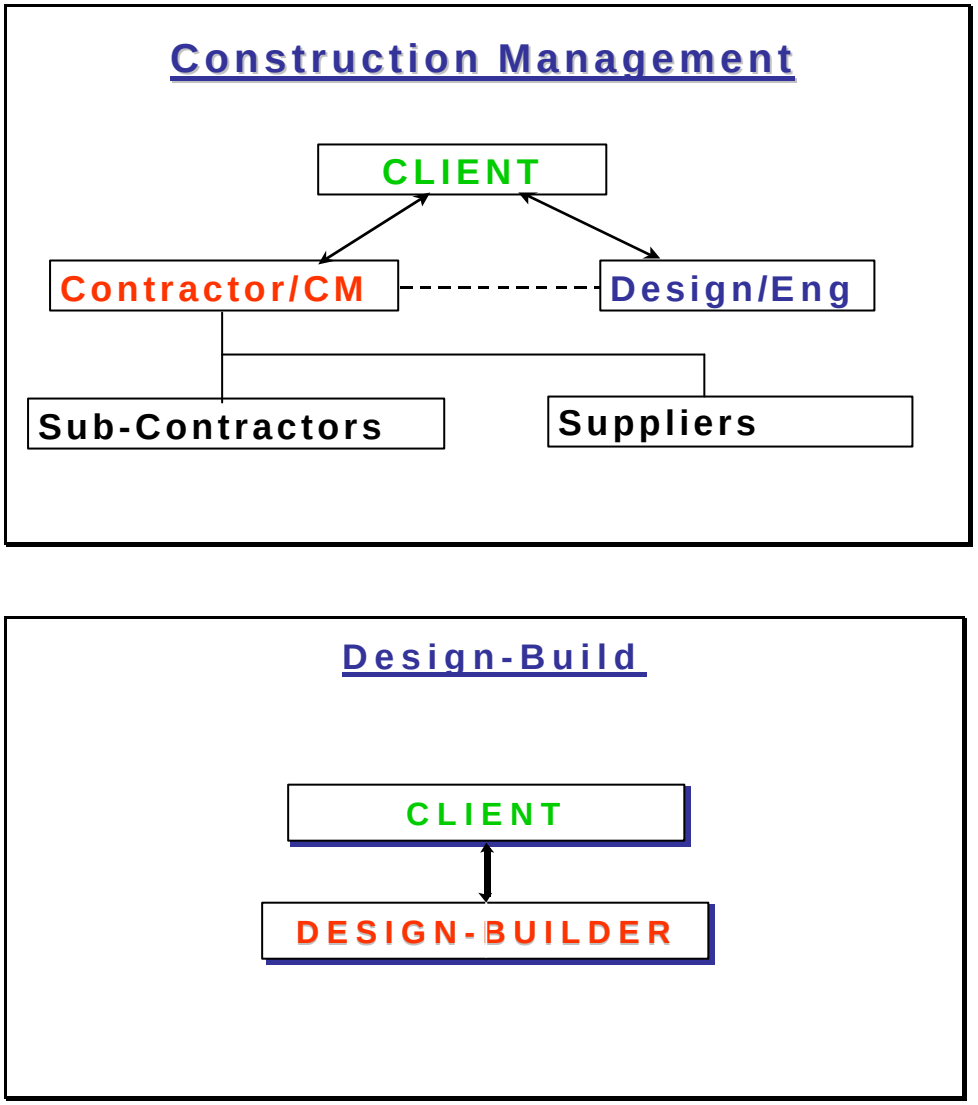


FIGURE 3 Structure of Typical Models

2.2 Methods used in Finland

Basically, Finland uses three delivery methods or models for capital investment projects. These models are:

- Design-Bid-Build (D-B-B)
- Finnish Design-Build Method
- Construction Management (CM At-Fee and CM At-Risk - Quite Rare)

Finland also used the Design-Build-Finance-Operate (DBFO) on one project known as the Lahti Motorway (Finland Route 4 - Järvenpää to Lahti), but has not reintroduced this model, as it appeared to be a special project. Because of the public opposition against traditional toll roads, this was considered a “shadow toll road”. Presently, there are other Design-Build-Finance-Operate projects under discussion.

The Finnish Design-Build system varies somewhat from the USA model of Design-Build, in that there is no pre-qualifications phase (short listing of Design-Build contractors) and the design portion is often too detailed (greater than 30%), which tends to minimizes the innovation potential of the Design-Build contractor. Otherwise, the two processes are quite similar.

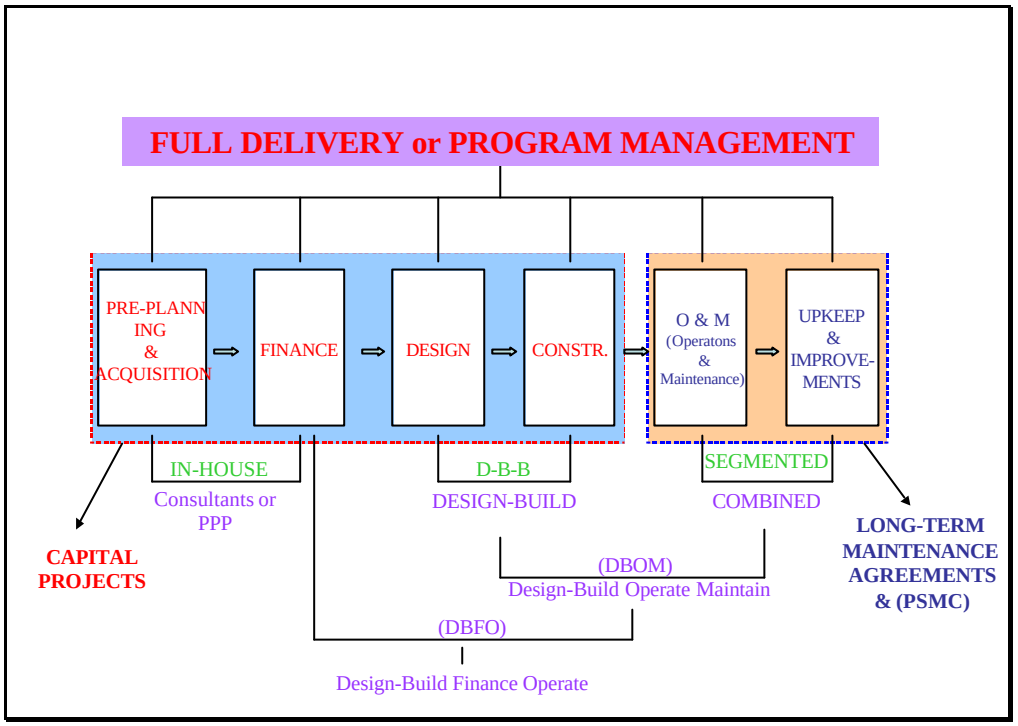
2.3 Innovative Project Delivery Methods

Some of the main criticisms of the traditional Design-Bid-Build (D-B-B) method are the lack of innovation, delayed completion periods, and cost overruns sometimes encountered on projects. Since the client bears most of the risks of both the design and construction aspects, there need to be better practices to assure the client's needs are being met, quicker project completion times, and cost effective solutions. More road administrations and other public organizations (rail transport, airports & others) are seeking better practices. Some are using or evaluating alternative models such as Design-Build (DB), Design-Build-Operate-Maintain (DBOM), Design-Build-Finance-Operate (DBFO), and Full Delivery or Program Management. Build Own Operate (BOT) & Build Own Operate Transfer (BOOT) are similar to the DBOM and DBFO model, but there is an official transfer of ownership. The main goals of these innovative project delivery methods are to produce projects that have better quality or longer life cycles, bring cost savings to the client, transfer risks (to the organization best able to manage risks), include integrated processes, and complete projects faster than the traditional method. However, changing to another project delivery method usually takes time, experience, and new approaches. The project delivery methods and key phases of the processes are shown in Figure 4. Some of the driving forces for change that have been noted in this study are:

- Cost savings
- Seeking innovation
- Staff reductions
- Desiring integration & technology
- Partnering potential
- Avoiding litigation
- Bringing trust back into the process

2.3.1 Comparison & Summary of Most Innovative Methods

A comparison of delivery methods based on interviews and background information gathered from the surveyed countries is presented in Table 4. It can be seen that most countries utilize the traditional Design-Bid-Build process and most have attempted to use Design-Build. Very few countries, with the exception of England and Australia, use other innovative procurement methods. New Zealand is supposed to trial their first full delivery (program management) method in the later part of 2001. This is probably the first road project attempting to use such a forward thinking method. It would be interesting to follow the results of such a project.



Source: Pekka Pakkala (Finnra)

FIGURE 4 Innovative Procurement Methods

	D-B-B	D-B	CM	DBOM	DBFO	FD Or PM
Australia	X	X (Rare)	X	X	X	
Alberta, Canada	X					
British Columbia, Canada	X					
Ontario, Canada	X			Toll (407 ETR)		
England		X		X	Mainly Shadow Tolls	
Finland	X	X	At-Risk & At-Fee		X (Shadow Toll)	
New Zealand	X	X				Expected in Late 2001
Sweden	X	X				
USA	X	X	Pilot	X	X	

Source: Pekka Pakkala (Finnra)

TABLE 4 Comparison of Models Used

These project delivery methods can also be pictured in a different context, which displays the project delivery methods viewed by means of two criteria. Segmented and integrated delivery methods are compared on one axis, and direct funding or indirect funding on the other axis, the result is a very simple diagram that shows the different delivery methods from another perspective. This is shown in Figure 5. It is very easy to determine which delivery methods are integrated and which methods require external financing mechanisms.

If the goal is to seek an integrated process in the selection of a proposed project, then the client would consider the following delivery methods:

- Design-Build-Operate (DBO)
- Design-Build-Operate-Maintain (DBOM) & Design-Build-Finance-Operate (DBFO)

These two models are sometimes intermixed, but the major difference is that maintenance activities can be included in the same contract.

If the goal is to seek external financing due to limited government allocations, then the client would consider the following delivery methods:

- Design-Build-Finance-Operate (DBFO)
- Build Own Operate (BOT) & Build Own Operate Transfer (BOOT)

If the goal is to seek traditional, segmented delivery methods, then the client would consider the following delivery methods:

- Design-Bid-Build (D-B-B)
- Design-Build (DB)
- Construction Management (CM) At-Risk & At-Fee
- Pure Operations & Maintenance (O&M)

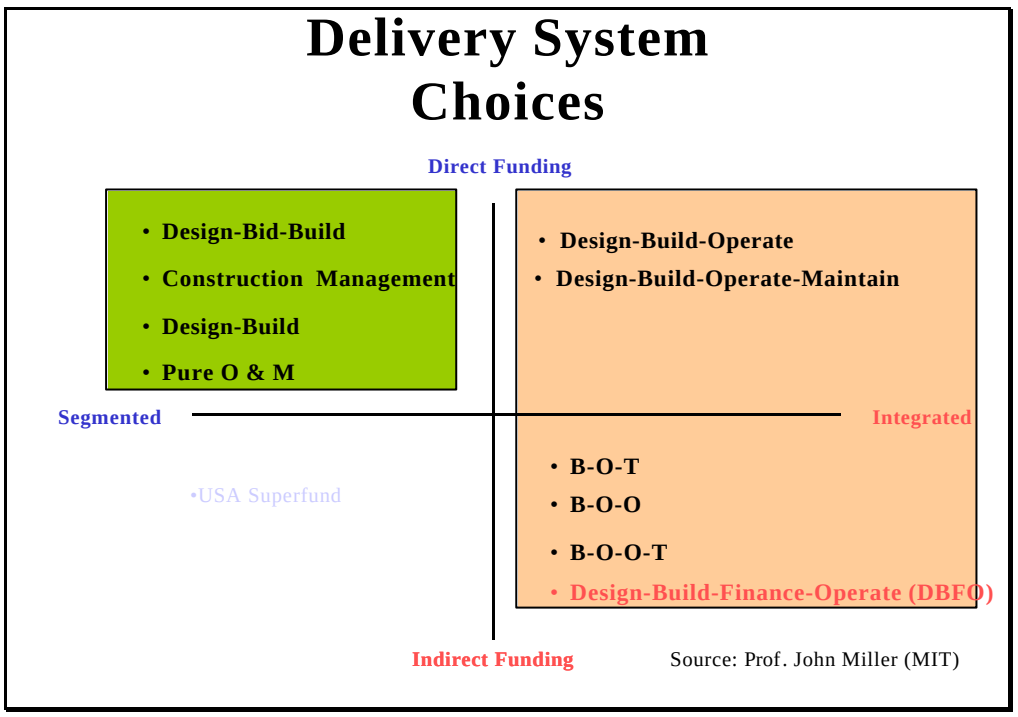


FIGURE 5 Delivery System Choices

2.3.2 Project Delivery Methods - Advantages & Disadvantages

Table 5 lists some of the benefits and disadvantages of each system. This should not be considered an exhaustive list, but merely a summary and highlights.

DELIVERY METHOD	ADVANTAGES	DISADVANTAGES
D-B-B	• Long History of Acceptance • Open Competition • Distinct Roles Are Clear • Owner Flexibility • Easy to Tender	• Innovation Not Optimized • Usually Cost Overruns • Disputes Between Parties • Client Retains Most Risks • Usually Low Bid – Incentive for Change Orders • Owner Responsible for Errors & Omissions • Linear Process
D-B	• Reduced Administration • Single-Source Responsibility • Quality Equal or Better Than D-B-B • Innovation • Cost Savings • Projects Completed Faster • Improved Risk Management • Early Knowledge of Total Costs • Accountability • Constructability Optimized • Early Partnering Potential & Trust Building • Integrating Design & Construction • Most Risks Transferred to the Design-Builder • Design Reflects Contractor Strengths & Ability • More Rewards/Profit for Contractors • Usually Guaranteed Maximum Price (GMP)	• Limiting Competition • High Tendering Costs • New Method & Unfamiliar With Process • Client Needs to Make Quicker Decisions • Clients Bringing Design Requirements > 30% (Reduces the Innovation)

CM at Fee (Usually Public Sector) **CM at Risk (Usually Private Sector, but now public sector using)**	• Provides a Managing and Administering for All Phases of a Project • Treats Planning, Design, Construction as an Integrated Tasks • Some Costs and Schedule Control • Good for Clients With Insufficient Staff • Owner Flexibility • Responsible for Time & Cost overruns • Holds & Manages the Trade Contractors • Constructability Design Review • Same Legal Position as a General Contractor • Provides A Guaranteed Maximum Price (GMP) • Works Closely as a Teaming Effort & Encouraging Partnering & Trust • Owner Flexibility	• No Contractual Relationship With Trade Contractors • No Contractual Responsibility for Outcomes of a Project • Client Retains the Risks • Duplication of Administration & Additional Paperwork • Some Duplication of Administration • More Paperwork for Client • Fast Tracking Difficult to Control With Designer & CM • Sometimes Difficult to Manage All Phased Packages With Costs, Changes & Schedule
DBOM	• Integrates the Process of Design, Construction, and Maintenance • One Contract for All Services and Products • Maintenance & Any Operations Aspects Can Be Considered During Design • Projects Completed Faster • Better Life Cycle Costs • Similar Benefits Earlier Mentioned in D-B	• Longer Tendering Process • Costly Tendering • Similar Disadvantages As Earlier Mentioned in D-B
DBFO	• Complete Projects that Could Not Normally Be Accomplished with Internal Funding • Integrates the Process of Design, Construction, and Maintenance • Maintenance & Any Operations Aspects Can Be Considered During Design • Projects Completed Faster • Better Life Cycle Costs • Better Net Present Value (NPV) • Similar Benefits Earlier Mentioned in D-B • Private Financing With No Revenue Risk	• Costs More In the Long Run • Longer Tendering Process • Costly Tendering • Similar Disadvantages As Earlier Mentioned in D-B • Difficulty With Long Term Relationships • Future Political Changes May Not Accept/Agree with Prior Agreements/Commitments

FD or PM	• Shorter Time To Project Completion • Fully Integrated Process From Project Inception • Maximizes Planning & Reduces Problems During Execution • Knowledgeable Alternative Funding Sources • Good for Large & Complex Projects • Single Source of Expertise • Quality Should Be Greater	• Difficult to tender and not knowing the costs • Compatibility Issues with Client • Quality Based Selection Process (Negotiated) • Client Needs To Make Decisions Quicker
BOT & BOOT	• Same Benefits as DBFO • Usually for Toll Roads • Includes the Operations Aspects • Ownership is Transferred	• Same Disadvantages as DBFO • Difficulty With Long Term Relationships • Future Political Changes May Not Accept/Agree with Prior Agreements/Commitments

Source: Pekka Pakkala (Finnra)

TABLE 5 Delivery Methods - Advantages & Disadvantages

The list of advantages and disadvantages has been gathered through much research from various sources, personal expertise and past knowledge, meetings with clients organization, reports, journals, experience with building technology practices, and other publications.

2.3.3 Suggestions & Recommendations

As it can be seen, there are differences in the usage of any project delivery method chosen by the client. When the time issue become more important and dominant, then some form of Design-Build is a good choice. If the Client does not have sufficient staffing to manage a project, then Construction Management (CM), especially CM At-Risk, may be a relevant option. If there are projects that do not require any innovation and are classical type projects, then Design-Bid-Build may be the better option. Obviously, when internal funding is lacking, the DBFO model is the method of choice. Since there is not enough experience and practice with the Full delivery or Program Management models for capital projects for roads, it is difficult to make any objective recommendations. However, when time is the ultimate factor, it is estimated that the full delivery model can potentially save years in project completion (depending upon complexity and other issues), because many stages of procurement, environmental statements, approvals, and pre-planning aspects can be accomplished simultaneously, or at the minimum, completed prior to the actual construction phase. There is also potential for reducing duplication, eliminating unworthy design solutions, and more efficiently controlling the process.

