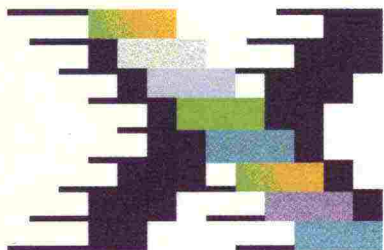


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GENERATION
INFRASTRUCTURES
FOUNDATION**

INTERNATIONAL OVERVIEW OF INNOVATIVE CONTRACTING PRACTICES FOR ROADS

by;

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February 19, 2007

RAMBOLL

 **TU Delft**

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INTERNATIONAL OVERVIEW OF INNOVATIVE CONTRACTING PRACTICES FOR ROADS



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FOREWORD

This international study titled “**International Overview of Innovative Contracting Practices for Roads**” was initiated from “The Netherlands” and derived from a large research program package called - “Next Generation Infrastructure (NGI)”. This study is one individual research component within NGI. This study is managed via Delft University of Technology and nationally funded in “The Netherlands” via Senter Novem & Delft University of Technology and co-funded in Finland by the Finnish Road Administration (Finnra) and its partners. These partners in Finland are Ramboll – Finland, The Confederation of Finnish Construction Industries (Rakennusteollisuus RT ry), and the Finnish Road Enterprise. The project manager for this project is Pekka Pakkala from Finnra, and the steering team consisted of Associate Professor and project leader Dr. Martin De Jong and Executive Director of NGI Dr. Paulien Herder, both from Delft University of Technology.

This international benchmarking study involves an international overview of innovative contracting practices, performance measures and indicators for the road sector. The main purpose of this project was to identify innovative contracting practices from various countries, and to ensure that “*Public Values – or Quality*” is being assured. Also, it was desired to determine the relationship of “*Performance Indicators*” and *Measures*” and those used in the actual tendering process. Overall it was desired to determine and summarize some of the good practices, lessons learned, innovations, and quality practices used for road portion of the infrastructure.

The countries/provinces selected in this study are as follows:

- Victoria, Australia
- Western Australia
- Alberta, Canada
- British Columbia, Canada
- Ontario, Canada
- England
- Estonia
- Finland
- The Netherlands
- New Zealand
- Norway
- Sweden
- In USA:
 - o Florida DOT (FDOT)
 - o Maryland State Highway Administration
 - o Minnesota DOT (MNDOT)
 - o North Carolina DOT (NCDOT)
 - o Virginia DOT (VDOT)
 - o DDOT (Wash DC - Maintenance only)

We are aware that this list is incomplete, mostly because some other progressive countries are missing from this list, but for reasons of time and language, a pragmatic choice had to be made.

There has been visibility of performance gaps between various countries with regard to the performance of road transport infrastructures. In those countries where liberalisation and open tendering of design, construction, maintenance, operation and/or combinations of each of them have taken place, authorities

have often assumed the roles of contract managers and quality monitors. One aspect of quality specifications or requirements is to determine which service levels are influenced and what performance requirements are incorporated into the contracts. These can be formulated in different ways and at different levels of aggregation for the various phases used in infrastructure management (design, construction, maintenance and operation), which has an impact on the opportunities for contractors to act flexibly and intelligently with relevant issues during the contract period. The underlying expectation is that these novel arrangements allow for lower costs and higher innovations while keeping up service levels with public expectations. It is here that the possible complementarities and tensions between the aspects of flexibility and those regarding public values become most visible. In those countries where all of these operations have remained in public hands, performance issues have often remained implicit, but are no less relevant.

In this project a systematic comparison or benchmark has been conducted, of which institutional structures exist in different countries, and how they impact on contracting practices and how they are adapted throughout time. The objective is to make an inventory of lessons learned, best practices, and possible recommendations when considering outsourcing of these services.

There are several different project delivery models or contracting arrangements in road transportation projects used throughout the world. Not until the last 10-15 years or so, have these alternative project delivery models been used or tested for the road infrastructure. Some reasons toward the shifting to these newer models can be seen by the results achieved and are attempting to provide innovations, better solutions, more efficiency, and at a lower or equivalent cost than traditional models. Also, due to the lack of skilled resources, finances, and decrease in human resources, road authority organizations are being motivated to use these newer types of contracting arrangements that will hopefully allow fewer resources for management aspects while maintaining the existing road network in satisfactory condition. The lack of substantial funding almost becomes the biggest challenge, but this was not the intent of this project.

Hence, this project was to seek out and evaluate the most innovative project delivery systems in use by the most progressive countries, for new construction projects and also for maintenance contracts. The duration of this project was essentially from January 2005 through December 2006. Considering the budget and time constraints, it is neither practical nor possible to evaluate issues in all countries, but rather to thoughtfully incorporate and analyze the most significant results and newer more innovative means.

The research approach to this project was to gather as many resources as possible through published details via reports, technical papers, conference proceedings, internet searches, and with contacts with other experts throughout the industry and internationally. It is very important to understand that there is a lack of published resources to meet the goals of the project, and this project included interviews/meetings with the appropriate authorities and experts in these countries. It was intended to discover the most recent innovative practices for both capital and maintenance contracts, determine some of the best practices, discuss some of the lessons learned, and attempt to decipher which methods might be recommended for application in the road sector. It is hoped that practitioners in the world of road infrastructures worldwide will benefit from the findings.

ACKNOWLEDGEMENTS

It is proper and deserving to honor the main sponsors' of the project - Senter-Novem and Delft University of Technology, both from "The Netherlands", who demonstrated the vision and need for such a project. Also, we are grateful to The Finnish Road Administration (Finnra) who valued the need to re-engineer the process and took the initiative to co-fund this project. In addition, it is proper to acknowledge and thank the Finnish funding partners, which includes Ramboll-Finland, The Confederation of Finnish Construction Industries (Rakennusteollisuus RT ry), and the Finnish Road Enterprise.

As a personal note of thanks, Pekka Pakkala the first listed author would like to mention Olli Nordenswan from Finnra, who saw the need and benefits of such a project, and to convince Finnra. It would not have gone forward or have been realized without his understanding and introspection.

Also, it is important to recognize those experts who reviewed the final working draft and their kind effort to correct any oversights in the report. Thank you!

Since this was an international and cross-national benchmark type of project, it is extremely important to thank all those that participated in this project. Their valuable time, knowledge, input, and most importantly willingness to share quite openly is the main reason that this report can share some of the lessons learned and issues encountered when facing these newer contracting practices. Those personal names are too numerous to mention, but it is proper to at least acknowledge the organizations that were included. Many who participated can reason what contributions are noted in this text. The organizations and countries are listed below.

Australia

VIC Roads
ARRB Transport Research
Works Infrastructure – Australia
VIC Roads - Southern & Eastern Integrated
Transport Authority (SEITA)
Main Roads Western Australia (MRWA)
Roadcare
Opus International - Australia

Canada

Alberta Infrastructure & Transportation
Lafarge – North America (Alberta)
Ministry of Transportation British Columbia
Partnerships British Columbia
Mainland South Island Contracting Ltd.
Focus Corporation Ltd
Ministry of Transportation Ontario
Carillion Canada Inc.
LaFarge North America (Ontario)

England

Department of Transport
Highways Agency
Balfour Beatty Ltd
Mouchel Parkman
Pell Frischmann Consultants Ltd
Halcrow International

Estonia

Ministry of Economic Affairs & Communications
Estonian Road Administration
Lääne Teed OÜ

Finland

Ministry of Transportation & Communications
Finnish Road Administration
Finnish Road Enterprise
YIT Construction Ltd
Ramboll Finland
RT - The Confederation of Finnish Construction Industries
VTT – Technical Research Centre of Finland

The Netherlands

Ministry of Transportation, Public Works and Water Management
Delft University of Technology
Heijmans Infrastructure b.v.
Dura Vermeer
BAM NBM

New Zealand

Land Transport New Zealand
Transit New Zealand
Opus International Consultants
Fulton Hogan Ltd
Transfield Services
Works Infrastructure
Fletcher Construction
Northern Gateway Alliance

Norway

Ministry of Transportation & Communications
Norwegian Public Roads Administration
Mesta
Kolo Veidekke
Selmer Skanska
Orkdalsvegen AS

Sweden

Ministry of Industry, Employment & Communications
Swedish Road Administration
Skanska

USA

Federal Highway Administration – FHWA

District Department of Transportation – DDOT

VMS Inc.– Washington DC

Science Applications International Corporation SAIC

Florida Department of Transportation – FDOT

Infrastructure Corporation of America – ICA

Florida Transportation Builders Association - FTBA

Maryland State Highway Administration – MDSHA

Facchina Construction Company

The Maryland Highway Contractors Association - MHCA

Minnesota Department of Transportation – MNDOT

C.S. McCrossan Inc.

Associated General Contractors Of Minnesota (AGC)

North Carolina Department of Transportation – NCDOT

Granite Construction Company

Virginia Department of Transportation – VDOT

VMS Inc. - Virginia

Bryant Contracting Inc.

Others

Halcrow International

The Ybarra Group, Ltd

Roy Jorgensen Associates Inc.

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EXECUTIVE SUMMARY

Today's key challenges are quite different from the past experiences in road management and require a different outlook in providing an efficient and effective road transportation system. Solutions to these challenges require a different attitude and innovative thinking as well as changes to the procurement practices. In order to depart from the traditional procurements practices it requires good leadership, time to implementation, courage to implement new practices, examples of successful project elsewhere, and changes to the internal public organization, which is no small effort.