In summary, the project delivery methods that are most suitable in providing innovation are:

- Design-Build (DB)
- Design-Build-Operate-Maintain (DBOM)
- Design-Build-Finance-Operate (DBFO)
- Full Delivery or Program Management
- BOT & BOOT - For countries desiring transfer of ownership and operations included

It should also be noted that there are some “tools” available for predicting which delivery method might be applicable to projects that are being considered or planned. It was not the goal of this study to investigate such tools, but it should be noted that there are tools available that can assist clients in this decision-making matrix. Two sources were uncovered during this study:

- Design-Build Selector^{TM} (from the University of Colorado, Georgia Tech & NSF)
- Project Procurement System Selection Model (PPSSM), Reference Journal of Construction Engineering & Management, May/June 2000

2.3.4 Future Developments

Since there is very little practice and knowledge related to the Full Delivery or Program Management model, this may be an opportunity to develop and study this method and possibly utilize it as a pilot project. If the lessons learned and this method produce good results, it may be a potential candidate for inclusion in the mix of project delivery methods used by clients. This method allows contractor participation during the project development process, emphasis on total delivery, a win-win approach, an open and honest relationship among the key stakeholders, and commitment from all parties involved.

Design-Build seems to be increasing in use as a viable delivery method, and it has many advantages compared to the traditional method. However, an innovative process is needed to reduce the tendering costs and keep a healthy level of competition for each project. This might require some forward thinking in order to resolve these difficult issues and make Design-Build more acceptable.

In some cases laws and public tendering regulations that may hinder or inhibit the use of innovative project delivery methods, such as the USA situation with Design-Build (Some states in the USA prohibit the Design-Build model). New legislation presently being implemented has been introduced by the Federal Highway Administration (FHWA) as an attempt to resolve this issue.

3 MAINTENANCE PROCUREMENT

3.1 Introduction & Overview of Maintenance Procurement

In the past history of road authorities, maintenance activities and duties in the road sector were typically self-performed by the road administrations with most of the control and decision-making taken care of internally. Throughout the years, changes were introduced and maintenance was procured from the private sector for diverse elements of maintenance requirements. Subsequently, this lead to more and more procurement from the private sector and created a private sector relationship for maintenance activities that could be done more efficiently and effectively. Some of the earlier procurement maintenance activities were typically achieved via separate agreements for each type of diverse activity. Some examples of these are listed below:

- Mowing & vegetation
- Guard rail replacement
- Some aspects of winter and summer maintenance
- Line painting
- Traffic signs and signals
- Materials & products

These maintenance activities were usually procured based on labor rates, materials and supplies, unit prices (schedule of rates), and sometimes a lump sum (fixed price). These maintenance activities were also procured on an as-needed basis and were typically for one or multi-year agreements. Some of the more common type of practices of maintenance procurement are described below:

- Labor Rates
- Unit Price (Schedule of Rates)
- Lump Sum (Fixed Price)

Further studies and global practices showed that outsourcing and privatization can result in significant cost savings and better efficiency of service. Several of the progressive countries actually changed to a new paradigm, in which all maintenance activities are procured from the private sector. This is sometimes referred to as a privatization process. As previously noted in Figure 1 (Introduction Section), the phases of a road organization generally determine the full extent of outsourcing of maintenance activities. Finland is no exception to this paradigm change, and it is one of the countries moving forward in the process of privatization. The Finnish Road Administration no longer retains any of its own internal work force for maintenance activities. Basically, emergency, traffic and safety management are still kept as strategic resources in the client organization.

Organizational maintenance and operations can be broadly categorized in three sectors as follows:

- All activities performed by own work forces
- Some activities via own forces and other aspects outsourced
- All activities outsource - no internal work force

Progressing further, more and more maintenance activities were combined into one agreement, and quite recently they are being procured for all activities, hereby referred to as “Fully Integrated Client Services”. As part of the progressive process, the maintenance contracts were also tendered for long periods of time, with the longest typically for 10 year arrangements. New Zealand, parts of Australia, and England are utilizing these “Fully Integrated Client Services” and long-term contracts for maintenance. With more and more experience and dissemination of these practices, it appears there is global interest or movement toward outsourcing maintenance, with most, if not all aspects of maintenance, being procured under one contract for a long duration.

3.2 Drivers for Change

It is extremely interesting to understand some of the reasons for change in the procurement process of maintenance activities. Each country needs to understand its own cultural needs, present state of industrial expertise, drivers for change, and ability to change. Some countries have followed the course of action of other countries, evaluated results derived from the World Road Association (PIARC) and other organizations, political decisions, attempts to reduce costs, and from any internal cultural and social issues.

Some of the reasons why some countries have decided to change can be explained with the elements presented below. This is not intended to be a comprehensive and exhaustive list, but it provides a good overview of some of the main reasons for changing to a new paradigm:

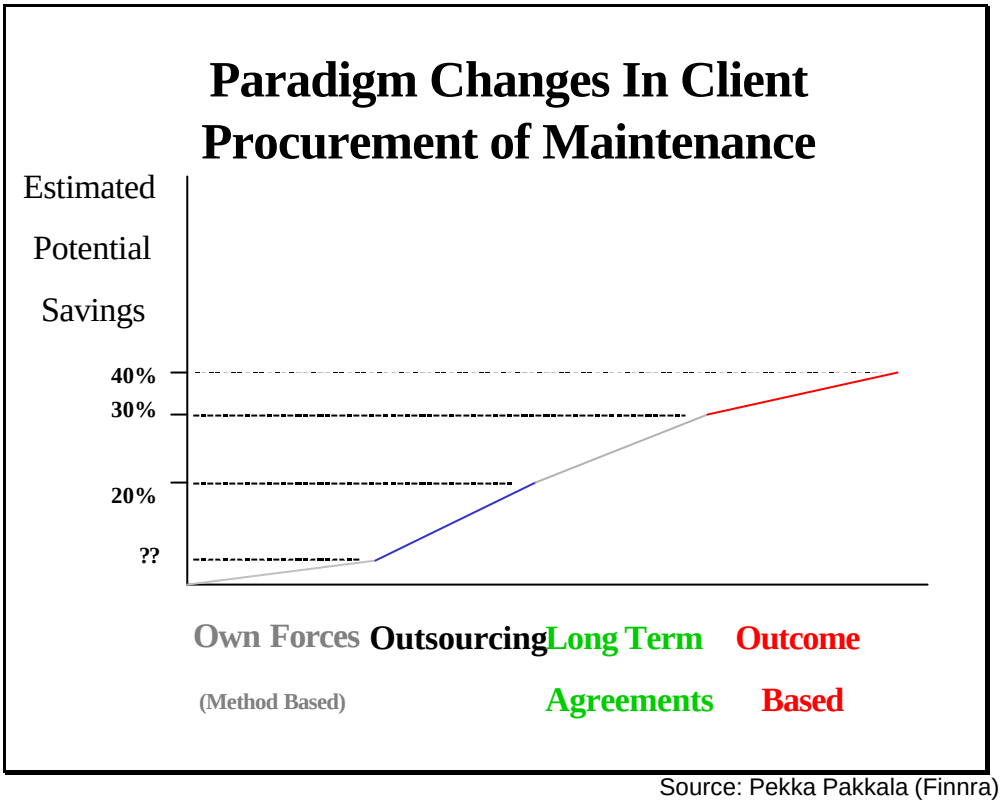
- Issues of providing present and future society with a better or equal road quality infrastructure in the demanding & competitive struggle for the appropriation of government funds
- Seeking integrated maintenance services (Fully Integrated Client Services)
- Cost savings
- Risk sharing
- Reductions in client staffing
- Changing to performance-based criteria (Outcome-based criteria)
- Partnering potential
- Innovation
- Better asset management
- Whole life cost decisions/Life Cycle Costing (LCC)
- Road user satisfaction
- Improved budgeting

- Allowing more focus on the strategic issues (safety, reliability & traffic)
- Too much contract administration
- Lack of profitability & competition by contractors
- Maintenance budget fluctuations (especially regionally)
- Lack of expertise and aging workforce
- Lack of future prospects (younger professionals) in this discipline

Client organizations are continuously competing for public funding resources and can appreciate the need to reduce costs. The accumulation of the asset value with limited financial expenditures has resulted in compromising the maintenance of the entire asset at a satisfactory level for ***all*** roads. There are continuous evaluations, and funds are given to roads with greater priority. Also, having demonstrated cost saving measures in the past can be considered a good driver when attempting to request increased expenditure.

Since costs are an important driver for change, they need to be seriously considered as an important aspect toward changing into a new aspect of maintenance. Figure 6 attempts to demonstrate some of the potential cost savings parameters associated with moving into different paradigms or changing to more innovative processes. The values displayed in the figure are not intended to be accurate or totally reliable, but they are examples of estimated potential levels of cost savings that might be achieved. Some countries have actually achieved these figures, but it should be noted that savings will vary from culture to culture, and depend upon each country's present starting conditions and status. Even savings of single digit values would be highly welcomed in this present situation.

Another example of the reason for change can be seen in Figure 7, which shows some key reasons why clients might be interested in changing to outcome-based criteria. If the desire is to transfer risks, seek innovation, and rely more on asset management, then it may warrant changes in maintenance practices.



Source: Pekka Pakkala (Finnra)

FIGURE 6 Potential Cost Savings from Paradigm Changes

Client Decisions

	Traditional (Method Based)	Performance Based (Outcome Based)
RISKS Transferred	NO	YES
Keep Control	YES	NO
Innovation	NO	YES
Significant Cost Savings	Minor/Some	YES
Less Management	NO	YES
Reliance on Asset Management	NO	YES

Source: Pekka Pakkala (Finnra)

FIGURE 7 Client Decision Matrix

It should be noted that “the good old days” of having sufficient organizational resources and expertise to manage an entire road network are not possible for most countries. Even the private sector does not have substantial (in-house) resources and skills for managing all aspects of road maintenance in long-term maintenance contracts. This requires the private sector to develop and utilize more of a partnering effort or alliances between differing service and product suppliers. Hopefully, the change would be a motivation for innovation and allow more incentives to utilize newer tools, equipment, and invest in innovative practices and products. Information Technology (IT) may be a good example of increased innovation potential, because the initial costs for new IT applications are quite high, but with partnering and long-term contracts, the expense can be itemized throughout the length of the contract.

3.3 Methods Used in Finland

As previously mentioned, the new organizational structure of the Finnish Road Administration (Finnra) and the Finnish Road Enterprise transpired on January 1, 2001. Finnra is now responsible for the procurement of maintenance aspects in Finland. Open, public tendering for routine/periodic maintenance began this year (2001) in 23 network maintenance areas. A few contracts still remain that are negotiated with the Finnish Road Enterprise, and they will be phased into open competition at a later date. Other network areas will be phased in on a yearly basis, and all the network area contracts are planned for open competition by the year 2005.

The 23 network maintenance areas that were opened to competition in 2001 for routine/periodic maintenance activities were for a duration of 3 years, with a “Lump Sum” (Fixed Price) contract. The contractor selection criteria in these 3-year contracts used weighted averages with 75% price criteria and 25% technical qualifications. All other non-routine maintenance activities are procured via the traditional system and by using unit prices and/or lump sum contracts.

Most of the services included in these new 3-year routine maintenance agreements include:

- Winter maintenance
- Summer maintenance (shoulders, pot holes, etc.)
- Gravel roads
- Vegetation control
- Drainage
- Minor bridge maintenance
- Certain types of road signs
- Cleaning activities
- Routine maintenance of pathways

Items not currently included, but possibly phased into these agreements later, include:

- Lighting
- Energy consumption
- Line marking
- Traffic signs and signals
- Resurfacing
- Rehabilitation

It should be noted that resurfacing and rehabilitation (presently tendered under capital investments) are generally not included in typical maintenance contracts, but this may change in the future. Winter maintenance is by far the largest single expense item in routine maintenance costs. Clearly, safety is the most important issue in the winter season, and strategies and practices are defined for effective and efficient snow removal and de-icing methods. Finland has also developed a snow/fuel/inflation index that accounts for aspects or risks that are beyond the control of the client and contractor. This indexing was a part of the 3-year contracts.

3.4 Innovative Procurement Methods for Maintenance

In recent years, several countries have developed progressive and innovative procurement methods and mechanisms for maintenance contracting. As part of the process, the maintenance responsibilities have been divided into certain defined road length areas known as network maintenance areas. The responsible organization is then responsible for all the maintenance activities on the roads, bridges, and pathways in that network area. The most innovative procurement methods encountered during this study could be classified as follows:

- Traditional 3-year contracts
- Hybrid type contracts (Combination of Lump Sum and Unit Price - Schedule of Rates)
- Long-term maintenance contracts
- Performance Specified Maintenance Contracts (PSMC)
- Under consideration - Privately Financed Managing Agent Contractor (PFMAC - England)

There are significant differences between traditional (output-based), hybrid (output and outcome-based), other long-term contracts (output and outcome-based), and PSMC type contracts (outcome-based). One key difference is that the PSMC contracts include both resurfacing and rehabilitation as well as all other “Fully Integrated Client Services”. PSMC contracts are typically long-term contracts of 10 years, which define the desired outcomes and allow the contractor more flexibility to meet or exceed these desired outcomes. Typically, traditional 3-year contracts have output-based criteria in which the client procures road services and products according to a complete list of activities, and the desired outputs are in terms of unit prices for each level of activity. A good example is that output-based criteria actual state the required procedures in order to achieve the level of

output, whereas outcome criteria state the desired outcomes, and it is at the discretion of the contractor to determine reasonable methods or means to achieve the results. Herein lies the key to the main difference of PSMC, where quality resides in the level of the outcome criteria specified by the client. Essentially, in the PSMC model, there is almost a form of ownership transferred to the contractor for the purpose of caring for and maintaining the assets specified in the given contract. The contractor then determines the intervention levels, treatment practices, and all actions needed to prevent consumption or deterioration of the asset. Other differences include the length of the contract, the maintenance activities included, the flexibility or risks transferred to the contractor, and the contract pricing arrangements.

It is important to realize that the New Zealand, Australia, and England models use a consulting organization as the network manager for the client in traditional and hybrid type models. This means the consulting agency actually manages the administration and network, directs the maintenance strategy, provides the contractor with the planned scope of work/maintenance, and administers the tendering process. In the PSMC model, the consultant is usually a partner/advisor to the contractor, and the contractor manages the agreement with the client.

A new and innovative method which is being considered in England is called a "Privately Financed Managing Agent Contractor" (PFMAC), which introduces private financing into the maintenance process. There are greater risks transferred, a longer-term contract of 15-30 years, and mechanisms similar to the DBFO model in capital projects. This has not been tested to date, but it is worth following up and determining the feasibility of this type of model for long-term maintenance contracts. This is quite innovative and it will be interesting to see if England can make this model a reality.

See Table 6 for a summary of the differences between the contract types.

	Traditional	**Hybrid**	**Other Long-Term Methods**	**PSMC**
Length of Contract	3-5 Years	5 years	Varies From 5-8 Years	10 Years
Contract Type	Unit Price & Lump Sum (Schedule of Rates)	Lump Sum & Unit Price (Schedule of Rates)	Lump Sum	Lump Sum
Activities Included	All As Prescribed	All Except Rehabilitation (Others As Prescribed)	All Except Rehabilitation & Sometimes Resurfacing	All
Prescribed Criteria	Output Based Criteria	Output & Some Outcome-Based	Output & Outcome-Based	Outcome-Based
Risks	CLIENT	CLIENT & CONTRACTOR	CONTRACTOR	CONTRACTOR
Contractor Flexibility	NO	SOME	YES (Except for Rehabilitation & Sometimes Resurfacing)	YES

TABLE 6 Differences Between Innovative Maintenance Practices

It should be clearly stated that when considering procurement of long-term maintenance via PSMC type contracts, a significant difference or paradigm change is required and a cooperative effort is needed between the client and industry organizations. One important aspect is defining the appropriate level or measure of outcome-based criteria. It is critical that the entire industry understands and can objectively measure the desired outcomes and the performance of the assets maintained in the contract. Some outcome-based criteria can be typically defined in terms of:

- Roughness
- Rutting
- Skid Resistance
- Deflection
- Texture
- Cracking

Based on Table 6 and interviews/meetings held during this study, the most innovative models would be the PSMC model and the long-term maintenance type contracts that utilize outcome-based criteria. The main issue is that longer-term contracts maximize the potential for innovation by the contractor because new equipment, IT tools, and practices can be adopted and the expenses can be amortized over the duration of the contract. Also, providing outcome-based criteria allows more flexibility and effective measures for utilizing new and innovative measures that could not normally be tried or tested. This means the contractor assumes the risk for these innovations, since most of the risks are transferred to the contractor.

3.4.1 Comparison & Summary of Innovative Practices

When trying to evaluate large countries such as Australia, the USA and Canada, it is not feasible or appropriate to analyze each state, territory or province and make general statements representing each country. So, the reader needs to understand that the results do not necessarily represent the entire country, but merely demonstrate where some of these innovative practices are utilized. Therefore, the comparisons describe the most innovative and best practices from each progressive country and do not represent all the practices of each country.

Based on the countries selected for this study and the interviews that were conducted, it can be concluded that the trend is toward longer-term maintenance contract duration and using a lump sum type contract agreement. Several of the countries in this survey began with shorter-term contracts of about 3 years, and then five years, and now most are moving toward 7-8 years. Australia and New Zealand have used 10-year contracts. Table 7 shows a summary of the models or procurement methods used for maintenance contracts. Also, Table 8 shows more detailed information regarding the long-term contracts existing in the selected countries.

	Type of Contract	Contract Duration	Contract Method	Contractor Selection Criteria	Activities Included
Australia Sydney, WA & Tasmania	Outcome-Based	10 Years	Lump Sum	50% Price 50% Other (Varies with Territory)	ALL
Alberta, Canada	Output Based	5 Years	Unit Price	78% Price 22% Other	All except Resurfacing & Rehabilitation
British Columbia, Canada	Outcome-Based	8 Years (New – 5+3)	Lump Sum	40% Price 60% Other	ALL except Resurfacing & Rehabilitation
Ontario, Canada	Output Based	8 Years (New – 5+3)	Lump Sum	90% Price 10% Other	ALL except Resurfacing & Rehabilitation
England	Outcome-Based	7 Years (New – 5+2)	Lump Sum	30-40% Price 60-70% Other	ALL
Finland	Output & Few Outcomes	3 Years	Lump Sum	75% Price 25% Other	ALL except Resurfacing & Rehabilitation
New Zealand	Outcome-Based	10 Years	Lump Sum	Quality Price Trade Off (QPTO)	ALL
Sweden	Output & Few Outcomes	8 Years (New – 6+2)	Lump Sum	90% Price 10% Other	ALL except Resurfacing & Rehab
USA	Outcome-Based	5 & 10 Years (5+5)	Lump Sum	50% Price 50% Other & (Negotiated)	ALL except Rehabilitation

Source: Pekka Pakkala (Finnra)

TABLE 7 Long-Term Contract Models

	NSW Australia	Virginia USA	Washington DC USA	Waco, TX TxDOT - USA	Dallas, TX TxDOT- USA	Tasmania Australia	PSMC 001 NZ	PSMC 002 NZ	PSMC 003 NZ
Start Date	1995	1995 - 1996	June 2000	Sept 1999	Sept 1999	July 1998	Jan 1999	Oct 2000	Nov 1998
Contract Duration	10 Years	5.5 & 5 Years	5 Years	5 + 3 Years	5 + 3 Years	10 Years	10 Years	10 Years	10 Years
Costs	AU$ 20 M Per Year	US$ 131.6 M (First Term) 2nd Term Renewed	US$ 69.6 M (Total)	US$ 19.8 M (Total)	US$ 11.3 M (Total)	AU$ 8 M Per Year	NZ$ 75 M (Total)	NZ$ 85 M (Total)	NZ$ 18 M (Total)
Length of Roads	1000 km	402 km	120 km	193 km	97 km	1200 km	463 km	712 km	Auckland Harbor Bridge
Maintenance Activities	ALL	ALL except Rehabilitation	ALL except Rehabilitation	ALL except Rehabilitation	ALL except Rehabilitation	ALL	ALL	ALL	ALL work on bridge
Contract Type	Lump Sum	Lump Sum	Lump Sum	Lump Sum Low Bid – Required by State Law	Lump Sum Low Bid – Required by State Law	Lump Sum	Lump Sum	Lump Sum	Lump Sum
Contract Criteria	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based

TABLE 8 Other Countries Long Term Contracts

	Western Australia TNC 01	Western Australia TNC 02	Western Australia TNC 03	Western Australia TNC 04	Western Australia TNC 05	Western Australia TNC 06	Western Australia TNC 07	Western Australia TNC 08
Start Date	Nov 2000	Nov 2000	Nov 1999	Sept 2000	May 2000	June 2000	July 1999	Feb 2001
Contract Duration	10 Years	10 Years	10 Years	10 Years	10 Years	10 Years	10 Years	10 Years
Costs	AU$ 95.05M Per Year	AU$ 136.2M Per Year	AU$ 244.7M Per Year	AU$ 99.1M Per Year	AU$ 141.7M Per Year	AU$ 109.3M Per Year	AU$ 89.3M Per Year	AU$ 95.05M Per Year
Length of Roads	2120 km	4280 km	3470 km	2350 km	3160 km	1560 km	375 km	315 km
Maintenance Activities	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
Contract Type	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum	Lump Sum
Contract Criteria	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based	Outcome Based

TABLE 8 Other Countries Long Term Contracts (Cont'd)

3.4.2 Long Term Contract Advantages & Disadvantages

During the course of this study it was important to realize what potential or motivation there might be toward accepting new maintenance type contracts. Maintenance by contract, especially long-term contract, should be carefully considered prior to making any quick decisions, because changes can effect the present industry and practices. Sometimes it seems as if it might be a radical departure from the norm, and it may be politically or socially motivated. Whatever, the influence, it is feasible to determine some of the potential advantages and disadvantages. Below is a comparison of some of the results from discussions with actual organizations and from reports that have been issued concerning these progressive practices.

ADVANTAGES

- Cost savings
- Fully integrated client services
- Transferring risks
- Innovation
- Better asset management
- Easier budgeting
- Lesser contract administration
- Better level of service
- Partnering potential
- Targeted maintenance
- Road user satisfaction
- Building trust
- Applying improvements to other roads
- Developing a new industry
- Benefits of economy of scale

DISADVANTAGES

- Costly tendering for PSMC
- Longer tendering period for PSMC
- Reduction of competition (social justice), usually for large contractors
- Client role changes (loss of experts)?
- Uncertainty of long term relationships
- Mobilization issues need to be addressed
- Specifying inappropriate outcome criteria
- Loss of control
- Loss of financial flexibility for other roads
- Applying changes in mid-term

One the most problematic difficulties in PSMC contracts is the cost of tendering and the longer tendering periods. If rehabilitation would not be included in the maintenance activity, then the tendering costs and duration would be substantially less, as noticed in the projects in the USA and Canada. Another major concern is the competition issues and their effects on the market and the inability to compete next to large companies. Results to date have not indicated any major problems with smaller companies or medium-sized companies, as they have found their place by specializing in their core areas and by partnering and forming alliances. This is one area for continuing investigation and updating as these long-term projects advance into their later years.

Partnering is one area that has unanimous agreement in all countries. Most, if not all, agree that partnering is essential in long-term agreements and may be the key reason why the industry can survive such a change. Since most organizations are sharing in a win/win scenario, both are benefiting and working more as a team to care for the entire road asset. As a personal comment, I believe this is the ***essential*** ingredient for true success in any

long-term maintenance agreements. Since there is not one organization that can meet all the needs of maintenance, a partnering or teaming approach is needed and there is potential to efficiently serve the maintenance needs at a reduced cost to the client. When a long-term agreement is shared with other key organizations, then innovation, efficiency, and the influence of supply chain management will maximize the overall potential for the client, and eventually, the road user.

3.5 Lessons Learned

Many changes are required and many aspects need reviewing when moving toward a new direction and when considering these Performance Specified Maintenance Contracts (PSMC) or long-term maintenance contracts. It is not an easy transition, and it requires partnering and cooperation from the industry to achieve the most effective results. It is of merit to demonstrate some of the potential difficulties and so called "***lessons learned***". Some of the lessons learned in this study are:

- ***Politically and socially*** sensitive decisions (each country needs to decide)
- Cost savings to be achieved (difficult to objectively measure - 10-20% has been quoted)
- Maintenance costs have not risen despite inflation, additional traffic volume & better perceived quality
- ESSENTIAL to develop ***PARTNERING & TRUST***
- Innovation is ***MAXIMIZED*** via long-term agreements, lump sum contracts & quality-based selection criteria
- Contract duration should be a minimum of 7 years
- Perceived loss of control by the client
- Loss of flexibility by the client
- Mobilization issues need to be addressed & include financial flexibility
- Hire an independent consultant as a monitor & evaluator
- Client have clear scope (know what you really want)
- Role of the client changes - Utilizing more management skills & requiring different skills
- Transparent tendering & fair competition
- Project plan portfolio that lists future upcoming projects
- Next key paradigm - Supply chain management
- Client to determine what risks/liability you want shifted to the contractor, or what decision-making you are willing to transfer
- Develop pre-qualifications for maintenance contracting
- Provide a stipend for the losers of tenders? (each country needs to decide)
- Client needs to decide what fully integrated services are required
- Good & reliable road data is needed for tendering & strategic work (mainly for rehabilitation & resurfacing)
- Create a long term procurement strategy - Message to industry
- Work together with the industry during the process of outsourcing & developing outcome-based criteria
- Equitable risk sharing (not going too far)

- Quality usually suffers during the first year - Startup
- Client perceived minimum level of effort by contractor in some cases
- Should work together with county & city administrations
- Must have proper incentives & disincentives in contract
- Need to push the contractor at the earlier stages
- Hybrid model - lump sum 3+1+1 has some good potential, especially for mid-sized companies
- Efficiency gains through streamlined work & targeted maintenance
- Client HQ & regional office should have a common focus
- Innovations should be described in the contract and enforced
- Applying alternative treatments and innovative practices
- Duplicate inspections not needed - saves costs
- How to input future innovations into the process, such as IT developments
- Match requirements (performance criteria) with the industry knowledge
- What will the road network performance be near the end of the contract - 9-10th years?
- Partnering is more difficult for clients
- Sub-contractors were not provided long-term contracts (usually 1-3 years)
- Contractors manage complaints and road user inputs

Now different questions are being asked:

Costs of associated levels of service?	vs. What are we getting paid for?
Preventative savings over the LCC?	vs. What was the level of quality?
Maintenance intervention LCC?	vs. Did the completed work meet certain levels of service?
Owner protection against inflation & rising costs?	vs. Were the expectations of the customer met?
No longer asking what are the costs per output? (unit prices)	

3.6 Case Study – Transit New Zealand PSMC 001

This case study is intended to provide background information as an example of a presently operational innovative maintenance contract. The objective is to provide a concrete example of the process, a general project description and some of the results to date. Hopefully, this may provide additional insight into this type of long-term contract and some of the related issues and aspects.

Transit New Zealand has outsourced their road maintenance more than 10 years now, and has progressed from method-based contracts to new, recently formed Performance Specified Maintenance Contracts (PSMC), which are outcome-based. This has, however, been a gradual progression from unit prices (schedule of rates) using output-based criteria quite typical of the contracts used by many road authorities. As a further progression,

Transit New Zealand decided to venture toward the PSMC maintenance model that would hopefully improve performance and quality while generating savings. Some of the background information was derived from a model used in Australia with the New South Wales Roads & Traffic Authority.

Description of the Contract Assets

The PSMC-001 Contract is a total asset maintenance contract concerning Transit New Zealand's assets on the state highway between Hamilton (in the middle of North Island) to the Port of New Plymouth. The network traverses through the Awakino gorge, which has a high rainfall index, and which is a young volcanic region subject to "slips" and "slumps" and other areas that are subject to flooding.

The road network consists of 450 km or approximately 1000 lane km and includes the following assets:

- 132 Bridges
- Pavements
- Vegetation control
- Drainage
- Emergency response
- Sign maintenance
- Pavement rehabilitation
- Pavement resealing
- Data collection
- Travelling stock permits
- Managing community issues
- Retaining walls
- Line marking
- Litter control
- Routine maintenance

Contract Agreement and Process

- Client - Transit New Zealand
- Commenced with an expression of interest
- Short-listed
- Request for proposal
- Contractor selection criteria - Quality Price Trade Off (QPTO)
- Tender awarded - December 9, 1998
- Winning contractor – Transfield
- Project start date - January 9, 1999
- Mobilization occurred in less than a month (Contractor had good implementation plan)
- Costs - $NZ 75 million lump sum
- Contract duration - 10 years
- Contract had a mechanism to incorporate or delete assets
- Most risks were transferred to the contractor with some risks being capped (Maximum)

Maintenance Aspects

This contract is for "Fully Integrated Client Services" and it includes all aspects of maintenance. The major emphasis and expense is for maintaining the pavement at the desired outcome criteria. The contract also includes a promise to rehabilitate of 50% of the network.

New Zealand uses key performance indicators (KPI) related to most of the roads assets. Many KPIs are in the area of pavement roughness, pavement rutting, surface cracking, texture depth, skid resistance, condition of signs, reflectivity of line markings, drainage functionality, number of potholes per kilometer, response times to incidents, quantity of pavement rehabilitated, guard rail condition, edge marker post existence and alignment, and many other criteria.

Partnering was typically utilized on a monthly basis and an external facilitator was used in the process. All the parties in the partnering chapter confirmed that the contract objectives were being measured and achieved according to the stipulated criteria. Reports indicate that this was a real partnering venture that proved to be very successful.

In addition to partnering, a strategic management board was included, which was comprised of key representatives from both the client and contractor organizations (senior executives). Their meetings were more of a strategic focus that evaluated major changes or variations, financial risks, policy issues, and other major issues during the process. An example of one decision was the addition of a connecting highway with an annual maintenance value of approximately 1 million NZD. The contractor was required to provide a maintenance program and costs for the duration of the contract term. This was subsequently approved by the management board.

Results to Date

- PSMC model is proven and functional
- Initial savings were in the order of 25%, currently between 14% and 20%. Savings are predicted to return to 25% for the client.
- Financial benefits to both parties
- Distinct improvement in the quality of service
- More well trained staff due to the long-term tenure of the job - they see it as a career, not just a job.
- Very few problems/disputes due to trust and ethics - Have a high-level dispute resolution team
- Great deal of ***trust*** has been developed
- Contractor has taken ownership of the road in terms of maintenance
- Concern about the future of the small subcontractor has not been a problem, as local sub-contractors were part of the purchasing policy and have become stronger and more skilled
- Met client's expectations - Reporting and auditing were satisfactory the first two years
- Reduction in the number of "bumps" as compared to national statistics
- Skid resistance improved

- Signs improved
- Performance on drainage systems were improved
- Performance on marker posts have been improved
- Contract services are being provided by the lump sum price

Benefits

- PSMC model is proven and functional
- Initial savings were in the order of 25%, currently between 14% and 20%. Savings are predicted to return to 25% for the client.
- Distinct improvement in the quality of service
- Concern about the future of the small subcontractor has not been a problem, as local sub-contractors were part of the purchasing policy and have become stronger and more skilled
- Met client's expectations - Reporting and auditing were satisfactory the first two years
- Reduction in the number of "bumps" as compared to national statistics
- Overall road quality has improved

Disadvantages

- Contract can close competition in that network area for 10 years
- Long-term tendering process
- High tendering costs

Lessons Learned & Suggestions

- Better understanding of pavement modeling
- Utilizing meaningful Key Performance Indicators (KPI)
- Must have committed personnel
- Develop strong working relationship with all parties
- Learn how to manage risks
- Set higher-level standards
- Continuous improvement programs
- Improved understanding of the road network
- 10 years is the minimum practical term
- Price should not be the ultimate measure, but "value for money"
- Long-term contract utilizes rehabilitation for 25 year design life
- Request the contractor to model the maintenance regime for 20 years in order to demonstrate what the maintenance costs might be for terms longer that the contract period

Innovations

- Allows and encourages trials and research with pavement stabilization materials.
- Asset management systems
- Asset maintenance schedules

- Whole life costing
- Long-term performance skills
- Improved training and skills matrix

Information about the above case study has been derived from the following sources:

Transit New Zealand, Media Release, May 18,2001
Transit New Zealand, Summary of Project Evaluation Report for Transit PMSC-001
Transfield, Memo dated November 26, 2001

3.7 Suggestions & Recommendations

One of the major problems in road maintenance is the temporary or short-term solutions applied to the road network. Long-term contracts have a more comprehensive, longer-term perspective to meeting the needs and future challenges of maintaining the assets of the road infrastructure. Road authorities in the future are predicted to experience problems such as:

- Aging workforce
- Lack of expertise in the future
- Sufficient future funding to satisfactorily maintain the entire asset
- Using effective and efficient procurement methods
- Possible inflation and increases in product and material costs
- Diminishing natural resources
- How to incorporate IT innovations into the road infrastructure.

It is suggested that it is worth at least putting long-term contracts into practice via a pilot project and have the results tested by an unbiased expert/consultant. A management decision to use either the PSMC model or other long-term models could also be made.

Results from the study indicate that innovation is maximized by:

- Long-term agreements - greater than 7 years
- Partnering (both client & sub-contractors)
- Lump sum contracts
- Using quality-based contractor selection criteria
- Providing most of the sub-contractors with the same long-term agreement or at least sharing the risks/rewards
- More risks transferred to the contractor
- Ability to use innovation throughout the length of the contract

4 CONTRACTOR SELECTION METHODS

Once the project delivery method has been selected by the client and the preplanning process has been completed, there usually is some form of public announcement about the project along with a notification as part of the EU regulations (European Union countries). After the public announcement, there is usually a Request For Proposals (RFP), sometimes referred to as a Request For Tenders (RFT), which includes the type of contract and the criteria that are being utilized to determine the eventual winner of the tender. This is referred to as a “contractor selection method”, and the criteria range between 100% price to 100% “quality-based selection criteria”. A tender evaluation team arranged by the client determines the eventual winner of the contract. This process is almost the same for both capital and maintenance contracts.

When criteria other than price are considered, the evaluation process for contractor selection is usually performed using a two-envelop system, where the quality aspects of all the contenders are evaluated first and then the price envelop is opened. Usually, some type of formula is used to determine the winner of the tender. In some cases, a “blind selection process” is used where the company names are not known by the evaluation team until all the envelops are opened. The blind selection process is sometimes used to prevent any prejudice during the evaluation of quality criteria, so there is no bias from the tender evaluation members.