Society is rapidly changing and becoming more of an information society. The general public is wishing and demanding to hold public authorities accountable for the expenditure of publicly collected tax money. Therefore, the road authorities need to find more efficient and effective methods for developing new road infrastructure as well as how to maintain the existing road network in good or acceptable condition. One way to gain efficiency is releasing the in-house maintenance works type personnel and allowing competitively outsourced routine maintenance practices. The other approach is to begin testing and trying new innovative procurement practices that will eventually be focused more on customer services and road user requirements. Congestion and urban sprawl appear to be problems without short term resolution and can be strong incentives for seeking alternative and innovative means to procure the main foundations of a mobile society and one that changes quite rapidly. Expansion or new road construction projects also need to be realized quickly and meet public values in the best possible way.

This study was to evaluate the international practices and methods that are used by many progressive road authorities and attempt to explain which practices might be more effective and meet the demands of the road infrastructure. This report is divided into two sections to distinguish the project delivery methods used for "*Capital Investments*" and those that are used for "*Maintenance Practices*". The countries chosen in this study are Australia (states of Victoria & Western Australia), Canada (the provinces of Alberta, British Columbia & Ontario), England, Estonia, Finland, New Zealand, Norway, Sweden, The Netherlands, and certain Departments of Transportation (DOT) in the USA (FDOT, MNDOT, NCDOT, VDOT, Maryland State Highway Administration, and DDOT - maintenance only). The significant findings are summarized below and dealt with more extensively throughout the body of this report.

Capital Investments

Most countries continue to 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 methods extensively. The use of PPP model, which incorporates private finance, has significantly increased since a previous study by the same first author in 2002. The main new method uncovered during the study is the "Alliance model" and Early Contractor Involvement" (ECI). Refer to Table 2 which summarizes the practices of all countries as well as other tendering information. These alternative methods seem to provide better results and are more aligned to reduced time of construction, improved cost control, equal or better quality, and overall client satisfaction.

These models are as follows:

- Design-Build (DB)
- PPP or Design-Build Finance Operate (DBFO)
- Alliance model - tentatively recommended

The main differences between Design-Build and all its alternatives as compared to the traditional models are:

- More transfer of risks to the party best able to handle and manage
- A teaming effort
- More opportunities for alternative solutions (design, innovations, constructability, & project management)
- Less administration (according to interviews) by the client organization.

There have been some noticeable impediments or difficulties when beginning to adapt and utilize these new Design-Build and its alternative models. These new models take time to develop, implement, and understand all the "tricks of the trade". Also, it is difficult to transform all the know-how to all those involved in the road authority all the way throughout the organization and throughout all road region personnel. The use of these new and innovative practices can be limited due to issues as relinquishing control from the methods based on traditional practices, limiting the design development to less than 30% (some even recommend 15-20%), having a majority of performance specifications fully developed, not using low-bid, lack of a real teaming concept, transparent information & communications, understanding risk allocation and responsibility, and having the private industry understanding these practices.

These issues and development aspects can be summarized briefly and the following shows five major categories that can be grouped together:

Learning Process:

- As a logical progression, Design-Build should be the first model tested
- Takes time to implement
- Creating trust with industry takes time
- Continual learning process - reengineering the models
- Performance specifications should be developed for Design-Build and all related DB models
- Standardization of contracts & continuity amongst all regional road authorities

Risks:

- Knowledge and competence of risks
- Allocating risks to the proper party
- Risk optimization

Gains by Early Contractor Involvement (ECI):

- Using the Early Contractor Involvement (ECI) model
- Minimize design development to < 30% or less
- Potential of the "Alliance model"

Quality:

- QC by contractor
- Quality Based Selection criteria for contract award
- Performance Specifications
- Contractor rating program
- Professional services rating program

Procurement Portfolio:

- Having a proper procurement strategy & project portfolio
- Having expertise in all models & disseminated to all regional personnel
- Offset higher tendering cost by compensation via stipends
- Consider short listing to a maximum of 3 tenders for medium and large-sized projects
- Consider the use of integrated phases for professional consultants for continuity
- No low bid tenders for the innovative models (except really small projects)

More details on capital investment projects are discussed in the "Capital Investments" section.

Maintenance Practices

Maintenance practices depend upon whether the physical works are done in-house (by public organizations) or are outsourced due to road reform, re-organizations, or other reasons. A majority of the countries in this study have no internal workforce and require outsourcing of the maintenance activities. During the earlier years of procurement of maintenance activities and during the first transition to outsourcing, the services were purchased yearly or via multi-year agreements, using separate contracts for each activity, and usually with a labor rate or unit price. Next, performance-based routine maintenance contracts began with 3 year contracts with service levels for quality standards and were typically unit price or hybrid contracts. The next progression was to longer and more lump type contracts.

Subsequently, there were more integrated contracts (periodic and routine maintenance), for a longer duration, basically lump sum contracts, using performance criteria or Levels of Service (LOS), and using more of a partnering concept. Table 12 in the Maintenance section of this report shows a summary of the different maintenance practice used by the countries in this study.

Figure 23 shows the international development of maintenance practices and it shows the development trend in today's maintenance practices. In short the results from this study continue to verify this trend of development and continue to be a valid strategy that many countries continue to follow. British Columbia, Canada has somewhat pushed the development as compared to the similar study, and their routine maintenance contracts are of 10 year duration.

The one new main development is the inclusion of the "Alliance Model" or what is termed E-MAC in England. This is a recent development and appears that this is a potential replacement of the Performance Specified Maintenance

Contracts (PSMC) or called Performance Based Maintenance Contracts (PBMC). Also, a significant observation is that the results from the PSMC type model have not been as expected. The "*Alliance Model*" is being investigated as a potential replacement model for the PSMC type models.

The following is a summary of the development of maintenance contracting:

- Opening the market to maintenance has been key issue and a deliberate process of development should be considered before advancing straight towards the advanced models
- Outsourcing of performance-based routine maintenance has demonstrated successful results
- Longer-term agreements - about 7-10 years
- Lump Sum or Hybrid type contracts (Combination of Lump Sum and Unit Price)
- Partnering and trust are still relevant (both Client & Sub-Contractors)
- Using quality-based contractor selection criteria
- Most innovations have been equipment related, ICT, and Project Management
- Alliance model appears to have good potential

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 is difficult (especially for public organizations), but is necessary to keep pace in today's society and the desire to progress into best practices that produce better services at a fair investment.

1 INTRODUCTION

The main purpose of this report is to present the results of a joint project between Holland and Finland, which involves innovative contracting practices and performance indicators. The results are based upon an international benchmarking type study and are derived from the road infrastructure. Also, this report presents the lessons learned and useful practices.

1.1 Background

As a background statement to this report, this particular project or study was essentially initiated from Holland by the introduction of a new technology program that is titled "*Next Generation Infrastructure - (NGI)*". This specific project is just one of many projects designed to assist the infrastructure development in Holland. Delft University of Technology received this grant and partnered with the Ramboll Finland and the Finnish Road Administration for the delivery for this specific project which was originally titled "*Cross-National Benchmark of Network-Bound Infrastructure: Performance Indicators & Innovative Contract Arrangements*" (NGI, 2004).

This is an international study and the following indicates the countries that were included in this study:

- Victoria, Australia
- Western Australia
- Alberta, Canada
- British Columbia, Canada
- Ontario, Canada
- England
- Estonia
- Finland
- The Netherlands
- New Zealand
- Norway
- Sweden
- In USA:
 - Florida DOT
 - Maryland State Highway Admin.
 - Minnesota DOT
 - North Carolina DOT
 - Virginia DOT
 - (DDOT (Wash DC - Maintenance only)

1.2 Methodology

The methodology for the project included an extensive literature review from resources that were available internationally, past studies related to the topic, collection of information via the internet, a "*Questionnaire*" that was completed by the experts from their respective countries, and probably most importantly - personal meetings with the experts during the country visits. One reason for the questionnaire and actual country visits is the limited amount of information publicly available, several instances of older or somewhat outdated reports and resources, and recent developments and upstarts to these approaches in the road sector that have not been documented. Also, the first author's past research projects, procurement experience, and expertise is used to complement the details gathered in the study Pakkala (2002).

The various aspects of contracting included in this report are capital investment projects, maintenance contracting, resurfacing contracts, design/civil engineering services, Public-Private Partnerships (PPP), quality/public val-

ues, and performance measures and indicators. In order to receive the most benefit and more holistic approach, the questionnaires and country visits included meetings with the client organizations, contractors or services providers, design/civil engineering professionals and some experts from universities and research affiliations. As a result of the first author being from the Finnish Road Administration, it was very efficient and quite effective to gather a large amount of information from a road authority's perspective, practices, and ideas upon improving the process. That being said, it was essential to maintain as much as possible, an impartial view.

1.3 Report Content

The goal of this report is to present the results, analyze and discuss the results, show the lessons learned, some of the best practices, the conclusions, and to develop or recommend which practices might be more fruitful.

The report is organized into five sections plus appendices and is structured in following manner. The lessons learned and recommendations are presented in the appendices.

- Section 1 - Introduction
- Section 2 - Capital Investment (including Professional Service Contracts)
- Section 3 - Maintenance Practices (both Periodic & Routine Maintenance)
- Section 4 - Performance Indicators
- Section 5 - Conclusions
- Appendix A - Lessons Learned from Capital Investments
- Appendix B - Recommendations for Capital Investments
- Appendix C - Lessons Learned from Maintenance Practices
- Appendix D - Recommendations for Maintenance Practices

Both the Capital Investment and Maintenance Practices sections will include discussion on:

- Contractor Selection Criteria
- Quality
- Conclusions

All of the above mentioned sections will address capital investment projects, maintenance contracting, resurfacing contracts, design/civil engineering services, Public-Private Partnerships (PPP), quality/public values, and to some extent performance measures and indicators.

It is not the purpose of this report to "*dig into*" the details that include each countries elaborate systems, practices, drivers, culture, business practices, and own ways of procurement practices. Even though they are relevant, it was decided that more of a lessons learned and best practices approach would be more beneficial and widely accepted. Also, a significant driver is to keep the output as brief as possible so that numerous readers will actually take time to indulge into the content and therefore very quickly understand the main issues of importance.

1.4 Client Issues, Drivers & Challenges

It is important to understand some of the motivations and drivers to seek new and innovative contracting practices. The subsequent paragraphs provide several explanations or reasons that have led to the use of innovative contracting methods. These are not in any order of preference or significance, but merely to understand the reasons and circumstances for the usage or trials in these newer type methods. It should also be mentioned that they are mainly initiated by the client organizations and they are the main drivers in the process to newer innovative practices.

Probably the most common and most difficult issue to resolve is the lack of sufficient funding to preserve the existing roads in good condition as noted in Short & Kopp (2004). There is also a lack of funding to meet the needs for expansion of the road network. There is significant data demonstrating lower expenditures across the years for roads in many countries and they can be somewhat attributed by meeting the other social needs and costs that have been increasing - for example the health care costs. Therefore, one of the main goals especially for maintenance type contracts is the savings achieved by the newer maintenance type contracts.

Another significant contribution or driver is the lack of experienced staff members, reductions in the staffing levels, and deficiencies in specialized areas of expertise. The lack of staffing resources is not expected to improve and conversely will get worse. In some countries it has become a common practice to hire new employees from other parts of the world. This is a difficult situation because there are no quick fix solutions and this is also true in the client organizations as well as for those providing those services. In many countries there is even a shortage of engineering professionals coming through the educational system that will even further hinder the hiring of future staffing experts. Sometimes innovative contracting arrangements require less management and administration and can explain in fact the reason for moving into these arrangements. Less staff is typically required to manage these innovative contracting arrangements.

Innovations certainly prompt many people's attention and drive the usage of different types of contracting practices. Some objectives are to utilize the innovations by designers/civil engineers, by contractors, and processes that promote innovative practices and systems. It makes practical sense to use those practices and arrangements that promote innovations, but actually achieving them can be a challenge.

Some countries are testing these models to determine if they do in fact produce efficiency in the process. Some contracting models do provide for more efficient approaches and timeliness in the process. Therefore, the efficient models are tested and used. These will be discussed more in their respective locations in the report.

One of the most significant issues encountered in the study and the reason why some countries seek the more innovative practices and why some stay in the traditional areas is in fact the differences in culture and traditional practices in those countries. For example, the Anglo-Saxon countries included in this study seem to have quite similar practices and very progressive approach,

especially in the maintenance type contracts. However, even within the Anglo-Saxon countries there are also extreme differences, such as the maintenance contracts in Victoria, Australia versus those in England. Some countries or states may be more pro-active, while others may be more cautious in adapting new practices.

Another driver can be seen within the client organizations and that is the "control issue". Most client organizations desire to continue to make all the decisions or controlling the processes, decisions, and means and methods. This can be seen very clearly in the Design-Build process as well as the long-term performance maintenance contracts that have the contractor making the most of the work process decisions. Those countries not using those innovative processes, are keeping controls of the decision making process. This control issue is a reality and the struggle for control to be released can be even more pronounced when trying to move into the Design-Build process where the most advanced countries plan and design up to conceptual design, which means about 15-30% design development before tendering. This is a strong area of conflict and has been noted in several other countries that take these statutory obligations too far, which are in effect keeping control of the development process. There has also been a similar struggle in long-term performance maintenance contracts, when the client tries to keep control, even though it has been relinquished in the contract. As a personal observation from the first author, this is a sort of cultural and control issue that is difficult to solve and typically cannot be altered overnight. This has an effect whether or not the innovative contracting practices are used and implemented.

Performance specifications have been thought to provide flexibility and to boost innovation by the contractors in Highways Agency (2004), but performance specifications (functional Specifications) have been quite slow to develop. Some have referred to performance specifications as outcome-based or describing the end conditions of the product or services. The development of performance specifications takes a great deal of time and good research to make sure that the performance levels meet the technical and material requirements. Also, there is need of verification and validity through robust data and practices. As the movement toward more innovative contracting practices progresses there should be more and more performance specifications or functional specifications used in the contracts. This sort of goes "hand in hand" with innovative contracting practices as one, more or less, complements the other. In FHWA (2002) the development of performance specifications is needed when moving towards innovative contracting practices and especially when private financing is included. Traditional methods rely extensively on very strict technical and material behavior requirements. Table 1 shows the progression of performance specifications and has a high correlation to the DBOM and DBFO models as opposed to the DBB and DB models. Even in Design Build model there should be more and more development of performance specifications.

MODEL	CUSTOMER FOCUS OR ROAD USER	PERFORM- ANCE SPECS	CONSTRUC- TION BEHAV- IOR	MATERIAL SPECS	RAW MATERIAL SPECS
DBB & cm	—	—	—	X	Y
DB	—	X	X	Contractor	Contractor
DBOM	—	X	Contractor	Contractor	Contractor
DBFO	X	Y	Contractor	Contractor	Contractor
Alliance	X	X	Contractor	Contractor	Contractor
Performance- Based Mainte- nance	—	X	Y	Y	Y

Source: FHWA (2002)

Table 1 Performance Specifications via Delivery Model

X - First level of consideration**Y** - Subsequent level of consideration**Contractor** - The "Contractor" may have to translate further details down the supply chain

Since the construction industry has typically been so fragmented, there is an interest or movement toward integration and innovative contracting models. The separation of design and any long-term maintenance and upkeep has been known as a limiting factor when the goal is to adapt to Life-Cycle Costs (LCC). Thus the interest and broadly accepted view that more integration increases the probability for successful project outcomes as mentioned in Courtney e. a. (2005), becomes a driver for the use of integrated and innovative contracting practices. However, as mentioned earlier the relinquishment of design control is a significant barrier which is also discussed in Herder e. a. (2004). This relinquishment of design actually means to provide less detailed design criteria (suggested maximum of 15-30%) before contract award in order to achieve innovative practices and constructability solutions from the contractor.

Copying and learning from one another is another driver, especially if those innovative practices do in fact provide better results. This can be seen in the "Nordic Road Association" and the "Baltic Road Association" where the Nordic and Baltic countries have common exchanges of information and practices, which promotes good practices from abroad. Copying of practices from one country to another is also been studied and reported in De Jong (2002).

2 CAPITAL INVESTMENTS

This section contains background information and the main results for this international study relating to “*Capital Investment Projects*” or commonly termed as new types of infrastructure development (new projects). This often means expansion of the road network and can be in form of lane widening, new bridges, tunnels, and just simply new road projects.

2.1 Background Information from Capital Investment Projects

Capital investments refer to those new type projects that require significant financing or capital for new bridges, expansion of road network, widening existing roads, or various types of safety and improvement features to the existing roads. These are typically outsourced to the private sector via various types of contracting agreements under the public tendering rules of each country. Countries in the European Union are required to follow the criteria in the EU procurement guidelines.

The Design-Bid-Build (DBB) or so-called traditional method has a strong separation between design and construction phases. The DBB method was essentially created around the time of the industrial revolution when the specialty fields of expertise of design professionals and contractors were developed and segregated from the integrated processes. The “Unit Price” contract (schedule of rates or bill of quantities) still seems to be the contract type developed under the traditional method.

This means that the contractor is paid based upon the unit price times the number of units put in place for each area of services or products delivered for that specific project. This requires a significant amount of administration and manual processes which can also contribute to potential conflicts. The quantities can be a source of arguments and lead to additional negotiations, as well as possible arbitration, if necessary.

Some countries are using the “*Lump Sum*” or “*Fixed Price*” contract for the traditional methods. This is essentially a total price for the entire construction work produced for that particular project.

Not until about the past 10-15 years or so, has there been a movement or trials toward more integrated contracts like Design-Build, Design-Build-Operate-Maintain, Design-Build-Finance-Operate, and the Build-Own-Operate-Transfer (BOOT) in the road sector. However, history reveals that some of the integrated contracts have been used in the past, but not as regular or normal part of most clients’ strategy and practices. Pakkala (2002) lists the definitions of the different models. These so called integrated or innovative procurement models have been somewhat more common practice in the buildings sector or vertical construction industry, where there was a need for fast and integrated delivery methods. These similar drivers are being used and tested to deliver road projects. Other drivers include downsizing of many client organizations and a need for lesser administration by the client organizations.

Also, the private finance models, such as the DBFO (many times referred to as PPP) and BOOT (and their variations – BOO, BTO & BOT) models are becom-

ing more widely used and the reasons vary from country to country. There are also other models similar to BOT and they are merely different financing, legal, ownership, and leasing arrangements. However, there is a common theme that arises, and that is the lack of public funding for road projects. Typically these projects are being delivered under the DBFO and BOT type models. The BOT type models have been used in a few road projects and are not a widely practiced as compared to other infrastructure sectors such as water, energy and power.

A new interesting model that has been used in some of the Anglo-Saxon type countries (UK, Australia, & New Zealand) is the "**Alliance**" model or the "**Early Contractor Involvement**" (used in UK). This will be discussed in more detail later as it is quite unique and requires further explanation. However, the Alliance Model attempts to solve some of the many issues in relationship contracting and boasts significant reductions of time consumed during the planning process.