This topic of contractor selection methods seems to result in diverse viewpoints and contradicting perspectives. The main issue seems to be in determining the most appropriate measuring standard when evaluating the non-price criteria. However, there are common aspects that most all organizations agree upon when discussing the contractor selection method. When these aspects are defined and clearly practiced, then even the non-winners of the tender are somewhat satisfied or assured that they were treated properly. These common issues are summarized as:

- Clearly defined client scope
- Transparent tendering
- Fair competition

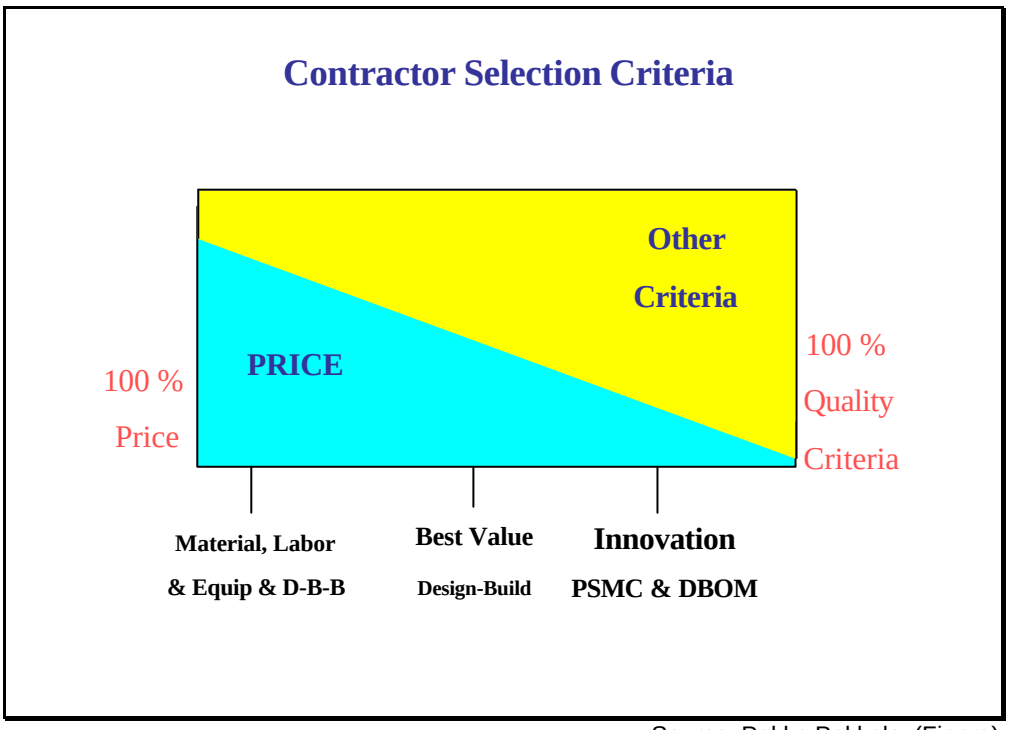
Some of the common forms of contractor selection methods used are:

- Low bid or lowest price
- Lowest price conforming tender (lowest price which meets certain pass/fail criteria)
- Weighted Average (WA - Formula for weighting price and non-price criteria)
- Quality Price Trade Off (QPTO - A trade off system for providing quality)
- Negotiated (Both parties negotiate until a satisfactory price is agreed upon - small projects)

4.1 Comparison of Most Innovative Contractor Selection Methods

Figure 8 shows the range of possibilities for "contractor selection criteria". In addition, some of the most common project delivery methods are shown at the bottom to represent some typical practices. It is easy to realize that the easiest and simplest method of choice would be the low bid process (100% price criteria). Because it is quantitatively measured, it is objective, unbiased and not contestable.

The main goal of this study was to determine which methods and practices introduce innovation into the process, and simply relying on a low price is not inducive to creating innovation and savings in the long-term perspective. Almost all agreed that the low-bid process does not accomplish this. Typically, consultants and designers are selected via quality-based criteria (usually 100% Quality), after which the price is usually negotiated. This is typical practice with most countries when procuring design/engineering experts.



Source: Pekka Pakkala (Finnra)

FIGURE 8 Contractor Selection Criteria Possibilities

The process is different, however, when selecting a contractor to complete the project and provide services, products, actual construction, and other requirements. Other than the low-bid method, most clients usually desire some elements of quality and technical criteria when taking on projects. There must be some declared aspects of quality (not only quality standards) in the tender to assure that the client receives a good product for a fair price. Since road projects are used by the general public, there should be some

demand for quality and reliability. Some of the more common quality criteria are:

- Technical skills
- Personal skills (resources)
- Management team
- Supply chain management
- Methodology
- Environmental criteria
- Relevant experience
- Past performance

Some of the quality criteria can be clearly identified as relevant and important, but the difficulty arises when evaluating these aspects, because some of them are personal skills and not totally objective criteria. Also important is the aspect that people create innovation, and choosing the best qualified people also increases the potential for innovation in the project. In a related "Finnish study" on the same topic, one of the most important reasons for success or failure in a project was the "Project Manager" from both the client's and contractor's organization. Another important result from the same study revealed that client organizations had difficulty in separating these quality criteria "points" and making them significantly different so that one organization was clearly superior than the competing companies. Most countries in this study also realized the same difficulty, that clients did not provide a substantial differential in the quality criteria "points", and most contractors were basically considered as being similar. It is unclear if this is due to the fear of contesting the contract and possibly requiring litigation to resolve the matter, or was it too difficult to measure these so-called subjective criteria. In any case, the weighting of these different factors should be appropriately defined and measured as objectively as possible for them to be effective. Most countries weighted each factor differently and also had a different proportion for the percentage of quality criteria versus the price. In order to reward quality aspects, they should be weighted to appropriate levels that make a distinguishable difference. Therefore, in order to improve innovation and have the best qualified organization provide the maintenance activities, appropriate percentages for the quality aspects should be considered. Since each country varies in their cultural and industrial aspects, they need to make decisions that reflect their own culture. It is quite safe and practical to say that a minimum of at least 30% "quality-based selection criteria" could be considered.

It should also be noted that there may be a potential for "*underbidding*" in these long-term contracts, which could possibly cause a default if a contractor does not correctly price all the aspects and future aspects of resurfacing and rehabilitation (road failure or subsurface deterioration). Therefore, consideration and emphasis should be placed on the contractor best suited to continue through the duration of the contract.

Methodology is a more clear determining factor, and it can determine what innovation or lack of innovation is being planned for the project. Typically, all countries valued the importance of methodology criteria and they were generally weighted as the highest criteria. In general, if quality and best suited organization to perform the construction portion are desired, it is

recommendable to include quality criteria as a substantial proportion of the weighting criteria.

Typically, Design-Build projects utilize a weighted average and can vary from project to project and country to country, but a typical value encountered is about 50% price based and 50% quality based.

A full delivery system probably utilizes the best qualified (mostly near the 100% quality criteria) team or consortium and then arranges a pricing mechanism (target price) that is fair and rewarding. It should be emphasized that time is the main driver in the full delivery method and everyone involved must understand and work toward this goal.

4.2 Advantages & Disadvantages of Contractor Selection Methods

It is wide practice that the Design-Bid-Build (D-B-B) project delivery method uses the low-bid contractor selection method, whereas most other project delivery methods use quality-based criteria with elements of price included. Table 9 shows some of the benefits and problems associated with each project delivery method when incorporating price and quality aspects.

	DELIVERY METHOD	ADVANTAGES	DISADVANTAGES
PRICE BASED	D-B-B CM Design-Build (Rare)	• Easily Administered • Widely Used & Accepted • Clear & Objective Selection Process	• Lack of Innovation • Tendency For Change Orders & Cost Overruns • Tendency For Mediocre Quality
QUALITY BASED ASPECTS	CM Design-Build DBOM DBFO FD or PM	• Quality Potential • Potential For Innovation • Best Qualified Organization • Better People Skills • Best Methodology Potential • Potential For Project Success	• Some Criteria is Subjective • Requires More Effort & Skill For Tender Evaluation Team

TABLE 9 Advantages & Disadvantages of Price Versus Quality Features

Several other contractor selection methods are in use or under development in other countries, and some have experimented with various types of innovative processes. It is not possible to list them all or to research all the possibilities, but there are a few that are worthy of note, especially to minimize road user impacts. Some of the most promising are listed in Table 10.

	DESCRPTION	POTENTIAL BENEFITS
Cost Plus Time Bidding **A + B + Quality (USA)**	• "A" portion is the total cost for completion of project • "B" portion is the total number of days to complete the project • B is multiplied via the given estimated cost per day (client supplied statistical data) • The "B" cost is deducted from the A portion to determine the value and contract awarded to the lowest price • Optional Use of Incentives & Disincentives • Optional Use of Quality is the warranty aspects	• Minimize delivery time • Reduce road user impacts on highly congested roads • Usually has cost savings • Better quality when included in agreement
Lane Rental (USA)	• A fee is assessed for occupying lanes or shoulders. • Rates are specified in the contract • Deducted from monthly payments when contractor occupies or obstructs lanes • Some alternates is to include the lane rental as part of the bid and determine the low bid via the A+B method the work.	• In areas of high traffic volume, it motivates contractors to minimize road user impacts or delays during construction. • Results have seen reduced cost to the client
Incentives & Disincentives (USA)	• Provision to reward or penalizes a contractor for early completion • Compensation is based upon a fixed amount per day for completing ahead of schedule • Penalty is incurred for each day that the project is delayed	• Complete projects on time or ahead of schedule • Traffic delays & congestion are minimized
Design-Build (Low Bid) **(2 step process with short listing via Pre-Qualifications**	• Using Pre-Qualification process to determine the preferred tenders (Quality) • Selecting the award to the lowest price	• Provides an alternative option for client • Easier to Administer • Reduces Tendering Costs • Objective criteria in step 2

TABLE 10 Other Alternative Contractor Selection Methods

5 CONTRACT TYPE

Capital Projects

Almost all clients have some form of general contract associated with capital projects which stipulates most of the requirements, including the contract type. There are not too many variations of the contract type, but there are a few differences and some favor one method over another. Table 11 shows the different types of contracts and some of their general benefits and disadvantages.

	PROJECT METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Lump Sum (Fixed Price)	**D-B-B**	A single stipulated sum of payment for the agreement of goods and services. (Does not include change orders by client)	• Contractors generally prefer • Efficient & effective contractors have better profit margins • Client knows price other than changes • Competitive environment • Reliable market price • Potential for innovation when used with alternative delivery methods	• Costs might exceed designers estimate • Potential for claims
Unit Price	**D-B-B**	A payment system made in terms of costs per specified unit. (Sometimes used in combination with Lump Sum contracts)	• Good when quantities are unknown • Generally have lower prices	• Can complicate the bidding process • May cause higher bids
Guaranteed Maximum Price (GMP)	**D-B, DBOM, CM, & DBFO**	This is the maximum price paid for goods and services. Usually used in D-B and CM methods.	• Client knows budget • Any savings can be shared	• May result in higher costs, unless savings are shared
Cost Plus a Fixed Fee	**CM**	Contractor is paid for all actual costs plus an agreed upon fee. (Also Can be capped to GMP)	• Contractor guaranteed a fixed profit & overhead • Good for projects that have uncertain criteria	• No incentive for innovation & cost saving measures • No Risks shared

TABLE 11 Typical Contract Types

Most contractors rely on the client's requirements and the type of contract stipulated in the general contract. For most Design-Bid-Build projects, the lump sum seems to be the more relevant, while Design-Build typically incorporates a Guaranteed Maximum Price (GMP). As mentioned in the contractor selection method, incentives are sometimes added to the contract for the purpose of faster delivery or to reduce the effects of road user delays. Unit prices are rarely used in most capital projects, but there are times when there are undefined aspects of a project. When undefined aspects are tendered they can be incorporated as unit prices, and the client (with the contractor) determines the appropriate quantity.

Maintenance Contracts

For the most innovative long-term maintenance contracts, it appears almost unanimous that the "Lump Sum" contract is the best and most commonly practiced in long-term maintenance contracts. A unit price contract will most likely provide lower costs, but innovation, best applied quality materials, and consideration of the whole pavement life may not be realized. As a final thought, it seems only wise to recommend the "Lump Sum" for long-term maintenance contracts.

6 QUALITY

Capital Projects

Quality is an important aspect in contracts and it is imperative to stipulate quality assurance and quality control measures in new construction projects. It is typically the function of the client to develop the quality assurance requirements and the contractor to provide the quality control measures.

It is not practical in this study to explain the different quality requirements of each country. However, it is important to acknowledge that all countries have quality systems and practices in place for both capital and maintenance procurement. How each country approaches quality varies, and it depends mostly on the accepted development and practices. The quality requirements in a given contract may include some of the following:

- ISO 9000
- Road authorities' quality standards, depending on the complexity of the project
- Contractor quality plan
- Quality organization/management plan
- Quality control & inspection
- Subcontractor quality control
- Certification & reporting requirements
- Standards & product requirements
- Warranties
- Performance-related specifications
- Optimum inspection levels

It should be noted that AASHTO and AUSTROADS have quality requirements that are followed in several countries and are quite respectable. Even the European Union (EU) has standards that need to be followed.

Maintenance Contracts

Quality in maintenance contracts is also an important aspect and it is imperative to stipulate quality assurance and quality control measures in maintenance contracts. Maintenance contracts also have differing quality requirements for different levels of service and for each class of activities. It is typically the function of the client to develop the quality assurance requirements and the contractor to provide the quality control measures. The quality requirements in a given maintenance contract may include some of the following:

- ISO 9000
- Road authorities' quality standards, depending on the complexity of the project
- Contractor quality plan
- Quality organization/management plan
- Quality control & inspection

- Subcontractor quality control
- Certification & reporting requirements

If outcome type criteria are utilized, then some of the quality aspects are determined by the level set for these end result criteria. For example, when the client specifies the roughness aspects, the quality of the road is set by the limit or average level. Therefore, the quality criteria can be set by appropriate outcome-based criteria measurements.

7 ENVIRONMENTAL ISSUES

Environmental consequences and issues are becoming more and more important in the transport sector, not only from the material perspective and existing land perspective, but also during the construction process of new roads. Environmental regulations are typically part of the requirements in most contracts of capital investment projects, and environmental impact and assessment studies are performed and analyzed. Each country has some form of environmental requirements, regulations, and restrictions that must be adhered to. The European Union (EU) countries have common legislation and regulations through the EU process.

During the course of the study there were no significantly new environmental methods, processes, or innovations. Most of the environmental criteria are incorporated in the standards and other portions of the general requirements, etc. The most innovative result that was noted was an example of utilizing local products and material suppliers, which reduces some of the environmental burden.

Maintenance aspects that are included in the environmental issues mostly concern the type of materials and products used:

- Hazardous fuels and oils (includes storage)
- Pesticides or similar vegetation products
- Salt usage for winter maintenance that may effect ground water contamination
- Salt storage
- Hazardous storage of products, etc.

All countries are aware of the fact that the emissions and other environmental consequences from actual maintenance activities are concerns, but so are safety and traffic issues.

Finland along with some EU countries is developing tools for analyzing the consequences of environmental criteria. This is probably one of the most innovative concepts. It is probable that environmental criteria will become more and more important and maybe part of the tendering criteria.

A good, noteworthy resource or reference for environmental and life cycle considerations was published by the IVL Swedish Environmental Research Institute Ltd. The title of the document is “Life Cycle Inventory of Asphalt Pavements.”

8 CONCLUSIONS

Capital Projects

Project delivery methods can be considered as tools for a client organization when deciding to initiate a project. The type of project, client expectations, and many other criteria are inputs into the process the client decides to utilize when selecting a project delivery method. Also, as part of a client procurement strategy it would be wise to consider a healthy mix of project types for flexibility, maintaining competition, and project duration.

More and more countries appear to be increasing the use of Design-Build in their new construction projects and also seeking some type of innovation. Some of the more innovative capital project methods are:

- Design-Build (DB)
- Design-Build Operate Maintain (DBOM)
- Design-Build Finance Operate (DBFO)
- Build Own Operate (BOT) & Build Own Operate Transfer (BOOT)
- Full Delivery or Program Management

The contractor selection method should also include some form of “quality-based selection criteria” in order to have a quality contractor perform the construction services and products. Other innovative considerations for minimizing road user impacts are:

- Multi-parameter bidding known as A+B and A+B & Quality (warranty)
- Lane rental
- Incentives & disincentives

It should be noted that it is essential that the tendering process is fair, transparent, and the client has developed a clear scope for the project. Other innovative concepts that can be used in the capital projects include:

- Partnering
- Constructability reviews
- Value engineering
- Performance & outcome-based criteria

Maintenance Contracts

More and more clients are outsourcing maintenance to private industry, and several innovative practices are being used in several countries. Based on the studies of this project, more and more countries appear to be practicing some form of long-term maintenance contracts. The most innovative include the following parameters:

- Long-term agreements - greater than 7 years
- Partnering (both client & sub-contractors)
- Lump sum contracts

- Using quality-based contractor selection criteria
- Provide some of the sub-contractors with the same long-term agreement or at least sharing the risks/rewards
- Utilizing outcome-based criteria
- Ability to use innovation throughout the length of the contract
- A new method that is under consideration in England is the called the "Privately Financed Managing Agent Contractor" (PFMAC)

It should be mentioned that changing from an in-house organization to a client-based organization usually requires a significant cultural change and is not a simple process. It requires an industry-wide cooperative effort, partnering and trust, and bold champions in the decision-making process in order to achieve successful long-term maintenance contracts. It also means the client needs to develop new, appropriate contracting systems that can be used in the public delivery process.

There are several benefits in these long-term contracts, and some of the advantages are listed below:

- Cost savings
- Fully integrated client services
- Transferring risks
- Innovation potential
- Better asset management
- Easier budgeting
- Better level of service
- Partnering potential

Not only are there advantages, but also disadvantages. The disadvantages that also need to be considered when considering these long-term maintenance contracts are mentioned below:

- Costly tendering for PSMC (when using rehabilitation & resurfacing in the contract)
- Longer tendering period for PSMC (when using rehabilitation & resurfacing in the contract)
- Reduction of competition (social justice), usually for large contractors
- Client role changes (loss of experts and know-how)?
- Uncertainty of long-term relationships
- Mobilization issues need to be addressed
- Specifying inappropriate outcome criteria
- Loss of control and applying changes in mid-term

9 INNOVATION SUMMARY

Innovation is simply defined as the introduction of something new, or an act or process for new ideas, methods, or devices. In actual practice this means new products, processes or methods. The intention of this study/project was to seek out new and better ways to procure infrastructure and to determine which procurement methods promote or simply encourage innovative solutions. The intent was to seek modes in which new practices, processes, and products would have incentives and propagate innovation.

However, it was discovered that other parameters, such as partnering, trust, cultural issues or political decisions, privatization, organizational structures, and social justice, have significant input as either incentives or disincentives for innovation. Originally, the main objective was to seek innovative ideas in three main areas of a project delivery process. Also, more effort was placed on “Maintenance Contracts” because of the priority strategy given to maintenance in the existing road network. The three main areas included in the study are listed below:

- Procurement delivery methods
- Type of contract
- Contractor selections methods

It was somewhat of a surprise or discovery that the manner in which a client orders procurement methods can have a significant impact on innovation. Even cost savings can be considered as an innovation because costs are reduced via changes (something new) in the delivery process or by utilizing different practices. The process can either stimulate and advance innovation, or it can suppress innovation. Hopefully, it is the desire of the client to encourage and provide mechanisms that promote and maximize the potential for innovation. This can be realized by using the most appropriate procurement method that would encourage and advance innovation.