The typical project delivery models available to be used for road projects are as follow:

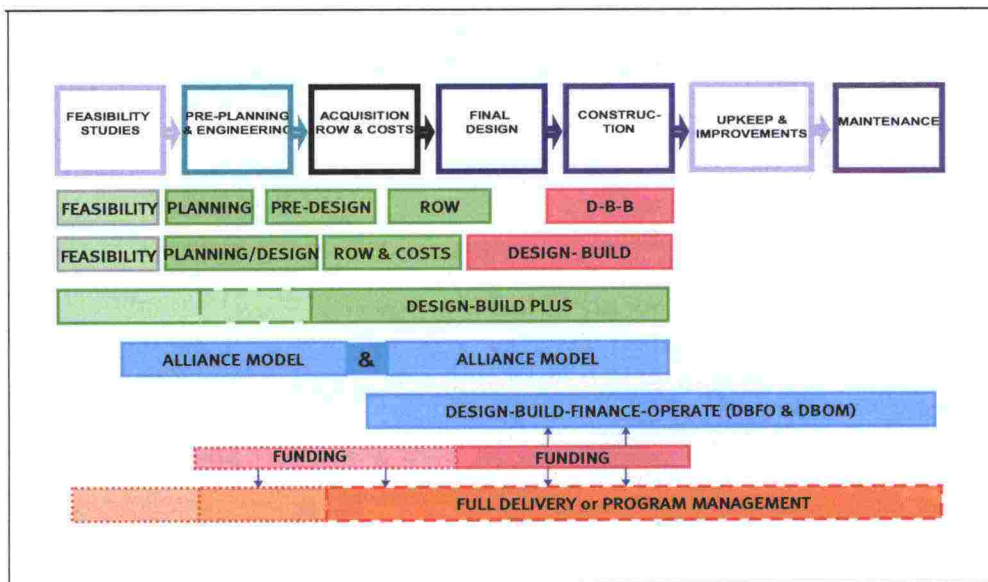
- Design-Bid-Build (D-B-B)
- Design-Build (DB)
- Construction Management (CM At-Fee) - Rare
- Construction Management (CM At-Risk) - Rare
- Design-Build-Operate (DBO) or Design-Build-Operate-Maintain (DBOM) - Rare
- Design-Build-Finance-Operate (DBFO)
- Build Operate Transfer (BOT) & Build Own Operate Transfer (BOOT)
- Early Contractor Involvement (ECI)
- New – "**Alliance model**"

It should be noted that the Construction Management (CM At-Fee) and (CM At-Risk) are seldom used. These are very similar to the traditional model as the design and construction are still separated. These two models are being tested in a few countries, but there were no results to include in this report. CM At-Risk and At-Fee are mainly applied when there are some buildings involved, such as rest areas and other types of building structures. However, Finland had tested these models in the early 2000s', but did not have any good results or positive experiences that would have caused interest in continuing these models. So, the Finnish Road Administration basically discontinued these models and will not be a standard practice. Basically, these models are used when the client is so downsized or does not have significant know-how for managing projects. This is not the situation for most road administrations, and most road organizations have significant project management skills and know-how in administration and contract administration and management.

It is not the purpose of this report to recommend that any one model is the solution for all projects. Actually, quite the opposite is true in that it very much depends upon the unique requirements of a given project. On the other hand, there are factors that affect the choice for a particular procurement method.

- Project costs
- Project size
- Available budget
- Degree of design development
- Project complexity
- Road market saturation
- Ability & competence of market
- Environmental issues
- Legal & financial risks
- Political issues -in project selection
- Degree of potential conflicts
- Degree of utility issues
- Client goals and objectives
- Time critical elements
- Client flexibility
- Distribution of risks
- Construction management skills
- Ability of construction market & resources

Figure 1 shows the main delivery models and the integration of the planning process through construction and maintenance.



Source: Finra (2003)

Figure 1 Main Project Delivery Models

Note that the Full Delivery or Program Management model has not been applied to any road projects and is more applicable to the building sector.

2.2 Summary Of Models

Table 2 displays the results from this study and summarizes the various procurement practices used in these countries. This table also includes the "**Contract Type**", "**Contractor Selection Criteria**" for each associated project delivery type, and a comment section for other explanations.

Information from Table 2 reveals that the main model for road projects remains the traditional (DBB model), which has been extensively used and probably will continue to be the main method for construction services for most countries, except in England. The separation of design and planning from the construction portion continues to be favored amongst the construction industry and many clients. The DBB results are discussed further in Section 2.2.1.

The Design-Build (DB) model is increasingly used as compared to the results from Pakkala (2002). More and more projects continue to use the DB method and many countries desire to test the efficiency and effectiveness. It is interesting to note that basically the Anglo-Saxon countries, USA (several DOTs), The Netherlands (has announced that Design-Build will be used extensively by 2007), and Finland are utilizing the Design-Build (DB) model. In England Design-Build is the standard practice for new projects and then the PPP mod-

el through the Private Finance Initiative (PFI). England is the only country in this study that does not use the traditional model and uses either Design-Build or variations of DB. Also, Ireland (not included in study) has joined England, and does not utilize the traditional model (DBB) anymore. In Finland, Design-Build is the model of choice, and basically all medium and large sized projects will be Design-Build, and small projects (typically under 2 million) will depend upon a thorough examination and what projects are practical for Design-Build. All models are being tested according to Finnra's "Procurement Strategy" Finnra (2003). Design-Build project delivery model has been used for road projects since the 1990s and has been expanding steadily in many countries and throughout the world despite the somewhat slow acceptance and implementation. As mentioned, The Netherlands has recently announced that the 90% of projects beginning in the year 2007 will be completed using the Design-Build model in Rijkswaterstaat (2004). The Design-Build results will be discussed further in Section 2.2.2.

Only Finland has completed any road projects using the Design-Build-Operate-Maintain (DBOM) model. This project is the extension of the relatively recently completed PPP motorway project (1989) called the E-75 Jarvenpaa-Lahti motorway. This new DBOM project extends the motorway to Heinola and is called Lahti-Heinola project. This project was completed on November 14, 2005. Massachusetts Highways in the USA was planning to use the DBOM or the DBFO model for the Route 3 project, but the actual tendering process was a Design-Build method that included finance, with a possibility of a maintenance option that was left to the discretion of the client (this is not a pure DBOM model). Refer to Section 2.2.3 for further details of the DBOM model.

It is interesting to note that the Design-Build-Finance-Operate (DBFO) or PPP model seems to be progressing forward as compared to the similar study by Pakkala (2002). More and more countries have tested and tried the PPP model and many other countries have been interested in this model. One of the main reasons for the increase in popularity and acceptance of the PPP model has been the lack of public funding for new projects. Also, some countries are testing the efficiency of the PPP model to determine the performance against traditional and Design-Build models. The PPP model and results are discussed in further detail in Section 2.2.4.

There are other project delivery methods that might be considered as PPPs, such as BOT, BTO, BOOT and all their variations. However, these are very rare as there have been only three projects in all the countries included in this study. They are almost a form of privatization, which tends to carry a negative connotation and is not detailed in this study. The projects that had used these models for roads are the Toronto 407 ETR (Ontario Ministry of Transportation - actually an auction type), the Melbourne City Link in Victoria, Australia, and the Dulles toll road in the US state of Virginia. One of the remarks was that these privatization models are being planned to introduce tolls or road user charging systems.

Some of the Anglo-Saxon countries like Australia & New Zealand are using the new "**Alliance model**" for road projects. The Alliance model is quite interesting and a new model that requires much understanding and substantial investigation to determine the value of such a process for any project. There are some issues that need to be considered and these projects should be selected in their early stages before too much design/planning has been completed. More details about the alliance model can be found in Section 2.2.5.

	D-B-B	DB	CM	DBOM	DBFO	ALLIANCE OR EARLY CONTRACTOR INVOLVEMENT (ECI)	BOT	MODEL	CONTRACT TYPE	CONTRACTOR SELECTION CRITERIA	COMMENTS
Alberta, Canada	X				X			DBB === DBFO ===	==> Unit Price === ==> Lump Sum ==	==> 100% Price ==> Lowest NPV	
British Columbia, Canada	X	(Rare or Past)			X			DBB === DBFO ===	==> Unit Price = == ==> Lump Sum ==	==> 100% Price ==> Lowest NPV or Upset Price with Quality	
Ontario, Canada	X	(Rare or Past)					407 ETR Toll	DBB ==== 407 ETR =	==> Unit Price === =====	==> 100% Price ==> Auction Type BOT	DBFO model under discussion & development
Estonia	X							DBB =====	==> Unit Price ===	==> 100% Price	Design-Build is under development and being pilot tested in near future
Norway	X	(Rare or Past)			X			DBB === DBFO ===	==> Unit Price === ==> Lump Sum ==	==> 100% Price ==> Lowest NPV	
Sweden	X	(Rare or Past)						DBB =====	==> Unit Price ===	==> 75% Price	
Finland	X	X	(Rare or Past)	X	X			DBB ===== DB/DBOM DBFO ===	==> Lump Sum == ==> Lump Sum == ==> Lump Sum ==	==> 75% Price ==> 75% Price ==> Lowest NPV	Very small contracts are Unit Price DB is the model of Choice. DBOM - Project completed Nov. 14 2005
Holland	X	(Few)			X			DBB ===== DB ===== DBFO ===	==> Unit Price === ==> Lump Sum == ==> Lump Sum ==	==> 100% Price ==> ==> Lowest NPV	Strategy for DB - 90% by 2007
Victoria Australia	X	X				X	X	DBB ===== DB ===== Alliance =	==> Unit Price === ==> Lump Sum == ==> Target Price =	==> 100% Price ==> Lowest NPV ==> 100% Quality	Bridges are usually Lump Sum DB - Short list to 3 Target Price with Pain & Gain
Western Australia	X	X				X		DBB ===== DB ===== Alliance =	==> Unit Price === ==> Lump Sum == ==> Target Price =	==> 100% Price ==> Lowest NPV ==> 100% Quality	DBB Projects are usually small projects DB - Short list to 3 Target Price with Pain & Gain
England		X			X	ECI		DB ===== DBFO === ECI =====	==> Lump Sum == ==> Lump Sum == ==> Target Price =	==> 50% Price ==> Lowest NPV ==> 100% Quality	Actual Prices with Pain & Gain
New Zealand	X	X				X		DBB ===== DB ===== Alliance =	==> Unit Price === ==> Lump Sum == ==> Target Price =	==> PQM Simple ==> PQM Special ==> 100% Quality	Up to 30% Quality or Lowest Price Lowest Adjusted Score Target Price with Pain & Gain
USA (MNDOT)	X	X						DBB ===== DB =====	==> Unit Price === ==> Lump Sum ==	==> 100% Price ==> 50% Price	
USA (NCDOT)	X	X						DBB ===== DB =====	==> Unit Price === ==> Lump Sum ==	==> 100% Price ==> 50% Price	
USA (VDOT)	X	X					X	DBB ===== DB =====	==> Unit Price === ==> Lump Sum ==	==> 100% Price ==> 50% Price	BOT - Dulles Greenway
USA (MDDOT)	X	X						DBB ===== DB =====	==> Unit Price === ==> Lump Sum ==	==> 100% Price ==> 50% Price	
USA (FDOT)	X	X	Pilot Test-ing					DBB ===== DB =====	==> Unit Price === ==> Lump Sum ==	==> 100% Price ==> 50% Price	FDOT is evaluating the CM@Risk potential, especially rest areas. The DBFO model (PPP) is being contemplated.

Table 2 Summary of International Results - Project Delivery Methods

2.2.1 TRADITIONAL MODEL - DBB

Some clients and contractors are satisfied with the traditional delivery model while other clients mention certain problem areas and issues for concern. Still other clients prefer the innovative or alternative project delivery methods, due to the more demanding needs in today's road building projects, traffic management concerns, and the appropriate risk transfer.

Table 3 lists some of the benefits and disadvantages of the DBB model that were obtained mainly from the private meetings and from many previously published resources. This should not be considered an exhaustive list, and highlights the main issues.

Based upon the number of projects, DBB is still the main method used by most countries and the "Unit Price" is the main contract type used, except for Finland. Finland uses the "Lump Sum" contract for DBB projects, which is also preferred by many contractors interviewed in this study. The "Lump Sum" element appears to provide a potential incentive and opportunity to use innovations that can lead to potential profits. There is less debate to verify quantities and potential quarrels than unit price contracts and there is also potential freedom and flexibility for the contractors to shift payment categories/attributes to meet the total lump sum payment.

METHOD	BENEFITS	DISADVANTAGES
D-B-B (Traditional Model)	<ul style="list-style-type: none"> • Long Proven History of Acceptance • Open Competition - Large Market • Distinct Roles Are Clear • Owner Flexibility • Owner Control • Easy to Tender • Low Tendering Cost 	<ul style="list-style-type: none"> • Innovation Not Optimized • Very Prescriptive Specifications • Usually Cost Overruns • Disputes Between Parties • Client Retains Most Risks • Incentives for Change Orders • Owner Responsible for Design Errors & Omissions • Linear & Lengthy Process • Lower Profit Margins • Contractor Cannot Affect Design

Source: Pakkala (2002)

Table 3 DBB Advantages & Disadvantages

Most countries use the DBB model with the lowest price criteria for selecting the winning tender. Finland and Sweden do not use the low bid method, as it is important to measure the "Quality Plans" and systems of the contractor, which cannot easily be compared in a low bid environment. Both Finland and Sweden use contractor led "Quality Control" systems in which the contractor is responsible for the "Quality Control - QC" in the supply chain management.

Typically in the USA, QC by contractors is difficult and most contractors in DBB contracts prefer the "Road Authority" to make the QC decisions, as it requires competence and knowledge of Quality Control systems. Typically there is very strict inspection done by the "Road Authority" in the USA to monitor the quality during the construction process. In some cases the "Road Authority" uses professional consultants to assist QC and Quality Assurance (QA) when there is a lack of own personnel or when the "Road Authority" has the lack

of experts. In Finland, Sweden, and in many Anglo-Saxon countries, most of the inspections are done by professional consultants as there is insufficient staff and project managers in the "Road Authority" to manage the QA aspects. These are usually tendered via normal professional service contracts. Sometimes it can be the same professional consultant that participated in the design and planning process and is quite beneficial as the knowledge and continuity of project is retained.

Lessons Learned - DBB Model

Some of the significant lessons learned that were mentioned during the interviews and questionnaires are as follows and in more detail in Appendix A.

- Lump sum contracts provide potential benefits for contractors
- Partnering
- Consider other options like A+B bidding, Lane Rental, & Incentives and disincentives
- Bundling several small projects provides gains and efficiency
- Good communications, quicker responses to questions & inquiries, and better management

Recommendations - DBB Model

Suggestions for re-engineering or improving the DBB model are included the following, however they have not been fully explained in this report, but were uncovered during the interviews and information derived from other recent research studies. Appendix B has more details.

- Lump sum contracts
- Partnering type concepts
- Financial rewards and penalties
- QC by Contractors
- Not Low-Bid selection criteria (includes other type measures aligned with project objectives)
- Ability to accept Alternative Technical Concepts (ATC) at tender stage
- Include LCC if possible (some do after tender award)
- Utilizing advanced project management information systems & ICT tools

2.2.2 DESIGN-BUILD - DB

The Design-Build (DB) model is an interesting and relatively quite recent model for many countries. In some of the more pioneering countries the DB model has been used for over 7-10 years and for some countries it is becoming the preferred model of choice for most medium and large sized projects. In England and Ireland (not in study) DB is the now the traditional process as DBB is not utilized. Even Estonia is now planning to develop and use the DB model in a pilot project. Recently Rijkswaterstaat (The Ministry of Transport, Public Works and Water Management - The Netherlands) has announced in that DB will be about 90% of project delivery models by the year 2007. In Finland DB is the model of choice and savings in the order of 10% has been reported. Most agencies have indicated that the use of Design-Build model will increase. Also, some refer to Design-Build as the Design & Construct method,

which is synonymous. In this report the Design-Build terminology will be used throughout the text.

Also, there have been numerous research studies on the topic and these have come to the conclusion that Design-Build is a viable and acceptable model to use for road projects. Design-Build is especially applicable:

- for time critical projects
- usually within allocated budget
- to increase the potential for innovation
- to optimize the constructability

One recommendation in Hughes (2006) indicates that early involvement by the contractor is required in order for the project to be effectively integrated. The objective of Design-Build is to bring the contractor earlier into the process, and the Alliance model brings the contractor into the planning process at the earliest possible stages of any give project. Koppinen & Lahdenpera (2004) show that Design-Build has an "economic efficiency" much greater than the traditional model and also demonstrates the attributes that can make Design-Build even more effective. FHWA & US DOT (2006) summarizes the results of comparing Design-Build to the DBB (traditional) model and highlights the benefits of the Design-Build as reducing the overall duration of the project and usually having a positive impact on project costs. In addition, the quality is essentially equivalent to DBB and is highly aligned to projects that have more performance specifications. Greater satisfaction is noted by having lower levels of design development before the tendering process. Warne (2005) also concludes that Design-Build is more aligned to reduced time of construction, improved cost control, equal or better quality, and overall client satisfaction. Also, Carpenter e. a. (2003) recognizes that innovative contracting practices encourage innovation, lower construction duration, reduces cost, and have comparable or better quality. However, the DB model should be used correctly and as it was originally intended.

The Design-Build model can also be utilized in the wrong form or abused, and basically any model can fail if the model is not understood and applied correctly. Koppinen & Lahdenpera (2004) and FHWA & US DOT (2006) include many suggestions, considerations, and recommendations for good practices for Design-Build. It is important to note that in order to make the Design-Build model more effective, the design progression should not be advanced too far prior to the tendering phase. This was a significant comment from many countries using the DB method.

Also there have been many cases of Design-Build for small projects and several clients have received significant benefits from these projects. However, there should be lighter restrictions and tendering requirements compared to the normal Design-Build and it is highly recommended to utilize a so-called "**light version**" for this process. In Finland the client has developed a light version of Design-Build model for projects typically under 2 million Euros. In regular DB projects, there is a "Request for Qualifications" (RFQ) and bidders are subsequently short-listed to 3-6 competitors before a full tender is provided. Many countries have been recently short-listing to 3 tenders for medium and large sized projects in order to reduce the tendering costs and "false offers".

Table 4 lists some of the benefits and disadvantages of the Design-Build model that were obtained mainly from the private meetings and from many published resources. This should not be considered an exhaustive list.

Lessons Learned - DB Model

Some of the significant lessons learned that were mentioned during the interviews and questionnaires, and from additional references are noted as follows:

- It is important to understand all aspects, implementation issues, time to develop, & re-engineer the Design-Build model according to local practices. FHWA & US DOT (2006) and Koppinen & Lahdenpera (2004) are resources for understanding Design-Build and model improvements
- There is a large gap of understanding, expertise, and knowledge with Design-Build models amongst the client organization's experts, especially at the regional level. Even greater differences were noted between the regional offices
- Develop Performance-based specifications. (Performance-based specifications have a strong relationship with Design-Build and their other variations)
- Limiting the amount of design development before tender (greater advantages with less)
- Co-location of Design-Build team with client (Quicker decisions and efficiency)
- Use partnering and teaming concepts
- Develop systems to measure Alternative Technical Concepts (ATC)
- Risk matrices and analysis should be developed and incorporated into DB model
- If possible, bundling several small DB projects

METHOD	BENEFITS	DISADVANTAGES
Design-Build	<ul style="list-style-type: none"> • Reduced Administration • Single-Source Responsibility • Quality Equal or Better Than D-B-B • Innovation Potential • Savings Potential • Projects Completed Faster • Improved Risk Management • Early Knowledge of Total Costs • Accountability • Constructability Optimized • Early Partnering Potential & Trust Building • Integrating Design & Construction • More Risks Transferred to the Design-Builder • Design Reflects Contractor Strengths & Ability • More Rewards/Profit for Contractors • Usually Guaranteed Maximum Price (GMP) • Contractor Responsible for Design Errors & Omissions • Contractor has Better Capability to Plan & Manage Project • Contractor has More Flexibility and Freedom from Strict Client Idiosyncrasies • Opportunity for Contractor to use product development 	<ul style="list-style-type: none"> • New Method & Unfamiliar With Process - Lack of know-how • Not taking advantage of the DB model in limiting Design development to under 30% (This is where the innovation potential is maximized) • Still too many technical and Prescriptive requirements for model effectiveness • Client Needs to Make Quicker Decisions • Initially difficult to develop and change the cultural acceptance. (Design Professionals - resistance) • Transformation to QC by the Contractor is slow • Client learning process - especially different practices from region to region. (Many offices have differing interpretations and practices of DB & misunderstandings continue to plague the DB model) • Client difficulty in approving alternative technical concepts, - more in DB projects • Limiting the Competition • Higher Tendering Costs