The prior sections discussed this in more detail and explained some of the benefits and disadvantages. In reality it does not mean that innovation is the main reason for securing a project, but rather that it allows innovative efforts and products through the completion of the project or maintenance activity. In addition, providing financial flexibility (flexible payment structure), especially for long-term maintenance contracts, can provide incentives for innovation and reduce problematic issues during mobility phases in the network area. Another simple consideration that is not necessarily a great innovation is simply to have a project plan portfolio that lists upcoming projects for the next several years.

Capital Project Delivery Methods

To the best of my knowledge, there are no really new procurement methods for capital projects for road projects, only existing methods (those used in the past) that have been utilized and refined. Some of the more innovative delivery methods that were demonstrated include:

- Design-Build (DB)
- Design-Build Operate Maintain (DBOM)
- Design-Build Finance Operate (DBFO)
- Build Own Operate (BOT) & Build Own Operate Transfer (BOOT)
- Full Delivery or Program Management

It is interesting to note that in the USA during the late 1790s and early 1930s, Design-Build Operate Maintain (DBOM) and Design-Build Finance Operate (DBFO) were the main delivery methods used to create some of the roots of infrastructure development in the USA. Refer to Table 2, which shows these past methods.

Even Construction Management At-Risk (CM At-Risk) can be seen as having potential in road projects and can be somewhat innovative. However, there are not many practical results (not known) to justify making a more definitive statement.

It was expected, or at least hoped, that there would be some real breakthrough, state-of-the-art type pavement or product innovations, but such were not encountered in this study. Most of the materials and processes that are used today have been in existence for many years, and the way pavements are basically constructed and repaired have not changed dramatically. Of course, there has been some progress, but the expectations were greater in light of the amount of investment in research and development over the years. It should be noted that there have been many safety and traffic-related innovations. It is expected that IT developments will be the next step for major innovations.

As far as the contract type is concerned, a “Lump Sum” or fixed price seem to be more favored than a unit price system.

Regarding “Contractor Selection Methods”, there were several parameters or practices that can be considered innovative, and it depends on what the main drivers are for each project. Some of these methods that are worthy of note are:

- More emphasis on quality criteria than price considerations. This is a general statement, but evaluation criteria are needed to measure the more important aspects such as methodology, past performance, project management expertise and quality promises
- A+B and A+B & Quality (warranty) – the USA utilizes these where the main issue is time for project completion and less effects on road closures, road user satisfaction, and warranty
- Lane rental method – the USA utilizes these; each contractor pays for occupying the existing roads and the emphasis again is on project completion and less effects on road closures and road user satisfaction

- Incentives & disincentives - an approach that provides incentives for innovation and a penalty if criteria are not met
- Quality Price Trade Off (QPTO) allows for quality consideration in the price

It should be noted that it is essential that the tendering process is fair, transparent, and the client has developed a clear scope for the project. Sometimes the client does not really know what they want, which can cause difficulties during the project.

Other innovative concepts include:

- Partnering
- Constructability reviews
- Value engineering
- Performance & outcome-based criteria

Maintenance Contracts

Maintenance contracts are seen as the new paradigm in which many of the maintenance activities are being outsourced to the private sector in many countries. Some aspects of maintenance were outsourced earlier, especially distinctive type items, but now changes have occurred and maintenance is moving in the direction of “Fully Integrated Client Services”, in which most services and products are procured under one contract. This is very interesting because it is creating different market opportunities and a possibility for new companies/existing companies to be formed, merged, and maybe displaced. This is the fear of mid-sized companies, but partnering and alliance concepts can allow them to continue to retain their specialty.

There are now newly-created maintenance contracts, including a special type called Performance Specified Maintenance Contracts (PSMC), that have integrated almost all the maintenance activities and procured them for a specified length of time. Some use the term “Long-Term Maintenance Contracts” as a general term, but there is an implicit difference in that PSMC utilize outcome-based criteria. Long-Term Maintenance Contracts are quite new to many road administrations, and the length of the contract varies from country to country. Some countries have utilized Long-Term Maintenance Contracts for over 10 years, and they are perceived to be the innovators in perfecting these methods and PSMC type contracts.

Results from the study indicated that innovation is maximized via:

- Long-term agreements - greater than 7 years
- Partnering (both client & sub-contractors)
- Lump sum contracts
- Using quality-based contractor selection criteria
- Provide most of the sub-contractors with same long-term agreement or at least sharing the risks/rewards
- More risks transferred to the contractor
- Ability to use innovation throughout the length of the contract

There are also innovations in the processes or in the efficiency/effectiveness of maintaining the network area which are resulting in cost savings. There have been some examples of innovative equipment, materials and technical efficiencies. Some of the innovations noted are listed below:

- New patching material
- New pot hole repair equipment
- Thermoplastic line painting
- Project management systems
- Pavement Managing Systems
- Technical efficiency in maintenance activities
- Performing activities correctly the first time
- Allows and encourages trials and research with pavement stabilization materials.
- Asset management systems
- Asset maintenance schedules
- Whole life costing
- Long-term performance skills
- Improved training and skills matrix
- Continually refining/improving the tendering process

A new and innovative method which is being considered in England is called a “Privately Financed Managing Agent Contractor” (PFMAC), which introduces private financing into the maintenance process. There are greater risks transferred, longer-term contracts of 15-30 years, and mechanisms similar to the DBFO model in capital projects. This has not been tested to date, but it is worth following up and determining the feasibility of this type of model for long-term maintenance contracts. This is quite innovative and it will be interesting to see if England can make this model a reality.

10 SUGGESTIONS TO PROMOTE INNOVATION IN THE INFRA SECTOR

Capital Projects

The Tekes INFRA National Technology Program was created to propagate innovation into the infrastructure sector. In the course of this study, it was determined that innovation can be enhanced or suppressed by both client and contractor processes and organizations. What this means is that client organizations can provide a mechanism that potentially increases the opportunity for innovation, or simply continue the existing method, which is a gradual process. Likewise, contractors can then place these innovations more rapidly into practice because of more flexibility, as compared to traditional methods. The contractor also has the option of not using an innovation. It should be realized that contractors do not strictly utilize innovation for the motivation of innovation in itself or provide the client with a better product unless there is some reward or incentive. For example, if a new innovation allows the contractor to save time during the construction process, it benefits both the contractor through cost savings and the client by having the project completed faster.

The methods and processes that are most suitable for ***maximizing*** the potential for innovation in this study are:

- Design-Build (DB)
- Design-Build Operate Maintain (DBOM)
- Design-Build Finance Operate (DBFO)
- Full Delivery or Program Management
- Partnering
- Constructability Reviews
- Value Engineering
- Performance & Outcome-Based Criteria
- Incentives & Disincentive
- Multi-parameter bidding known as A+B and A+B & Quality (warranty)
- Lane Rental

These methods provide the potential for innovation, but they are not automatic. When a healthy atmosphere of trust and partnering is created, there is reasonable potential for an increase in innovation. Since most innovations are produced from the “bottom up”, the contractors’ and sub-contractors’ partnering efforts are an essential part of the process.

Maintenance Contracts

The maintenance contract methods and practices that provide the most potential for innovation are:

- Long-term agreements - greater than 7 years
- Partnering (both client & sub-contractors)
- Lump sum contracts
- Using quality-based contractor selection criteria
- Provide most of the sub-contractors with the same long-term agreement or at least sharing the risks/rewards
- Utilizing outcome-based criteria
- Ability to use innovation throughout the length of the contract
- Incentives & disincentives

Since innovation at times results in higher initial cost, it can be introduced into the process and amortized through the length of the long-term contract. Normally, it may not be applied because of the extra costs, and because the contractor may not be able to recoup these costs in a traditional process. Therefore, the innovative process is maximized mostly via long-term contracts.

Also, most of the innovations discovered under these contracts were primarily innovations in the processes or in the efficiency/effectiveness of maintaining the network area. In some cases there were examples of innovative equipment, materials and technical efficiencies. Some of the innovations are noted below:

- New patching material
- New pot hole repair equipment
- Thermoplastic line painting
- Project management systems
- Pavement managing systems
- Technical efficiency in maintenance activities

It was initially pondered during meetings with many of the participating organizations whether innovation criteria could be added into the contract to possibly promote innovation. However, there was a great deal of opposition and uncertainty over whether it would be an effective tool. Some contractors might expose their innovation in the tendering process and then may not be awarded the contract. Also, it could be difficult to measure and difficult to enforce. Therefore, adding innovation into the contract was not a widely accepted approach or practice.

In summary, if innovative potential is desired for the entire infrastructure sector and to make innovation occur more rapidly, these innovative methods should be considered to transform the infrastructure industry. Not only is innovation enhanced, but cost savings and value-added services are realized.

11 POSSIBLE FUTURE DEVELOPMENTS FOR FINLAND

Capital Projects

If it is desired and decided to seek innovative methods and practices, then there are several aspects that could be developed in Finland. Some of these so-called alternative or innovative practices are easier to implement than others, and it mainly depends on which methods or practices are to be implemented. From the capital projects perspective, some of the following practices could be considered as development possibilities:

- Make Design-Build more productive and flexible (less focus on strict methods & over-design)
- Develop the Design-Build Operate Maintain (DBOM) method
- Use the Design-Build Finance Operate (DBFO) method when permissible
- Create a pilot project for the Full Delivery or Program Management method
- Partnering
- Constructability reviews
- Value engineering
- Developing performance & outcome-based criteria
- Incentives & disincentives
- Consider multi-parameter bidding where appropriate: A+B and A+B & Quality (warranty)
- Consider lane rental where appropriate

Maintenance Contracts

Maintenance developments are probably more easily introduced because these activities need to be performed on a routine basis and there is a continuous search for better practices and refinements. As mentioned above, it depends mostly upon which aspects are desired and which parameters are more strategic. Some of the following items could be considered as development possibilities:

- Long-term agreements - greater than 7 years
- Partnering (both client & sub-contractors)
- Develop outcome-based criteria & performance specifications
- Pilot project using PSMC type model
- Developing objective quality-based contractor selection criteria
- Pre-qualification system
- Mobilization criteria & financial flexibility
- Develop a procurement strategy
- Continue with asset management
- Develop a proper mix of procurement models (keep the industry competitive & social justice)

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http://www.austroads.com.au/austroads/default.html

ARRB Transport Research WWW Site (Home Page) http://www.arrb.org.au/

Department of Transport And Regional Services - Australia WWW Site (Home Page) http://www.dotrs.gov.au/

Main Roads Western Australia WWW Site (Home Page)
http://www.mainroads.wa.gov.au/

VIC Roads - Australia WWW Site (Home Page)
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http://www.transport.tas.gov.au/about/

Roads and Traffic Authority (NSW) - Australia WWW Site (Home Page)
http://www.rta.nsw.gov.au/

Ontario Ministry of Transportation WWW Site (Home Page)
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Federal Highway Administration WWW Site (Home Page)
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13 APPENDIXES

APPENDIX A - AUSTRALIA

Road Network

Australia has diverse cultures and a mixed population of around 19 million inhabitants. The country is approximately the size of the United States, but it has only about 3 people per square kilometer or 23 people per kilometer. Eighty five percent of the population resides in urban areas and 39% is located in Sydney and Melbourne. Due to its vast size, the entire road network of Australia has approximately 810,000 kilometers of roads. See Table A-1 for details on the road length in each territory.

Road Type	NSW	VIC	QLD	WA	SA	Tas	NT	ACT	Total
National Highway	3,010	1,010	4,190	4,647	2,752	320	2,670	20	18,400
Rural Arterial	29,489	18,060	19,588	12,241	8,625	2,543	3,992	255	94,793
Urban Arterial	4,181	3,180	1,524	1,588	929	369	160	510	12,441
Rural Local	123,516	106,100	139,269	117,815	76,846	12,940	14,403	25	600,914
Urban Local	21,103	26,400	14,814	10,469	7,431	1,728	59	1,830	84,834
Total All Roads	181,299	154,750	179,385	146,760	96,584	18,901	31,284	2,640	811,603

Source: Road Facts 2000 (Austroads)

TABLE A-1 Road Length Via Territory (km)

Road Organization

The hierarchy of road management has 3 layers: the Federal Government, the territories or states, and the local government. The Federal Government manages about 18,500 kilometers (National Highways, Roads of National Importance, selected black spots - high traffic volumes) with an annual budget of approximately $AUS 710 million. The remaining roads are the responsibility of the territorial and local authorities, accounting for an annual investment of approximately $AUS 6.3 billion. The federal government provides untied grants to the state and local governments for road development and upkeep. The entire road infrastructure is valued at $AUS 100 billion.

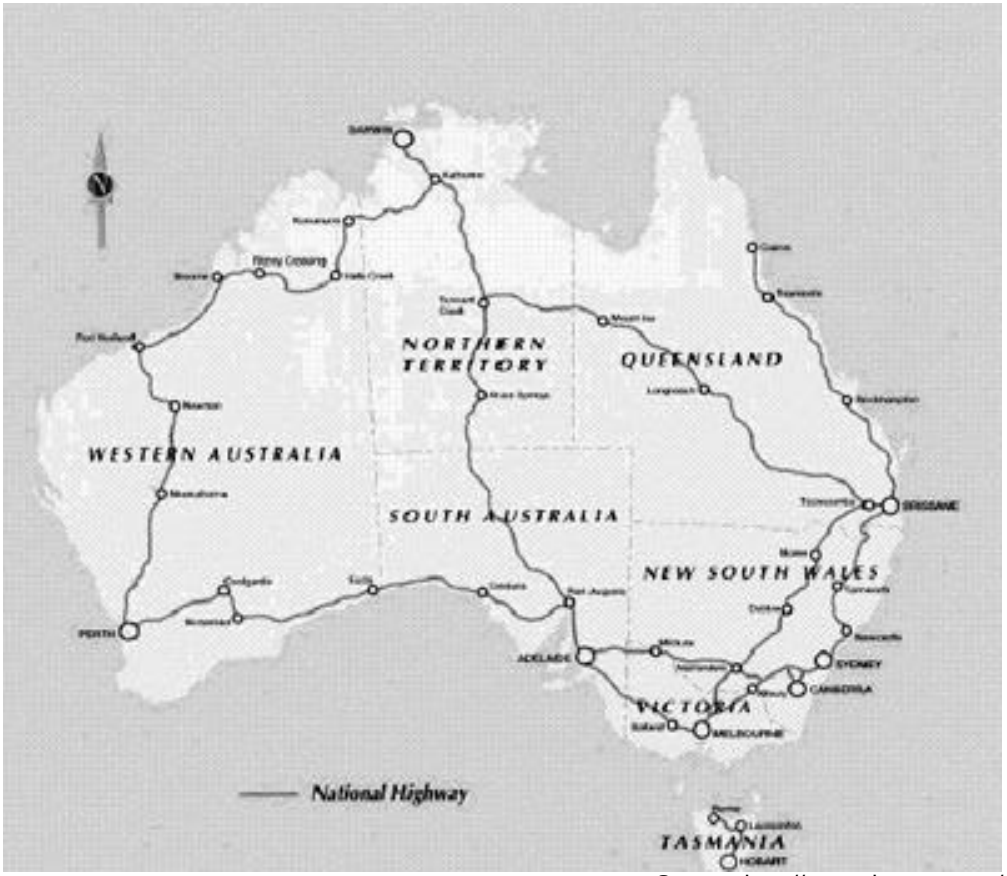
Australia's road administration is totally different from that of New Zealand. Each state or territory of Australia is autonomous (self governing) and provides road management via its individual policy and practices. It is highly political and depends upon territorial and local issues. Each territory receives co-shared funding from the federal government, which is quite similar to the USA system. In November 2000, the Federal Government announced it

would provide an extra $AUS 1.2 billion over four years to the local councils under the Roads to Recovery Program.

Since the climate and land terrain is so diverse and many areas are not inhabited, 40% of the roads have sealed surfaces, usually bitumen or concrete. Another 40% have a gravel or other improved surface and 20% are some form of built or cleared roads. The distances are great between the north and south, and the east and west territories. In addition, there are about 33,000 bridges.

The state road administrations or territories vary, depending on cultural and local interests. Australia's eight independent states and the national road network are shown on the map in figure A-1. The territories are listed below:

New South Wales (NSW)
Victoria (VIC)
Queensland (QLD)
Western Australia (WA)
Southern Australia (SA)
Tasmania (Tas)
Northern Territories (NT)
Australian Capital Territory (ACT)



Source: http://www.dotrs.gov.au/

FIGURE A-1 Map of Australia

It is difficult to characterize the entire country of Australia and not practical to analyze and explain the differences in each state territory. Just as the USA has many states, the practices vary accordingly. A good resource for an overview is the Austroads Publication “Road Maintenance By Contract: what are the risks and benefits”.

Australian territories incorporate a wide range of client type organizations, with some totally in-house and some a type of hybrid concept, and outsourcing contractor arrangements. A summary of the practices in each territory is shown in Table A-2.

Capital Project Delivery Methods

Capital investment projects are procured with almost all models, depending on the territory in Australia. Each project is handled as a separate case and the client determines the delivery system used. Contractor selection methods vary from low bid to weighted average, and contracts may be lump sum, schedule of rates, cost plus fee, or costs reimbursable.

TERRITORY	IN-HOUSE OR OUTSOURCED	TYPICAL CONTRACT	LONG-TERM CONTRACTS
New South Wales (NSW)	Both	Schedule of Rates & Labor Rates	Yes
Victoria (VIC)	Both	Schedule of Rates	No
Queensland (QLD)	Mostly In-House	Schedule of Rates & Labor Rates	No
Western Australia (WA)	Outsourced	Lump Sum	No
Southern Australia (SA)	Both	Schedule of Rates & Labor Rates & Lump Sum	No
Tasmania (Tas)	Outsourced	Schedule of Rates & Lump Sum	Yes
Northern Territories (NT)	Outsourced	Schedule of Rates	No
Australian Capital Territory (ACT)	Both	Schedule of Rates	No

Source: Maintenance by Contract – ARRB Transport Research

TABLE A-2 Maintenance Structure & Contracting Arrangements

Maintenance Contracts

Maintenance contracts also vary from territory to territory, with the most innovative being the long-term contracts in Western Australia, Sydney, and Tasmania. Neither Tasmania or Western Australia have any in-house maintenance workers, while Sydney still maintains its own workforce. Table A-3 shows most of the information concerning the type of contract, contractor selection criteria and the method of delivery. Because of its internal staff and own experts, only the RTA Sidney long-term maintenance contract does not include consultant type assistance.

	Type of Contract	Contract Duration	Contract Method	Contractor Selection Criteria	Activities Included
RTA, NSW	Outcome-Based	10 Years	Lump Sum	80% Price 20% Other	All
Tasmania (Southern Region)	Outcome-Based	10 Years	Lump Sum	50% Price 50% Other	All
Western Australia	Outcome-Based	10 Years	Lump Sum	40% Price 60% Other	All

TABLE A-3 Long-term Maintenance Contracts Used in Australia

Benefits & Disadvantages

Benefits:

- Clients receive cost savings ranging from 10-35%
- Knowledge of the network data and conditions significantly improved (right to monitor)
- Innovation is maximized through longer maintenance contracts
- Partnering and teaming efforts were realized & effective (Utilizes a viewpoint that partnering and teaming were more important than what the legal documents said)
- Better management of the network & targeted maintenance - cost effective solutions
- Applying alternative treatments and innovative practices
- Network contractors can provide cost savings for other improvements in the network
- Emergency response improvements by contractors
- Client has been able to transfer many risks to the contractor
- Duplicate inspections not needed - saves costs
- Realized improvements in gravel roads by maintaining a greater thickness in the top layer

Disadvantages:

- Politics play an important role in which systems will be adopted (Social pressures)
- Most long-term projects were 1st time efforts and problems were noted in defining proper performance criteria and how to tender the project properly
- Road data that contractors are bidding on is not 100% reliable (Predicting performance on data)
- Uncertainty of long term relationships
- Difficulty during the tender process with placing a price on innovation
- How to input future innovations, such as IT developments, into the process
- Targeted maintenance - not always what the client was normally used to achieving
- Too much duplicate inspection in some projects, if Client mandates
- Perceived loss of control
- Some political & social consequences were noted in rural areas
- Role of the client changes - utilizing more management type skills
- Some loss of quality in the first few years, due to startup learning and developing the network
- Client perceived minimum level of effort by Contractor in some cases
- Contractor layers results in chain of command inefficiencies

APPENDIX B - CANADA

Road Network

Three provinces in Canada were included in this study: Alberta, British Columbia and Ontario. The road network in each province is shown in Table B-1.

Province	Network Areas	Road Length	Year Totally Outsourced
Alberta, Canada	30	15 000 km New – Additional 15 000 local km	1997
British Columbia, Canada	28	42 000 km	1988
Ontario, Canada	41	16 500 km	1996

TABLE B-1 Canadian Road Lengths Via Territory

Road Organization

All of these Canadian provinces are required to secure their own funding, because there is no centralized federal allocation of funding. Therefore, each province needs to fund and manage its own road network. Each province is quite decentralized and utilizes regional offices to manage day-to-day operations. Due to changes in the government process, these territories were required to outsource maintenance activities to the private sector in the year shown in Table B-1. This means the road administration needs to procure services and products for both capital and maintenance projects.

Capital Projects

For the most part these territories utilize the same traditional Design-Bid-Build project delivery method for roads. Only the Toronto 407 ETR utilized a combination of Design-Build and Design-Build-Maintain-Operate as the most innovative project.

Delivery Method	Contractor Selection Methods	Contract Type
D-B-B	Low Bid	Lump Sum

Maintenance Contracts

Ontario, Canada

Ontario province has outsourced maintenance since December 1996, and it uses quite a different approach compared to the other provinces and countries. They have two scenarios for maintenance, which are:

- Area Maintenance Contracts (AMC)
- Maintenance Outsourced (MO)

The strategy was to outsource via AMC if cost savings could be demonstrated. Otherwise, they would outsource via Maintenance Outsourced using the traditional process. The AMC were for 3 years with a possible 2-year extension, and they usually incorporated 3-4 areas of 300-500 km length roads. These 3-4 areas could be bid on separately or as any combination, or all the areas could be included in one bid package. Resurfacing and rehabilitation are still performed under capital projects.

The contractor selection method for all contracts is based on 90% price and 10% other criteria, and they are administered by the central administration, not the regional offices. These contracts are based on a Lump Sum contract.

Recently, a new round of AMC has increased the duration to 8 years (5+3).

Alberta, Canada

Alberta province has been outsourcing maintenance since October 1995, but it still manages the process via in-house control. In other words, the road administration orders the service levels as physical work packages. Alberta is divided into 30 Contract Maintenance Areas (CMA) of about 500 km lengths, for a total road network of 15,000 km. The CMAs are for a 5-year duration, and contractors originally could only win a total of 4 areas. Also, these original contractor selection methods were based on 60% price and 40% other criteria, under a unit price agreement. Resurfacing and rehabilitation is still performed under capital projects.

The second round of contracts began in the year 2000 and the contractors were allowed to win a total of 7 CMAs. In addition, the contractor selection method was changed to 78% Price and 22% other criteria, under a unit price agreement.

The most recent change is that the road authority has now inherited an extra 15,000 km of local roads, which need to be added to the total network length.

British Columbia, Canada

British Columbia started outsourcing maintenance prior to any other province in Canada, in 1988. Since outsourcing has been practiced longer, they have basically gone through 3 phases. British Columbia has 28 network contract areas for a total of about 42,000 km. The first phase was for 3-year Lump Sum agreements, and in 1995 the term was increased to 5 years.

Now the contract length is 8 years (5+3 years), on a lump sum basis with outcome-based criteria, which differs from the other provinces. Contractor selection is based on 40% price and 60% other criteria.

All the provinces were required to outsource their maintenance activities, but each province took a different approach to the maintenance contracting situation. Table B-2 shows some of the different approaches and what differences there were in each province.

	Type of Contract	Contract Duration	Contract Method	Contractor Selection Criteria	Activities Included
Alberta, Canada	Output Based	5 Years	Unit Price	78% Price 22% Other	All except Resurfacing & Rehabilitation
British Columbia, Canada	Outcome Based	8 Years (New – 5+3)	Lump Sum	40% Price 60% Other	All except Resurfacing & Rehabilitation
Ontario, Canada	Output Based	8 Years (New – 5+3)	Lump Sum	90% Price 10% Other	All except Resurfacing & Rehabilitation

TABLE B-2 Long-term Contracts in Canada

Benefits & Disadvantages

Benefits:

- Canada has created a new maintenance industry
- Clients receive some cost savings (unable to provide any figures)
- Outsourcing has progressed quite well and forced the industry to develop
- Good cooperation with industrial groups
- The beginning is the best time to create new start-up companies (new industry)
- Better asset management
- Knowledge of the network data improved
- Innovation is enhanced (slow improvements) in longer length contracts
- Typically there has been equipment innovation & targeted maintenance (3-5 year contracts)
- Network quality is as good or better in these area contracts
- Partnering is working well
- Better management of the network and cost effective solutions
- Client has been able to transfer many risks to the contractor (except Alberta)

- Duplicate inspections not needed - saves costs, too (random inspections)
- Better level of service for the roads
- Alberta claims to have the lowest prices

Disadvantages:

- Ontario - not all network areas were transferred to the AMC
- Unit price (Alberta) - Client retains the risk & little innovation
- New maintenance industry needed to be bonded
- Major innovations were not really realized - earlier contracts were 3-5 years
- Mobilization issues need to be discussed/resolved early in the process (financial flexibility)
- How to input future innovations, such as IT developments, into the process
- Targeted maintenance - not always what the client was normally used to achieving
- Loss of control
- Loss of flexibility
- Loss of costing information
- Loss of operational knowledge (transferred to the private sector)
- BC has had defaults & labor problems (Union labor was about twice that of the private sector)
- Role of the client changes - moving to more asset-based management & aging workforce
- Some loss of quality in the first few years, due to startup learning and developing the network

APPENDIX C - ENGLAND

Road Network

England has a multi-cultural population of around 53 million inhabitants with a road infrastructure of approximately 9,760 kilometers of main highways and trunk roads. These main highways and trunk roads are managed by a government agency known as the Highways Agency (HA). The network value is estimated to be approximately £55 billion (540 billion FIM). The remaining road network is managed and cared for by county councils throughout England, and it contains approximately 275,000 kilometers of roads. There are 90 somewhat county councils with various districts, which dictate the strategy for road maintenance within their local areas. A map of the road network is shown in Figure C-1.

Road Organization

This section only addresses the roads managed by the HA, which is funded from the state budget (through the Department of the Environment, Transport and the Regions - DETR) and is authorized £1.533 billion (approximately 15 billion FIM) for the year 2001/2002. However, one county council - Hertsfordshire County Council, is summarized since a visit was made to their head office, and they are seeking an innovative path for future road maintenance. The Highways Agency was formed in April 1994, and it's mission was to manage and care for the highways and trunk roads in England. Prior to 1994, the road network was totally managed by the 90 county councils, but this seemed to be inefficient, and it was very difficult for the private sector to administer to the varies procurement and contracting methods tendered through these 90 client type organizations. The HA was formed to bring more efficiency and effectiveness to the process. The total budget targeted for the fiscal year 2001/2002 is:

- £687 million (about 6.7 billion FIM) - Maintenance
- £212 million (about 2.1 billion FIM) - Making Better Use of the Existing Road Network (MBU)
- £634 million (about 6.2 billion FIM) - Major improvements (2.2 billion FIM - PPP)

The Highways Agency has a total staff of about 1,770, with eleven offices in the 9 Regional areas that incorporate the 20 area networks (A1-A20) of the entire road network of 9,760 km. The Highways Agency operates similarly to many road administrations in which actual day-to-day operations are managed by regional offices, and the headquarters personnel provide support, objectives, strategic direction, and future vision. The HA is considered a client organization which procures capital projects and maintains the existing road network. The main federal government authority began a Compulsory Competitive Tendering (CCT) process in the late 1980s, which has continued through today. All road maintenance and capital projects are competitively tendered through this CCT process. Even the county councils are mandated to outsource road projects. The HA has set objectives and a strategy for the road network. The eight key objectives

(agreed on with the ministers as part of the 1998 integrated transport white paper “A New Deal For Trunk Roads in England”) are:

- To give priority to the maintenance of trunk roads and bridges with the broad objective of minimizing whole life costs
- To develop the Agency's role as network operator by implementing traffic management, network communications and other measures aimed at making the best use of the existing infrastructure and facilitating integration with other transport modes
- To take action to reduce congestion and increase the reliability of journey times
- To carry out the Government's targeted program of investment in trunk road improvements
- To minimize the impact of the trunk road network on both the natural and built environment
- To improve safety for all road users and contribute to the Government's new safety strategy and targets for 2010
- To work in partnership with road users, transport providers and operators, local authorities and others affected by our operations, to promote choice and information for travelers, monitoring and publishing information about the performance and reliability of the network
- To be a good employer, managing the Agency's business efficiently and effectively, seeking continuous improvement

In pursuing these objectives, the Agency works in partnership with local highway authorities to share information and expertise on the management, maintenance and improvement of roads. The above objectives support one or more of the road-based outcomes identified in the 10-year plan, which are set out along with additional outcomes, smarter roads, as identified by the Agency in Strategic Roads 2010. The agency’s outcomes in the 10-year plan (set in July 2000) are:

Easing Congestion - Reduction in congestion on inter-urban trunk roads to 5% below 2000 levels (compared with present forecast growth of 28%) by 31 March 2011.

Effective Maintenance - Road condition maintained to a high standard, so that the proportion requiring maintenance in any future year is held at an optimum level (between 7% and 8%).

Safer Travel - A one third reduction in the number of people killed or seriously injured on the strategic road network and a 10% reduction in the slight casualty rate by 31 March 2011.

Better Information - Greater confidence for road users planning their journeys as a result of instant access to information about conditions on the network.

Quieter Roads - Reduction in traffic noise benefiting three million people living within 600 m of trunk roads.

Delivering in Partnership - A more effective roads program, with better evaluation of needs, and options, quicker delivery and lower impacts on the environment.

Smarter Roads - Increasing the use of new technology to improve the real-time management of traffic on our strategic road network. New systems will provide more reliable journey times, improve safety and control traffic flows.

The above-mentioned 10-year plan outcomes are in turn supported by:

- Ministerial Targets - 12 targets according to which the performance of the Agency will be assessed by ministers.
- Strategic Roads 2010 Targets - 33 targets aimed at delivering 10-year plan outcomes
- Road Users' Charter - 16 targets based on customer-focused performance service standards published in the new edition of the Road Users Charter.
- The Agency will continue to work with DETR to develop performance indicators and measures with which to monitor progress towards meeting the 10-year plan outcomes.

Therefore, the Highways Agency's role is to procure capital projects and maintenance services from the private sector via a public competitive tendering process. The HA does not have any in-house design capability. HA information, reports, and activities can be found at the following www site - http://www.highways.gov.uk/.

Recent Changes

The HA are now changing their organizational strategy. The staff from the Central HQ in London will be reconfigured to 30-50 administration and upper management, while the remaining staff will be transferred to the 9 Regional offices or to other agencies, if they do not wish to relocate. This change is planned to occur in the year 2002.

Another significant change is that £2 billion (20 billion FÍM) is expected to be invested in the Private Financing Intiative (PFI) during the 2010 plan, which calls for increases in DBFOs.

One other change is that the HA is de-trunking some of the roads and returning the areas back to the county councils for management. Some 500 km of roads are expected to be transferred during the year 2001/2002.

Source: HA Paving The Way

FIGURE C-1 Main Highways and Trunk Roads in England

Capital Projects

The Highways Agency has evolved so that the only main procurement method utilizes the DBFO model for all future capital projects. Another process being evaluated is almost considered a Full Delivery Method. These models are:

- Design Build Finance Operate (DBFO)
- New Engineering Contract (NEC), which is somewhat similar to the New Zealand Full Delivery Method. (The contractor and design team are brought into the process during the early initial pre-planning phase as a

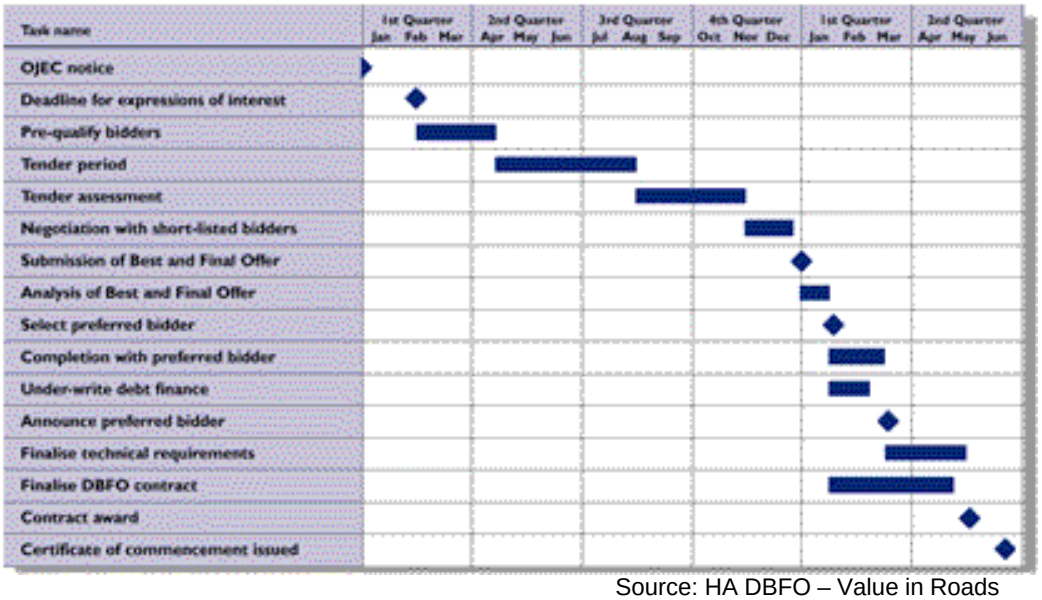
Variable Lump Sum contract, and then later on when the design can be formed into design documentation, a Target Price is negotiated).

In the past, the HA used to utilize Design-Bid-Build, but has made this obsolete. Presently there are 2 remaining DBFOs projects to be tendered, and more when the PFI projects are determined.

The Agency formally launched its use of the Private Finance Initiative (PFI) to procure road service on parts of the motorway and trunk road network in August 1994. The Agency's objectives for each DBFO project were:

- to ensure that the project road is designed, maintained and operated safely and satisfactorily so as to minimize any adverse impact on the environment and maximize benefit to road users;
- to transfer the appropriate level of risk to the private sector;
- to promote innovation, not only in technical and operational matters, but also in financial and commercial arrangements;
- to foster the development of a private sector road-operating industry in the UK; and
- to minimize the financial contribution required from the public sector.

The service includes assuming responsibility for the operation and maintenance of a length of existing road (where relevant) and ensuring that specified construction scheme(s) along the length of road are constructed and made available to road users. The private sector is subsequently responsible for the operation and maintenance of the new sections of road. Figure C-2 demonstrates the process quite well.