Updated from Source: Pakkala (2002)

Table 4 Design-Build Advantages & Disadvantages

Recommendations - DB Model

Some improvements to the DB model that have not been fully explained in this report, but were uncovered during the interviews and information derived from recent research studies include:

- Maximum design prior to tender < 30% (Huge hurdle)
- Using Quality-based selection criteria (guideline - spread of greater than 40% is recommended)
- Develop performance-based specifications as a deliberate process
- Use real teaming & partnering concepts
- Consider reward sharing practices within the DB contractor's team
- Allow and accept Alternative Technical Concepts (ATC) at tender stage
- Co-location of Design-Build team with client
- Utilizing advanced project management information systems & ICT tools
- Risks allocation matrix at tendering stage

2.2.3 DESIGN-BUILD-OPERATE MAINTAIN - DBOM

In Finland the Design-Build-Operate-Maintain (DBOM) and Design-Build-Finance-Operate (DBFO) models are termed as "**Life-Cycle Models**" due to the closer relationship in obtaining "**Life Cycle Costs (LCC)**" provided the duration is significantly longer. The main difference is that the DBOM is using public or direct funding and the DBFO model includes private funding from various sources. Of the countries/provinces/states included in this study, only Finland has used the DBOM model and this project was completed in November 2005 (Lahti-Heinola project). This project is for 27 kilometers and is a motorway standard, which now completes a full motorway section from Helsinki to Heinola. The agreement includes maintenance and any operations up until the year 2012. DBOM model is part of the strategy of the Finnish Road Administration (Finnra 2003) to evaluate all main forms of project delivery models and test the results for overall evaluation. The Lahti-Heinola project was estimated to save approximately 15% compared to the traditional model - DBB.

Since there is no robust data available on this model for road projects, it is difficult to make any conclusions other than those from the Lahti-Heinola project in Finland. However, there have been considerable comments by the contracting professionals (in this study), stating that the contractors would significantly include better quality practices as they would also be responsible for the maintenance aspects. Some contractors said that they would consider more whole life costs and even add more quality into the project to make sure that the maintenance costs would be optimized. This is a significant comment which makes practical logic and is worth mentioning. Koppinen & Lahdenpera (2004) includes the DBOM model as having better economic efficiency compared with the Design-Build model and even significantly better against the DBB model. Also Table 5 shows the advantages and disadvantages the of the DBOM model. There are so few DBOM road projects to evaluate that is not practically possible to determine results without further research. More study and research on this model is needed with actual project results.

Method	ADVANTAGES	DISADVANTAGES
DBOM	<ul style="list-style-type: none"> • Integrates the Process of Design, Construction, and Maintenance • One Contract for All Services and Products • Maintenance & Any Operations Aspects Can Be Considered During Design • Better Quality (via interviews) • Better Life Cycle Costs • Similar Benefits Earlier Mentioned in DB 	<ul style="list-style-type: none"> • Longer Tendering Process than DB • Costlier Tendering than DB • Similar Disadvantages As Earlier Mentioned in DB

Updated from Source: Pakkala (2002)

Table 5 DBOM Advantages & Disadvantages

2.2.4 DBFO & PPP

Many refer to Design-Build-Finance-Operate (DBFO) model as the Public-Private Partnerships (PPP), but there are many definitions, forms, and variations of Public-Private Partnerships. However, in this report, PPP will be used synonymously as the Design-Build-Finance-Operate (DBFO) model (Finland uses the term "**Life-Cycle Model**"). The following definition is the first author's preference as it stipulates an arrangement that brings together the "**Public Sector**" and "**Private Sector**" in a long-term relationship or partnership, for the mutual benefit of both parties, with the "*emphasis on long-term and benefiting both parties*".

Many countries around the world are striving to answer the challenges in constructing and maintaining the transport infrastructure, which are important for the development of society. The recent trend in the lack of funding for capital investment projects has been a common problem for many road authorities. Most road authorities are lacking a road fund or earmarked funds and are dependent upon the typical year to year budget fluctuations and approval processes for new capital investment projects. Also for those countries that focus on "*Preventative Maintenance*" and outsourcing of maintenance for the entire or nearly entire road network, there are insufficient funds for development projects and meeting the needs of road expansion or widening. This is especially true for construction of large road projects and PPP is attracting the attention of many road authorities and from many countries not included in this study. More countries are now using the PPP model and Table 6 shows the PPP projects that have been completed or underway in the selected countries.

COUNTRY	NUMBER OF PPP PROJECTS	BOT	COMMENTS
ALBERTA CANADA	2		2 more planned
B.C. CANADA	4		
Ontario canada		1	ETR- 407 Project - Auction (PPP under discussion)
NORWAY	3		
FINLAND	2		
HOLLAND	5		3 more planned
ENGLAND	12		M25 DBFO London Ring Road in Tendering
VDOT - USA		1	Dulles Greenway Project (PPP Under Discussion)
Victoria Australia		1	Another BOT - East Link project under investigation

Table 6 PPP Road Projects by Country

PPP projects vary with each country and England has tendered more PPP road projects than any other country. England has used the PPP model for over 600 different types of projects with successes as well as problematic experiences. However, the road projects have been quite successful and a

report by National Audit Office (1998) summarizes the results of road projects as quite good in terms of "Value for Money".

Often the argument is raised that in some countries where the credit-worthiness of the state is very high (for instance, Finland which has a triple A rating), interest rates for the Ministry of Finance for loans at the capital market are lower than for private construction firms or consortiums. This argument is flawed to the extent that the state can be a reliable lender since it always has the opportunity to pass on risks and higher costs to the tax-payer.

Despite the successes in one country, it does not necessarily mean that PPP can be successfully implemented in all countries. England has led the way and other countries like Alberta and British Columbia - Canada, Finland, Holland, Norway and Virginia DOT (BOT) have reported good results for road infrastructure type projects. However, each country has differing cultural reference points and each country needs to decide whether the PPP model is appropriate for projects in their country.

A feasibility research study on PPP would certainly assist a great deal. It would be a very wise decision to thoroughly evaluate and conscientiously study all aspects of the PPP model for any proposed projects. There are so many dynamics involved and securing a project over a long-term period requires much research, wisdom, and a huge learning process for the client as well as the service providers.

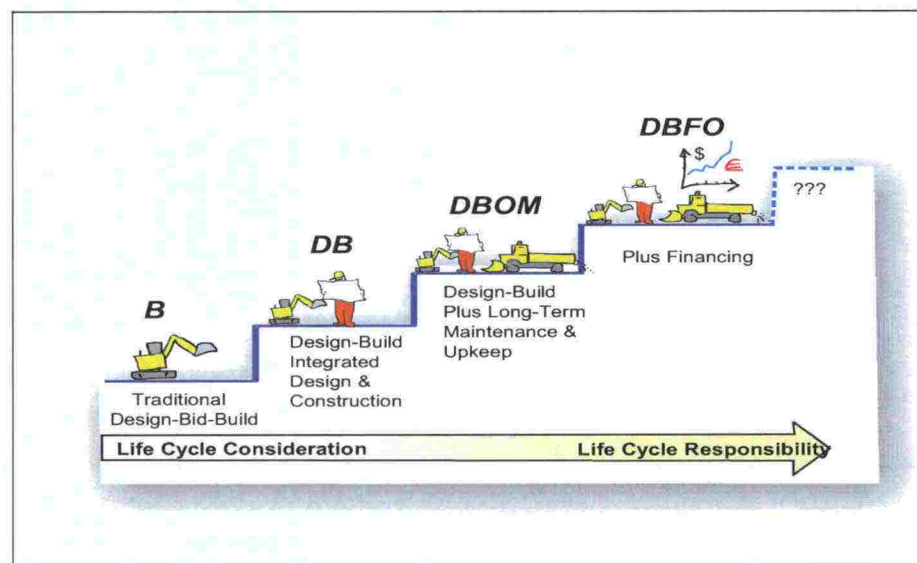
It is very important to understand the concept of Design-Build which is the root of PPP. PPP basically means design, construction, maintenance, any operations, and private financing for a long duration, which typically is for about 30 years. If Design-Build has not been practiced or utilized in a country, it is very difficult to move from the traditional process straight into PPP. In other words, it is strongly recommended that one has some knowledge and experience of the Design-Build model and was doing it correctly, before proceeding to the PPP model. This may have a significant effect on whether PPP will produce the highly publicized benefits that have been reported in many publications. It is possible to move directly from the traditional model into PPP and some countries have done this, but the results will not be as beneficial had the lessons learned from Design-Build been implemented in the past.

The illustration in Figure 2 shows the project delivery methods typically used for road projects and also shows the stages of progression from one model to another. Usually, it requires some form of development, research, studies, experience and etc. before moving to the next progressive model. It is easy to visually see and understand from this figure that it is quite difficult to move directly from the traditional model directly to the DBFO model. The experience of testing and implementation of any models in between can be considered as a learning process. This will help alleviate any possible difficulties and lack of experience when the DBFO model is attempted. Any valuable experiences learned from those models will make adaptation quicker and more beneficial.

Additionally, it is very difficult to describe the maintenance related requirements portion of a DBOM or a PPP contract, if one has never outsourced maintenance in the past or had any experience in specifying contracts for maintenance. In practice it is difficult to determine maintenance outcome type

criteria, service levels, risks and many additional aspects if they have never been done in the past or scoped in any contracts. It is much easier to use existing maintenance contracts and translate the maintenance requirements into a PPP agreement (about 20-30 years), when one has acquired experience in outsourcing maintenance and realized the lessons learned and best practices.

Since PPP involves private finance there are many aspects of private finance that need to be considered before undertaking such a progression forward. For example there needs to be legal verification that private finance can be used. For example, in the USA the Federal Highway Administration (FHWA) adopted SEP-15, to provide more flexibility to the states to have early involvement of the private sector in projects likely to use PPP's. Also, other countries may require some type of legal approval or authorization for private finance.



Source: Finnra (2003)

Figure 2 Project Delivery Progression

Payment Mechanism

Since the payment mechanism is an essential part of the private finance component, it is necessary to discuss this point. Since private finance is involved, this means that loans will be required from the private sector as well as large infrastructure banks, or possibly the European Investment Bank (EIB). Since the payment mechanism is the main form to capture all expenses, overheads, Return on Investment (ROI), and profits, it should be designed to favor the least amount of risks so that the most favored interest rate can be obtained. It should also be understood that these financial sources do not accept many risks. The risks within a project also determine what financial rating will be applied to a project. This leads to the next issue of determining what types of risks are associated with the payment mechanism used and if they are associated with market risks or non-market risks. The concessionaire or "DBFO Company" that wins the contract award needs to obtain private financing from the private sector, other consortium partners, and borrowing money from financial institutions. Even a small fraction of a percentage rate has a significant impact on the Value for Money (VfM) or costs over the life of the concession.

The main types of payment mechanism are as follows:

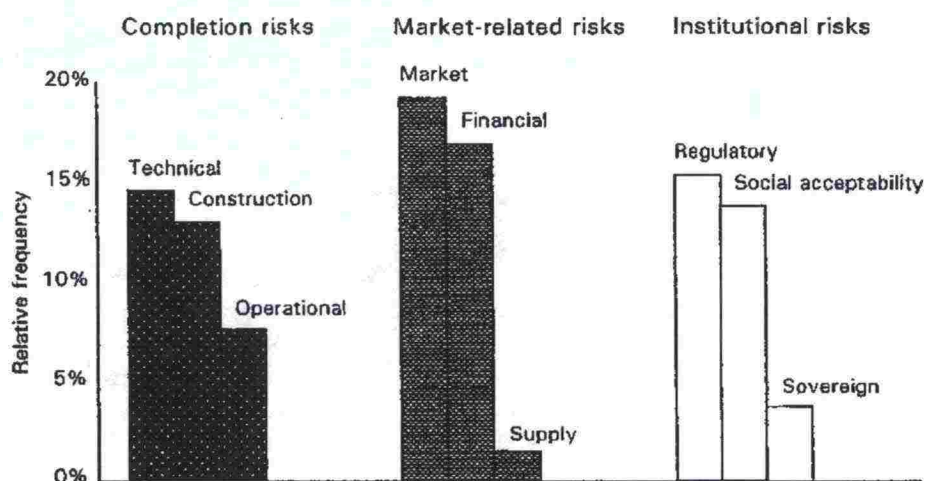
- Availability Payments
- Shadow Tolls
- Real Tolls (heavy vehicles or all vehicles - market risks)
- Performance based payments (England - A1 Darrington-Dishforth PPP project)

Also, the financial ratings in a country can determine the rates at which the borrowing risks are determined by the financial sources. These can have a great impact and sometimes can determine who will provide the best Value for Money (VfM) and eventually lowest Net Present Value (NPV) and eventual winner for the PPP project. Thus the financial partners have a large influence upon the entire project and the optimum payment mechanism should be achieved. If tolls are used then they are considered as a market-based risk and can incur higher interest rates, if the risks to the financial partners cannot be minimized. Shadow tolls were used quite often during the earlier PPP contracts as the risks were capped based upon "**the bands**" in the shadow toll calculations. Recently the "availability payment mechanism" seems to be the favored mechanism as it incurs less risk to the financiers. In other words the "Availability Payment Mechanism" has significantly more favorable financial impacts as opposed to a toll road which has some market risks because it is difficult to forecast the actual usage and is thus part of the financial impacts and affects the overall VfM. This report does not cover the details of each payment mechanism and generally summarizes the main ones.

Therefore it is important to consider choosing market type risks versus non-market type risks and how they affect the VfM of a project. On the other hand it is important to find a funding stream to pay back for the investment and some form of toll for roads seems to be one of the options for reimbursement. Fortunately, there are financial advisors to assist the client to determine the best situation for that country's project as most road authorities have not needed this expertise as funding has typically come from the governmental allocation system.

One strong criticism that has been raised by many contractors is that it is a difficult development process to find strong financial packages. Many medium and even some larger contractors cannot qualify for the best financial packages while often very large/global contractors find the best financial rates. However, these smaller contractors are able to become sub-contractors to the winning contractor if desired, but this is not the preferred choice by most contractors.

Figure 3 from Miller & Lessard (2000) displays the different types of risks that can be encountered in large construction projects. This figure shows that the greatest risks to be encountered are those from market based risks. These should be optimized in order to receive the best possible payment mechanisms so that VfM can be achieved. It is interesting to note that the next highest risk is financial. The main point is to reduce or minimize the greatest potential risks in order to achieve the overall best for any project. It is wise to consider the greatest risks first, and the lesson to be learned is that market and financial are more important than technical and construction risks. One simple choice could be to reduce market based risks altogether, and choose the availability payment mechanism.

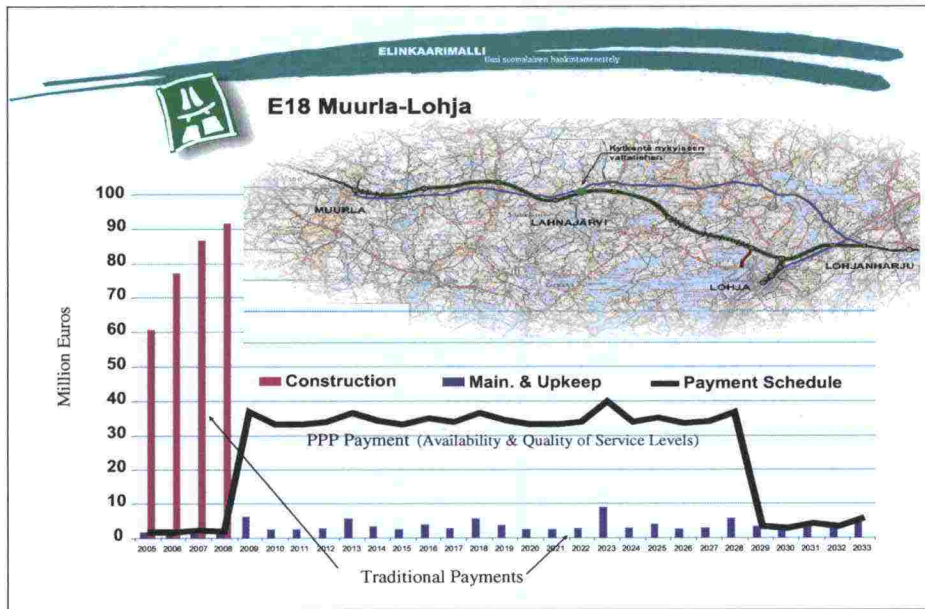


Source Miller & Lessard (2000)

Figure 3 Market Based Risks

As an example of the availability payment mechanism, Figure 4 compares a traditional payment scheme to the availability payment for the recently tendered E-18 PPP project in Finland. The figure attempts to show the difference between the payments in a traditional project versus that from a typical PPP project. In a traditional project, the client or government would be responsible for the capital costs of the project during the construction phase, plus all maintenance costs throughout the life of the project. This can be seen by large vertical bars on the left side of the figure (year 2005 to 2009) which represents the capital payments. The smaller vertical bars (shown by the traditional payments arrows - years 2010 to 2030) showing the maintenance costs required for each year of operation.

On the other hand the PPP payment begins after the project is completely constructed and approved. Then the payments start and remain relatively horizontal across the contract duration depending upon the quality of service and availability (shown by the PPP payment text around the 35 level) of the road to public use. The PPP payments begin from the year 2009 (proposed completion date) through to 2029, when the contract period ends and the road project is completely returned to the client.



Source: Finnra (2003)

Figure 4 Finland E-18 Availability Payment Mechanism

Some countries have established or created a PPP team within the client or road authority organization. England has implemented many PPP projects that have justified the need for the creation of a PPP team to carry out the due diligence from the early planning phases throughout project completion. The benefit of having a PPP team is the continuity and competence does not have to be recreated if the project is in another jurisdiction or region. PPP projects require different skills and expertise, so that a PPP team within the road authority would be beneficial as the tendering aspects require a different level of expertise. This also helps retain a knowledge center within the organization when another PPP is proposed. If only one or two projects are being developed then a PPP team probably will not be necessary.

England has also developed sophisticated and modern practices in their PPP management of contracts. One organization called Partnerships UK establishes the feasibility and business cases and they also have a "Gateway Review Process". These are very advanced stages and features and are mainly used in the UK as they have developed a formal process. These are not needed by most countries until a significant amount of PPP projects, but demonstrate that a commitment or scheme similar to the Private Finance Initiative could be worthy.

Despite the many issues and complications involved in PPP projects, a report by Koppinen & Lahdenpera (2004) shows that the economic efficiency of PPP projects are better as compared to DBB and DB models. Hughes e. a. (2006) also indicates that partnering and collaboration in PPP can be viable despite the increased tendering costs associated with private financed projects. "Value for Money" (VfM) will probably be the ultimate test of the PPP project delivery method. PPP can be successful if used wisely, and will probably account for a minor portion of the project delivery methods used for road projects. There is also a limit to the amount of PPP projects that can be sustained from the finance ministry or treasury departments.