Source: HA DBFO – Value in Roads

FIGURE C-2 Typical Project Delivery Process in England

Key aspects of this project delivery are noted below:

- Fixed price with variable schedule of payments during the actual construction phase
- Typically a 30-year contract for both capital and maintenance
- Utilizes the EU negotiated process (Short Listed and negotiated with a preferred bidder)
- All statutory orders were publicly approved prior to contract award
- The specifications from the Client are Core requirements with outcome-based criteria to allow for innovation and value-added schemes. The client also provides standards, design data, and its own existing design, which supplement the core requirements in the tender. Even alternative design and value engineering techniques were used to reduce costs and demonstrate their know-how.
- The contract included penalty points and incentives
- Project risks were transferred to the private sector, provided they could be managed (a Risk Register was used – Risk Transferred, Shared Risks, Other Risk and Retained Risks)
- A Project Management structure was in place for all key stakeholders

DBFO Benefits:

- Complete projects that could not normally be completed due to a lack of public funds
- Whole life costing of projects - more life cycle costing
- Risk transfer
- Efficient service & reduced management
- Outcome-based criteria were realized, creating innovation
- Integrated process (design, construction & maintenance)
- Constructability is increased
- Road schemes are delivered faster
- Created partnership
- Real value for money
- Changing of client skills & developing performance-based criteria
- Options from traditional process
- Develop stable, long-term businesses
- Creates opportunities for competing in the international sector
- Development of the private sector in road projects

DBFO Disadvantages:

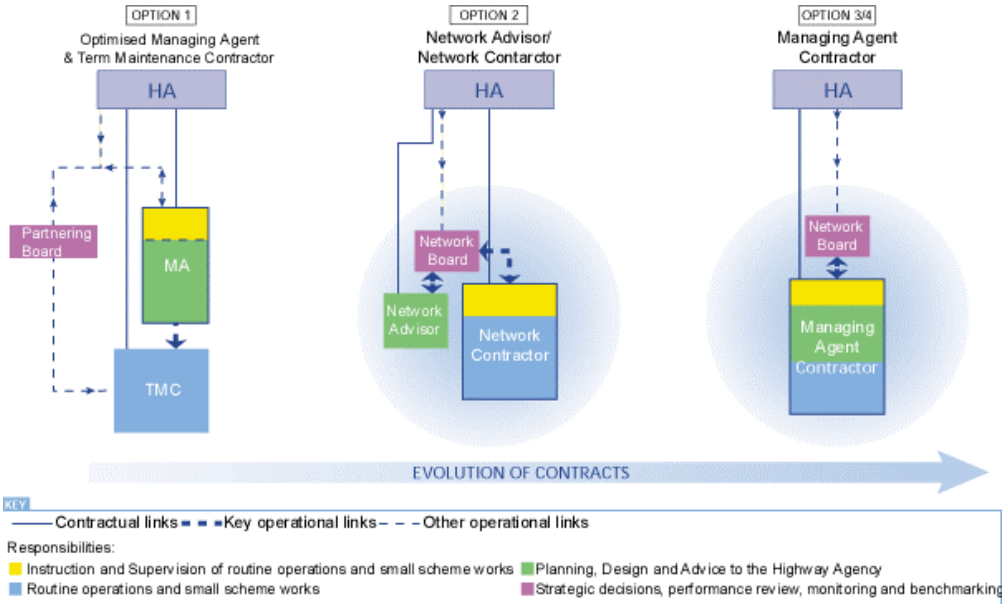
- Costing and long tendering process
- Allowing for changes in the 30-year process
- Predicting the future (budget, political & social changes)
- Possibly limiting competition due to high risk transfer to private sector
- What level of service is standard for the maintenance portion of the contract
- What would happen if there is a default in the contract or a breach of contract
- Continued non-performance - what actions to be taken

Maintenance Contracts

The maintenance procurement process is quite different. The Highways Agency is still considered as the client, but they have 3 basic models for maintenance activities. The HA typically utilizes a consultant known as the Managing Agent (MA), which manages the following activities:

- Managing agent on behalf of the Highways Agency
- Long-term maintenance focus
- Engineering role
- Work with agency
- Performance auditing
- Strategic role - Innovative Engineering Advice (IEA) & advising HA on procurement
- Administering the procurement of the Term Maintenance Contractor (TMC)

The Managing Agent provides instructions for maintenance activity to the Term Maintenance Contractor. In addition, the TMC can directly perform rehabilitation and upgrades to the road network when the value of the project is less than £250,000 (about 2.5 million FIM), which would be administered via the MA. The contractor's role then becomes the physical work based on the instructions provided from the MA. These contracts include all maintenance aspects. Figure C-3 shows the evolution of the maintenance process.



Source: HA Paving The Way

FIGURE C-3 Maintenance Managing Models in England

The client first selects the MA via quality-based selection criteria and negotiates a price. Then the MA administers the selection process of the TMC together with the HA. There is also a partnering agreement in all maintenance contracts, because the HA realizes that partnering is ***essential*** in the process. It can be clearly seen and realized that the MAC process and processes of other countries have placed the Contractor in the leading role, since they are the best organization to manage the process and accept the risk transfer.

The second model (Option 2) is very similar to the first model, but with more contractor flexibility and quality assurance. In addition, a Network Board is established to provide strategic direction, increase contract partnering, monitor improvements, and possibly act as a complaints resolution team.

The third model (Option 3) transfers the management of the network to a Managing Agent Contractor (MAC), which is a combination of the Network Advisor and the Network Contractor from Option 2. In addition, a Network Board is created to lead the strategic direction of the project. The board typically has two members from the HA, two members from the Contractor, and one from the managing agent within the MAC partnership.
Some key features of the MAC arrangement are:

- More outcome-based criteria
- Lump sum contracts with some unit prices (schedule of rates)
- Creating more partnership and trust (integrated teams)
- Open and fair characteristics
- Drive continuous improvements
- Demonstrate best value
- Accounting for adjustments/changes during the contract duration
- More emphasis on whole life decisions (need a longer time period)
- Risk management
- Supply chain management

A fourth model is also being developed, called a Private Finance Managing Agent Contract (PFMAC), which introduces private financing into the process. It is characterized by greater risks transferred, a longer-term contract of 15-30 years, and mechanisms similar to the DBFO model for capital projects. This process has not been tested to date, but is worthy of a pilot test case scenario. Table C-1 shows the contracting type and selection criteria.

Maintenance Model	Contract Type	Duration	Selection Criteria	Focus
Option 1 Managing Agent	Unit Price	5 Years 3+1+1	80% Quality 20% Price	Method Based
Option 2 Network Advisor	Unit Price with Lump Sum	5 Years 3+1+1	80% Quality 20% Price	Output Based
Option 3 MAC	Lump Sum	7 Years 5+1+1	80% Quality 20% Price	Outcome-Based
Option 4 PFMAC	Lump Sum	15-30 Years	Negotiated Target Price	Finance & Outcome-Based

Source: HA Paving The Way

TABLE C-1 Maintenance Models Used in England

BIDDING PROCESS

The bidding process of the Client organization is quite similar to that of most road administrations. The process includes the following:

- Notification of Intent
- EJOC - EU notice of procurement
- Short-listing the pre-qualified participants (2-4 selected)
- Invitation to tender
- Tender due date
- Open envelope A of the tenders (quality submissions)
- Possible interview of contractor (clarify & verify quality statements)
- Final analysis of envelope A
- Open envelope B (price submissions)
- Evaluate and determine top 2 tenders
- Team interviews with 1 or 2 tenders (HA discretion)
- Final bid assessment
- Contract execution & mobilization
- Possession date

QUALITY

Quality is assured through several mechanisms:

- ISO 9002 quality standards
- Quality audit trail
- Quality management
- Quality plan
- Core requirements

There is also a requirement to submit individual quality promises or submissions in the tender, which is evaluated to meet requirements.

BENEFITS:

- Reduced administration
- Some costs savings
- Maintenance costs have not increased despite higher traffic conditions
- Better value for money
- Good partnering
- Quality service
- Reduced complaints
- Better targeted maintenance
- Full depth reconstruction not necessarily needed
- Some innovations
- Contractors focusing on client needs
- Better public confidence
- Equipment innovations
- Budgeting tool

DISADVANTAGES:

- High tendering costs
- Long tendering period
- Possibly unfair competition for medium-sized contractors
- Client needs to specify clear outcome-based criteria
- Balancing of workforce by the contractor

NOTE

Some large companies are developing full services in-house for full client services.

Lessons Learned

The following is a quick listing of innovative ideas and practices that might be used for future procurement developments:

- Partnering agreements as part of the process - Partnering is **essential** and a **MUST**!
- Key for the client is to determine what risks/liability are to be shifted to the Contractor or what decision-making can be transferred to the contractor
- DBFO projects are increasing
- Develop full delivery models
- Determining methods to bring the contractor into the pre-planning and acquisition phases earlier
- 7 years seem to be the minimum acceptable contract length for innovative maintenance. England is now procuring new maintenance via the Managing Agent Contractor (MAC)
- Client needs to know what they want and determine a set level of expected quality

- Innovation should bring down prices
- Need to create a cultural change internally in the client organization
- More full service contractors are evolving
- England utilizes Key Performance Indicators (KPI)
- Maintenance costs are decreasing despite increased road travel
- Next key paradigm - Supply Chain Management
- Once competition is realized - have substantial quality in contractor selection process (~50%)
- Seeking whole life cost decisions (Asset Management) - cannot be realized with less than 10-year agreements
- Biggest problems with contractors is keeping skilled people and maintaining a balanced yearly workforce for the differing seasons
- Contract characteristics:
    - Single responsible party for capital & maintenance contracts
    - Recommended 7 – 10-year maintenance and 15 years for capital DBFO projects
    - DBFO contractor selection criteria set at 50% quality & 50% price
    - Maintenance contracts set at a minimum of 40% quality and the remainder for price
    - Quality promises by the contractor are bound into the contract
    - Clear & transparent tendering process
    - Interview top two tenders prior to contract award (this may seem time consuming, but you can not afford not to do this. Does the interview match the tender's words & oral proposal)
    - Procurement model depends upon the knowledge of the contractors and how the contractor can price the details in the proposal

APPENDIX D - FINLAND

Road Network

Finland has quite a stable population of about 5.2 million people. The country is situated in an arctic type climate similar to Sweden's. The Finnish road network incorporates a total of approximately 78,000 kilometers, and it is a combination of unpaved (35%) and paved (65%) roads with a flexible pavement system. The road network is divided into 99 contract areas. An interesting fact is that there are only 549 km of highways and 4,300 km of pedestrian and bicycle paths managed by the road administration.

Gravel roads comprise about 35% of the roads in Finland, and they can be a major source of problems during the springtime when freeze-thaw cycles are quite prevalent. Sometimes road weight restrictions are needed in some areas where this is a problematic situation. New schemes for the care of gravel roads are being tested, but presently no major solutions or cost effective means have been developed. Typically, these gravel roads are low traffic volume roads, and hence a lower priority.

Road Organization

Finland's roads are managed by the Finnish Road Administration (Finnra) which behaves similarly to a public client that needs to procure products and services for the road infrastructure. On January 1, 2001 the "Production" portion, known as the Finnish Road Enterprise, became a corporatized agency under public ownership. The Finnish Road Enterprise previously performed all maintenance activity via negotiated contracts until this year, when they were required to compete against private sector competitors. By 2005 all network areas will be subject to open competition. In the meantime, some of the existing and phased areas are under negotiated contracts.

Finnra has a staff of approximately 1,000 people, with nine regional offices that manage day-to-day operations in their areas.

Capital Projects

Basically, Finland uses three methods or models for delivery of capital investments. These models are:

- Design-Bid-Build (D-B-B)
- Finnish Design-Build Method
- Construction Management (CM At-Fee and CM At-Risk)

Finland also used Design-Build-Finance-Operate (DBFO) on one project known as the Lahti Motorway (Finland Route 4 - Järvenpää to Lahti), but it has not reintroduced this model, as it appeared to be a special project. Because of the public opposition against traditional toll roads, this was considered a "shadow toll road".

The Finnish Design-Build system varies somewhat from the US model of Design-Build in that there is no pre-qualifications (short listing of Design-Build contractors) phase and the design portion is often too detailed (greater

than 30%), which tends to minimizes the innovation potential of the Design-Build contractor. Otherwise, the two processes are quite similar.

Contractor selection is based on 75% price and 25% other criteria. They are lump sum type contracts.

Maintenance Contracts

Finland has only recently begun outsourcing maintenance aspects as of October 2001. Maintenance contracts typically have been procured under yearly or multi-year agreements for the periodic/routine type maintenance activities via negotiated contracts with the old production organization. But this year the agreements were opened to the private sector and the new procurement method for periodic/routine maintenance was tendered for a period of 3 years with a “Lump Sum” contract. This involved 23 network areas for a total of 16,570 kilometers. Other maintenance activities, such as line marking, traffic signs and signals, resurfacing, rehabilitation, and lighting, are typically procured separately via unit prices (Schedule of Rates).

Finland is presently divided into 99 network areas, which is presently perceived as too many areas. There should be longer road lengths and fewer network areas. There is some discussion and debate, but longer lengths should be considered in some appropriate areas. Table D-1 summarizes the present maintenance contract system used in Finland.

Delivery Activities	Routine/Periodic Maintenance
Duration	3 Years
Contract Type	Lump Sum
Contractor Selection Criteria	75% Price & 25% Technical Criteria

TABLE D-1 Present Maintenance Contract Model in Finland

Benefits & Disadvantages

Benefits:

- Savings are estimated to be approximately 7-10% in new maintenance contracts
- Somewhat less administration burden
- Easier to budget
- Seeking to integrate more maintenance activities
- Seeking to increase length of contract terms

Disadvantages:

- Using too much traditional D-B-B project delivery methods
- 3 years is too short a time period in maintenance contracts
- Still too many network contract areas
- Little innovation
- Too many small contractors
- Little value-added client services
- Low profit industry - not enough competition
- Lack of partnering

APPENDIX E - NEW ZEALAND

Road Network

New Zealand has a diverse multi-cultural population of around 3.8 million inhabitants with a road infrastructure of approximately 10,760 kilometers of state highways and approximately 81,290 kilometers of local and rural roads, for an approximate total of 92,050 kilometers. New Zealand is the only country in the world with a dedicated road fund for all publicly owned road infrastructure. In 1999/2000 Transit New Zealand received 582.7 million NZD from Transfund New Zealand. More than half the budget, 317.6 million NZD, was spent on capital works and 275.5 million NZD was put into maintaining the country's existing network of state highways. It should be noted that the national road administration (Transit New Zealand) manages only the state highways. The urban and local road maintenance and capital expenditures are funded through Transfund New Zealand on a cost share basis of approximately 50%.

Road Organization

A brief history of the road administration is essential because it has progressed and developed significantly and this explains some of the changes in the organization, as well as the progression to an innovative road administration. In addition, government reform and policy changes were common and an unprecedented restructuring and commercialization of many government entities was realized, and the road sector no exception.

Prior to 1987, the road administration was known as the Ministry of Works and Development (MWD), which was responsible for policy, safety, design, construction, maintenance, and a wide range of infrastructure activities for roads. In other words, the MWD self performed most of the road construction and maintenance activities. The staff comprised about 9600 people. In 1988 the government transferred the commercial activities to a new state-owned enterprise called Works and Development Services Corporation Limited, which was responsible for consulting and construction of the roads. The policy and regulations were transferred to the Ministry of Transport. Works and Development Services Corporation Limited was a limited liability company that was 100% held by the government, and staffing was appointed by the government to maintain some expertise and know-how in various positions.

Briefly afterwards in 1989, Transit New Zealand was created by the Transit New Zealand Act to enable integrated planning and funding of roads, passenger transport services, and road safety. The act also made New Zealand the only country in the world with a dedicated road fund for all publicly owned road infrastructure. In addition, a process needed to be developed for tendering and true competition, which was initiated by the development of Competitive Pricing Procedures (CPP).

Between 1989-1991 Works and Development Services Corporation Limited was given 100% of all the contracts. Consultants' fees were based on a percentage of the work type, and maintenance was methods-based. The physical works or construction was basically performed on a low price scenario. Subsequently, to create competition and skilled tendering, competitive tendering was enacted in 1991.

In 1996 Transfund New Zealand was formed to allocate resources for a safe and efficient road network. Transfund New Zealand became the financier of local and regional funds for road projects and maintenance and for the state highways. Transit New Zealand's role then changed to management of the state highway system, and the objective was to operate a safe and efficient highway network. Transit New Zealand had very little management and contracting expertise. Maintenance and construction work were mainly procured via "input-driven" or method-driven specifications versus "outcome-based" or performance-based specifications.
This required training and knowledge on the part of all the parties involved in the road industry and it was a major task to be accomplished. In addition, a process needed to be developed for tendering and true competition, which was developed via the Competitive Pricing Procedures.

In 1996 Works and Development Services Corporation Limited was privatized via management buy-outs. Works Consulting Services became the consultant arm and was subsequently sold to Kinta Kellas Ltd (now known as Opus International Consultants). Works Civil Construction Limited became the contracting experts and was subsequently sold to Downer and Company Limited (now known as Works Infrastructure). Both were considered profitable and attractive purchasers.

Current Administration

The vision of Transit New Zealand is to be a world leader in road administration and industry, while the mission is to provide a safe and efficient state highway system which meets the needs of road users and communities it serves. This can be recognized by the customers and stakeholders as the best road provider in New Zealand through the excellence of the state highway system, the responsiveness to customers' needs, and the quality of the expertise and business practices.

Transit New Zealand currently manages all the state highways. It has seven regional offices and a national staff of nearly 190 with 110 in the regional offices, which are directly involved in managing the state highway network.

There are 12 regional councils, 4 unitary authorities, and 74 territorial local and urban authorities, that receive funding for construction and maintenance of the local road systems. These are managed and administrated by the local authorities.

Maintenance and construction operations are implemented via a Network Maintenance Management (NMM) consultant for a typical period of 3-5 years. NMM is appointed by Competitive Pricing Procedures (CPP) and is

responsible for the area management plan, program planning, contracting, and an expert advisor to Transit New Zealand.

The construction or physical works contracts are administered by the NMM with oversight by Transit New Zealand. Common maintenance work is based on a lump sum, while other items are based on unit prices (Schedule of Rates) and by rates for each unit of work performed.

The three distinct divisions or organizations are the road administration, consultants, and contractors. The division into three separate entities has resulted in independent and distinct roles for the client, management/consultant, and Contractor functions. Transit New Zealand was required to change due to legislation, staffing reductions, and to divest some functions to a more efficient commercial provider. It has developed skills and know-how and required partnering of all parties involved. This has allowed Transit New Zealand to focus on the true client, which is the road user. The traditional process is described below in broad terms.

Client Role:

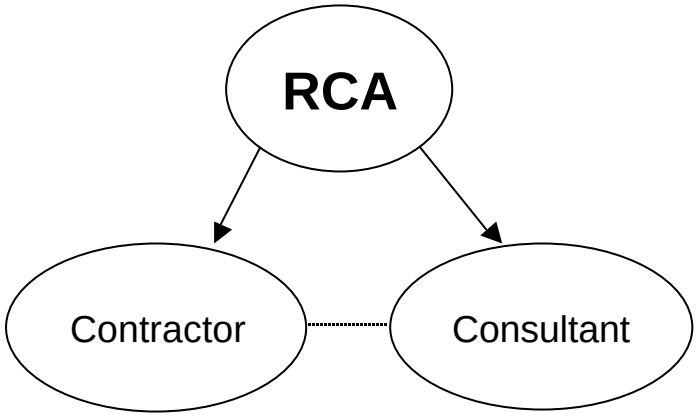
- Audit
- Agree on investment needs
- Manage funding Issues
- Approve asset management plan

Consultant Role:

- Develop network management strategies
- Draft asset management plans (seals, rehabs, etc)
- Approve routine maintenance program
- Audit work done
- Approve claims

Contractor Role:

- Identify routine maintenance work
- Prioritise & program routine maintenance
- Execute works
- Ensure work quality and satisfy liability requirements



Source: Opus Int.

FIGURE E-1 Traditional Maintenance Model in New Zealand

Capital Procurement

Through progression, New Zealand has implemented many strategies and new ways to focus on the main purpose of being a road administrator. One such strategy is to provide a "Long Term Procurement Strategy (LTPS) for the many diverse capital and maintenance contracts to be implemented. This is quite a bold effort to follow and commit to this strategy. This strategy can be found at the following www site (http://www.transit.govt.nz/news/index.html).

New Zealand utilizes the following delivery methods for capital projects:

- Traditional or Design-Bid-Build
- Design Build (It should be noted that Design-Build is separated into two components)
    - Design-refine Construct (USA model – Client engages a Design Consultant to develop the Design until it is feasible to obtain consent and resources. Then the Design-Build contract is competitively tendered)
    - Full Design-Construct (Design-Build is fully tendered when the development phase is completed and land and resource consent is obtained).
- Full Delivery Method (This may be equivalent to the USA Program Management model)

The target or directional strategy for all new procurement of capital projects is to increase the use of Design-Build, bring contractors into the early stages of the project life cycle, and to improve resource management

Table E-1 shows the expected delivery methods for the next few years:

Procurement Model	2000/2001	2001/2002	2002/2003	2003/2004
Traditional (LS >5M)	3	6	8	6
Traditional (M&V >5M)	3	12	5	6
Traditional (LS <5M)	10%	20%	30%	40%
Design-Build	3	4	3	2
Full Delivery	0	1	0	1

Source: TNZ Long Term Procurement Strategy

LS - Lump Sum
M&V - Measure & Value (Schedule of Rates)

TABLE E-1 Future Procurement Strategy in New Zealand

Capital Projects

For Transit New Zealand projects, the Consultant Agency Network Maintenance Manager (NMM) is competitively tendered based upon experience, technical expertise, past performance, and methodology. Then this is weighted against a price level and the award is granted to the highest overall index, or Brooke's Law is used to evaluate the highest index for the most qualified tender prior to opening the price bid. If necessary, a price is negotiated before the award is granted.

Three types of contracts are used in selecting contractors for the physical work packages:

- Measure & Value (similar to Schedule of Rates)
- Lump Sum
- Cost Plus

Contractor Selection Methods

One of the following six contract selection methods is used for the physical work packages:

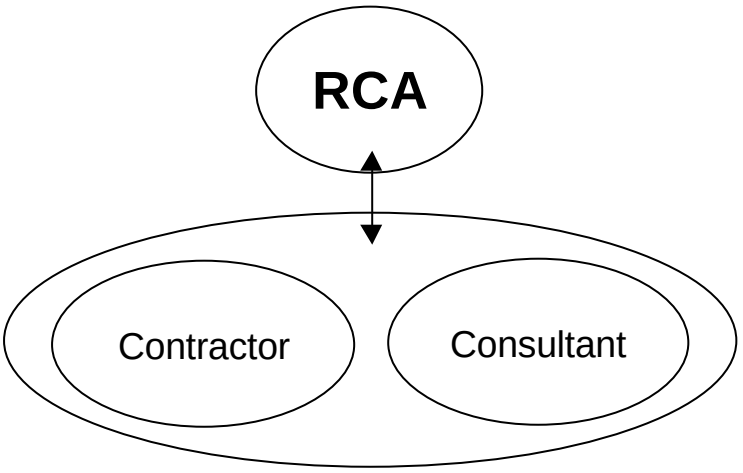
- Lowest Price Conforming Tender (LPC)
- Quality Price Trade Off (QPTO)
- Weighted Attributes (WA)
- Brooke's Law
- Target Price
- Direct Appointment

Usually, a short listing is implemented for Design-Build projects and traditional projects that are over 15 million NZD and/or for projects involving high complexity.

Maintenance Contracts

New Zealand utilizes the following delivery methods for maintenance contracts:

- Traditional or Design-Bid-Build (up to 3-year contract)
- Hybrid (This is a traditional model with packaged activities and outcome-based - usually 3-5 years)
- Performance Specified Maintenance Contracts (PSMC - utilizes a single contract for the entire road network services, lead by the contractor team and granted for 10 years). Figure E-2 shows the typical PSMC procurement model.



Source: Opus Int.

FIGURE E-2 PSMC Procurement Model

The target or directional strategy for all maintenance contracts is to enhance the traditional approach, increase the use of designer and contractor functions, equally utilize all procurement methods based on expenditure (1/3 traditional, 1/3 hybrid, 1/3 PSMC), and improve the scope to include the maintenance activities within the geographic area.

Table E-2 displays the expected delivery methods for the next few years.

Procurement Model	2000/2001	2001/2002	2002/2003	2003/2004
Traditional	3	6	0	3
Hybrid	3	1	0	0
PSMC	1	0	2	0

Source: TNZ Long Term Procurement Strategy

TABLE E-2 Expected Quantity of Maintenance Contracts In The Future

Contracting Methods

For Transit New Zealand projects, the Consultant Agency Network Maintenance Manager (NMM) is competitively tendered based upon experience, technical expertise, past performance, and methodology. Then this is weighted against a price level and the award is granted to the highest overall index, or Brooke's Law is used to evaluate the highest index for the most qualified tender prior to opening the price bid. If necessary, a price is negotiated before the award is granted.

The following are used in selecting contractors for the physical work packages:

- Measure & Value (traditional)
- Lump Sum (traditional, hybrid or PSMC)

Contractor Selection Methods

One of the following six contract selection methods is used for the physical work packages:

- Lowest Price Conforming Tender (LPC)
- Quality Price Trade Off (QPTO)
- Weighted Attributes (WA)
- Brooke's Law
- Target Price
- Direct Appointment

Usually, a short listing is implemented for PSMC projects and traditional projects that are over 15 million NZD and/or for projects involving high complexity.

Benefits & Disadvantages

Cost savings for professional services over a five-year period (1991-1995) were estimated at 30%, while maintenance savings were reported at 17%. This has resulted in a total estimated savings of 135 million NZD, which is

impressive considering inflation of 37% and a 35% increase in traffic volume. Some side benefits have been increased knowledge, skills, expertise, and allowing innovation into the marketplace.

The benefits should also include the new players and products in the marketplace, because competition has created new opportunities and businesses, with a side benefit of new innovations and products.

Benefits:

- Clients receive cost savings ranging from 10-25%
- Maintenance costs have not risen despite inflation, more road traffic & better perceived quality
- Knowledge of the network data and conditions significantly improved (right to monitor)
- Innovation is maximized through longer PSMC contracts
- Network quality is as good or better in PSMC contracts (fit for purpose)
- Partnering and teaming efforts were realized & effective (utilizes a viewpoint that partnering and teaming were more important than what the legal documents said)
- Better management of the network & targeted maintenance - cost effective solutions
- Applying alternative treatments and innovative practices
- Network contractors can provide cost savings for other improvements in the network
- Emergency response improvements by contractors
- Client has been able to transfer many risks to the contractor
- Duplicate inspections not needed - saves costs
- Better level of service for the roads
- Consolidation with some local authorities - two methods

Disadvantages:

Some disadvantages during the years of change has been displacement of staff and workers, criticism of unfair practices when using evaluation of proposals based on other than price alone, some litigation, and some times of difficulty in this changing structure.

- Politics play an important role in which systems will be adopted (social pressures)
- Most PSMC projects were 1st time efforts and problems were noted in defining proper performance criteria and how to tender the project properly
- Road data that contractors are bidding on is not 100% reliable (predicting performance on data)
- Uncertainty of long term relationships - should a walk-away clause be developed?
- Difficulty during tender process with placing a price on innovation
- How to input future innovations, such as IT developments, into the process
- Targeted maintenance - not always what the client was normally used to achieving

- Too much duplicate inspection in some projects, if Client mandates
- Perceived loss of control
- Some political & social consequences were noted in rural areas
- Role of the client changes - utilizing more management skills and requiring different skills
- Some loss of quality in the first few years, due to startup learning and developing the network
- Client perceived minimum level of effort by Contractor in some cases
- Contractor layers results in chain of command inefficiencies

APPENDIX F - SWEDEN

Road Network

The Swedish road network is very similar to Finland's in type, climate, and practices used. The total road network length is approximately 100,000 kilometers and it is a combination of unpaved and paved roads with a flexible pavement system. The road network is divided into 147 contract areas.

Road Organization

Sweden is quite similar to Finland in road management and practices. However, Sweden differs from Finland in one area, which is that the "Production" portion is separated, but still part of the Swedish National Road Administration (SNRA) and not corporatized, as in Finland's situation. However, Sweden has been outsourcing maintenance activities since 1996 and "Production" has had to compete with the private sector via open competition in all network areas since July 2000.

SNRA has a staff of approximately 3,700 people and it has seven regional offices. SNRA is in the position of the client and procures services for both capital and maintenance contracts.

Capital Project Delivery Methods

Capital investment projects are procured almost entirely via the traditional method of Design-Bid-Build, with only some bridges using the Design-Build delivery method. It should be mentioned that Sweden is contemplating the DBFO possibility for some future projects. Contractor selection is based on 75% price and 25% other criteria and uses a lump sum agreement.

Maintenance Contracts

Sweden has tested several maintenance contracts or models and different functions for granting contracts. It was somewhat difficult to determine the exact models utilized, but it appears that the newly accepted model for tendering maintenance contracts is for 8 years (6+2 years) with a lump sum contract. Contractor selection is based on 90% price and 10% other criteria. Table F-1 displays the criteria quite well.

	Type of Contract	Contract Duration	Contract Method	Contractor Selection Criteria	Activities Included
Sweden	Output Based	8 Years (6+2 years)	Lump Sum	90% Price 10% Other	ALL except Resurfacing & Rehabilitation

TABLE F-1 Typical Long-term Maintenance Contract in Sweden

Benefits & Disadvantages

Benefits:

- Quoted as saving 20-25% in costs (how are they measured is always an issue)
- Somewhat less administration burden
- Quality equal to or better than old process

Disadvantages:

- 90% price for contractor selection criteria
- Lack of control with the regional offices - no centralized standards & systems for synergy
- Using too much traditional D-B-B procurement methods
- Need to develop debriefing sessions for contract losers
- Contracting selection methods are not transparent

APPENDIX G - USA

Road Network

The USA has a multi-cultural population of around 278 million people and a total of approximately 6.31 million kilometers of roads. Only 75,600 km are classified as interstate highways and 626,000 km as arterial roads. The largest percentage of roads are local roads, which consist of 4.33 million km, and the remaining roads are considered as collector roads, estimated at 1.28 million km. The major roadways in the USA are federally assisted by the Federal Highway Administration (FHWA), which is part of the Department of Transportation (USDOT). Table G-1 displays the road network in the USA.

Interstate highways	**75 600 km**
Arterial Roads	**626 000 km**
Collectors	**1 280 000 km**
Local Roads	**4 330 000 km**
Total	**6 310 000 km**

Source: FHWA – Our Nation's Highways, Selected Facts and Figures

TABLE G-1 Length of Roads in the USA

Road Organization

The FHWA provides federal financial assistance to the individual State Highway Agencies, usually known as Departments of Transportation (DOT), for construction and improvements to the National Highway System, urban and rural roads, and bridges. It should be noted that funding does not include appropriations for maintenance. The program provides funds for general improvements and development of safe highways and roads. In addition, the FHWA provides access to and within national forests, national parks, Indian reservations and other public lands. This involves preparing plans, granting contracts, supervising construction facilities, and conducting bridge inspections and surveys for these public lands. The estimated expenses for 2001 were approximately 33.4 billion USD. The budget is collected by means of a dedicated highway trust fund, which is derived from fuel taxes, tires sales, and sales of trucks. In order to support all of these program areas, the FHWA conducts and manages comprehensive research, development, and technology programs. (See the following www site for additional information: http://www.fhwa.dot.gov/)

The FHWA's main goals are:

- Satisfy the general public's need for safe, comfortable, convenient, economical movement of people and commodities, and improved access to road transport.
- Environmentally conscious organization that promotes and practices sustainable environmental principles and delegates the same leadership with their partners in order to protect and enhance the natural and human environment.
- Improve the delivery and quality of our transportation programs services, and products
- Develop, transfer, and implement technology through alliances with our partners and international cooperation.
- Improve surface transportation safety through a coordinated effort to reduce fatalities, injuries, property damage, and hazardous material spills.

The state highway administrations receive matching funds from the FHWA, which is a sort of cost sharing program. Projects are both authorized and appropriated prior to being granted assistance.

The state's authority then has to provide all the administration and staffing levels to complete the projects. Since each state has independent rights regarding what projects, methods, and resources are used, it is their choice as to how appropriations are used within each state. Each state typically manages all other areas of transportation, such as rail, airports, and shipping.

This study did not attempt to analyze each state's practices and it would not be of any added benefit or feasible to evaluate all the states in the USA.

Capital Projects

Since each state decides what projects are to be completed, they also control what type of project delivery method will be utilized. Each state is typically a client, and it outsources most of its engineering/design services as well as the actual construction. Some states do have an engineering/design staff, but mostly for review and approval. Some states are considered more progressive or innovative than others, and have used some innovative methods, but the main procurement delivery systems for roads in the USA use the traditional method, which is Design-Bid-Build. In recent years, Design-Build is demonstrating its value and increasing in practice. Construction Management At-Risk is also being tested as another appropriate delivery method. These delivery systems are shown in Table G-2.

DELIVERY METHOD	CONTRACTOR SELECTION METHODS	CONTRACT TYPE
D-B-B	Low Bid	Lump Sum
D-B	Weighted Average	GMP
CM	?	GMP
DBOM	SEP-14	Lump Sum
DBFO	Past History	Lump Sum

TABLE G-2 Delivery Method Matrix Used in USA

Other innovative aspects used in conjunction with traditional and innovative procurement methods are:

- Partnering
- Value engineering
- Constructability reviews
- Incentive and disincentives
- Performance specifications
- Multi-parameter bidding (A+B+Quality)
- Lane rental

More details about capital investment projects are given in the AASHTO publication “Primer On Contracting 2000 2nd Edition”.

Benefits & Disadvantages

Benefits:
- Partnering works well when utilized
- Value engineering improves LCC and product selections
- Constructability reviews increase innovation & reduce costs
- Design-Build usage is slowly increasing
- Beginning to see signs of a cultural change from traditional methods (deliberate)

Disadvantages:
- Laws are inflexible & usually prevent innovative concepts
- Many state laws require a Low Bid contractor selection method
- Shorter LCC
- Innovation is not realized
- Culture accepts litigation
- Trust and ethics are diminishing

Maintenance Contracts

Most state authorities in the USA typically have their own workforce for maintenance or they hire another local authority to carry out maintenance activities. Some states are granting contracts for long-term maintenance for periods of 5 years or greater. (The VDOT project was recently renewed for another 5 years). It is quite diverse and depends upon the road administration's level of expertise. Again, it is not practical or feasible to compare each state's practices in maintenance.

Some examples of long-term maintenance practices used in some of the progressive states are shown in Table G-3.

	Type of Contract	Contract Duration	Contract Method	Contractor Selection Criteria	Activities Included
Washington DC	Outcome-Based	5 Years	Lump Sum	50% Price 50% Other	All except Rehabilitation
VDOT Virginia	Outcome-Based	5.5 + 5 Years	Lump Sum	Negotiated	All except Rehabilitation
TxDOT Waco	Outcome-Based	5+3 Years	Lump Sum	100% Price	All except Rehabilitation
TxDOT Dallas	Outcome-Based	5+3 Years	Lump Sum	100% Price	All except Rehabilitation

TABLE G-3 Long-Term Maintenance Contracts in the USA

Benefits & Disadvantages

Benefits:

- Clients are receiving cost savings (unable to provide any objective figures)
- Better asset management
- Knowledge of the network data and conditions improved
- Innovation is enhanced through longer length contracts, lump sum, & quality-based selection criteria
- Usually equipment innovation & targeted maintenance
- Network quality is as good or better in these area contracts
- Partnering is working well
- Better management of the network & targeted maintenance - cost effective solutions
- Client has been able to transfer many risks to the contractor
- Duplicate inspections not needed - saves costs, too (random inspections only)
- Better level of service for the roads
- Share experience with industry and client agencies throughout USA

Disadvantages:

- New maintenance industry needed to be bonded
- Mobilization issues need to be discussed/resolved early in the process (costs & start-up issues and financial flexibility)
- How to input future innovations into the tendering process
- Targeted maintenance - not always what the client was normally used to achieving
- Loss of control by the Client
- Loss of flexibility by the Client
- Loss of costing information by Client
- Role of the client changes - utilizing more management skills and problem solving skills (also, required the Client to have “hands off policy” - change from commanding to partnering)
- Some loss of quality in the first few years, due to startup learning and developing the network
- No disincentives

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