Drivers for PPP

It is important to understand some of the drivers for PPP projects and why this is attracting attention globally. As mentioned earlier and probably the most common reason is the lack of public funding for road projects. Even though this was not the intent of the PPP model, nevertheless it has been one of the key drivers.

Originally the PPP model was developed in the late 1700s when there were few roads, rail transport was developing, and harbors and ports were being constructed. The PPP model was designed to increase the pace of infrastructure delivery via private financing as well as public financing. That is the beauty of this model and was intended to quickly develop the infrastructure. A systematic application of public and private investment could build the infrastructure at a rapid pace to achieve economic viability. Today's situation is quite different and expansion to meet the urban congestion is an important part for using the PPP model.

The efficiency of the PPP model is another reason why many countries are trying to use it. This efficiency can be understood in several ways. First the efficiency should result in "*Value for Money*" (VfM) and also to complete projects faster than traditional methods. In addition, there should be the incentive to utilize innovations and better quality (more durability) by seeking after whole life solutions or "*Life Cycle Cost*" (LCC). These hopefully will be the achievements from successful PPP projects.

Off-balance sheet (not considered as a public debt) were previously considered as a driver or incentive to use PPP, but the new European Union (EU) rules have changed and has a new definition of what is considered off balance sheet. This is not a significant driver anymore, but was mostly that in the past.

Another driver was to pass through risks from the public sector to the private sector, because it was the government and eventually the tax payers who took the risks in traditional projects. The old saying about risk is allocating them to the party that is best able to influence and manage risks. In PPP projects risks are an essential part of the process and include passing construction, design, and financial risks to the service provider. As one is more experienced in risks, then it becomes an issue to optimize the risk transfer, because one could pay too much for risks that never occur. Many have developed sophisticated risk analyses and matrixes for the PPP model, which can assist in determining VfM and the tradeoff between certain risks. This also can be accomplished with the assistance of experts dealing with these risks and by the financial advisors to the client.

One issue that is not so apparent is the fact that PPP will not disrupt other projects in client's portfolio package of normal budgetary allocations. So this means that the other capital investment projects through the traditional budgetary process will not be affected as this is typically a separate line item in the budget calculations.

Another small issue is that it helps create a national learning process of PPP and assists the promotion of international competitiveness, whether it is for

consultants or the construction sector. This is demonstrated by the presence of many consultants, legal advisors, financial advisors, and other types of consultants that are coming from England and elsewhere in Europe. Even some financial lenders from Australia are entering the market as location is not the determining factor when dealing with private finance.

Differences in PPP Contracts

PPP projects are very different from traditional and DB methods. Since private finance is involved it is very important to develop a business case for the project and make sure that it is viable and what some call "**bankable**". Traditional projects had to be politically attractive and approved, but PPP projects need to be financially attractive.

Other developments that differ from non PPP projects include the following:

- Develop some form of a comparison such as a Public Sector Comparator (PSC). There needs to be some form of comparison that PPP projects are better than traditional methods. This can be in the form of a simple comparison or one that requires a formal PSC
- Begin to transform existing technical specifications into "*Performance Specification*" & "*Outcome Based Criteria*". It is an essential part of the PPP model and can be basis of potential innovations
- Also approving Alternative Technical Concepts (ATCs) should be a formal practice in order to approve new and untested solutions
- A "Payment Mechanism" should be developed and one that reduced risks and costs
- Developing a risk matrix for technical, financial, and project risks
- Hiring financial, legal, and technical experts
- Determining the road condition after contract expires or a "*hand-back clause*". This is important to define the technical conditions and quality standards that the road characteristics will be returned back to the road authority. It is recommended that some financial fund be escrowed to account for any lacking quality during the last five years of the contract. This might be considered a guarantee that the project would be returned in good order or the escrow fund pays for needed corrections

Key Choices & Issues in PPP Contracts

There are many other considerations, choices, key issues, and aspects that should be understood before undertaking PPP projects. Several of these are summaries and highlighted in the following and in more detail in the lessons learned section in Appendix A. The following are some of the main choices available once the decision has been made to go forward with a PPP project.

- Toll roads are market based risks
 - Market risk payment mechanism:
 - Real tolls collected - all vehicles
 - Heavy vehicle tolls
 - Performance-based and /or congestion based
- Non-market based risk projects
 - Availability
 - Shadow tolls

- Series of projects – or just one? (how to attract "international players")
- Any stipends to non-winners (helps reduce tendering costs)
- "**Open Book**" (for Life Cycle Cost)
- How tenders are awarded - (lowest NPV or best value or other)
- Having a "PPP team" or ad-hoc staff
- How the evaluation of "**Alternative Technical Concepts**" (ATCs) will be managed

Lessons Learned - PPP Model

From the information mentioned earlier, the significant lessons learned are as follows and are categorized according to the different actors involved. These are highlighted as:

Overall Ministry & Society

- There may be legal issues preventing private finance and may need law changes or government approval
- Need a good "Public Sector Comparator" (Benchmarking capability)
- In PPP - consider series of PPP projects and not just one - costs of entering market is high
- Selecting a good measurable, objective "Payment Mechanism" (Transparent)
- Influence of project size – recommendation of over 80 million Euros

Road Authority

- Risks from both a legal, financial and design & construction perspective
- Adding as much as possible "Performance Specifications" & "Outcome-Based Criteria"
- Enticing international competition & ability to find/network with reliable national partners
- Consider the use of stipends to offset the large tendering costs
- Monitoring & measuring acceptance during the "Delivery Phase" (construction portion)
- Appropriate "Hand-Back Clause" (what is the condition of the asset when returned back to the authority)
- If you have not outsourced maintenance activities via maintenance contracts, it will be difficult to include all the detailed aspects of maintenance into the PPP contract

Private Sector Contractors & Others

- Ability to get competitively priced private finance
- Lack of understanding of DBFO delivery model

Recommendations - PPP Model

Suggestions for the PPP model is included in the following, however they have not been fully explained in this report, but were uncovered during the interviews and from other recent research studies.

- Having a legal framework for private finance (don't assume it already exists)

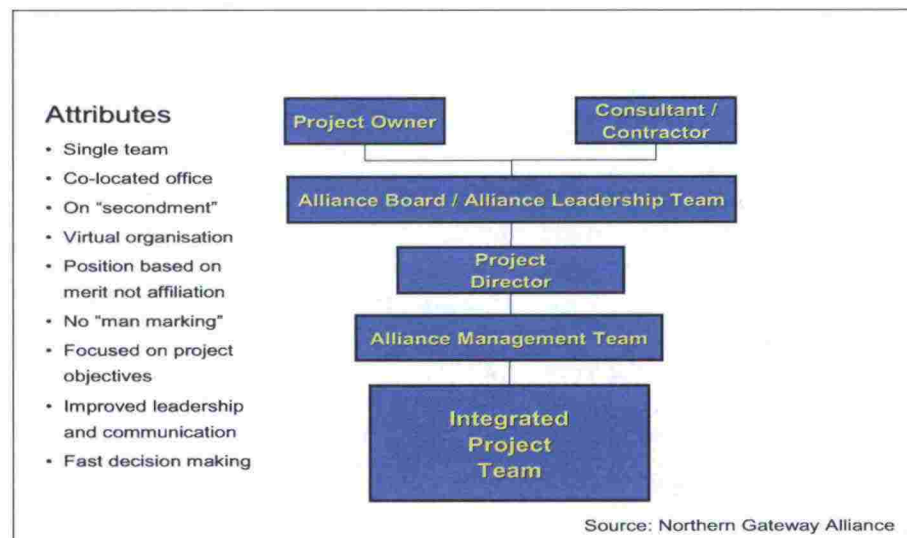
- Understanding all the issues, consequences, pitfalls, and important aspects of PPP model. (May have to prepare a feasibility study on PPP for your local practices)
- Understand private finance and legal/banking/financial requirements and consequences. (may need to hire financial professionals)
- Having approval at high governmental levels - Ministry of Finance
- Having a benchmark comparison - some form of Public Sector Comparator (PSC)
- Developing a business case for projects
- Thorough understanding of risks and risk optimization. (May have to prepare a research study on risks and categorized according to all main models)
- Understanding different payment mechanisms & which ones provide better value
- Assigning a client PPP team that is continuously involved in all aspects of PPP projects
- Determine project size for PPP - typically general guideline has been greater than €80 million
- Developing performance specifications as a continuous process
- Accepting Alternative Technical Concepts (ATC) - numerous in PPP projects
- Early contractor involvement by minimizing design prior to tender < 25-30% (huge hurdle)
- Make long-term private finance contract that is flexible
- Short Listing to 3 potential candidates

2.2.5 ALLIANCE MODEL

As mentioned earlier, a recent newer model has been identified as the «**Alliance Model**», which has been utilized for road projects. This model has been used in Victoria and Western Australia, New Zealand, and England. In England it has been termed as the «**Early Contractor Involvement (ECI)**» and to the best knowledge it is quite similar to the Alliance model. It is quite difficult to define the Alliancing Model in brief, and it might be easier to understand «Alliancing» by describing the features of this model. In the Alliance Model the selection of the winning alliance in the tendering process is based upon the alliance team that is best capable to bring a project to completion. In other words the alliance team is selected by **100% «Quality Criteria»**. The winning alliance will be able to bring the remaining portion of the client's design/planning process and develop it until a «Target Price» can be determined for the project construction. This means that the winning alliance has the obligation to complete a project from the very early design/planning phases right to project completion, and is paid all costs (including profit & overhead) up to the «Target Price» for construction. Depending upon the performance against the construction «Target Price» estimates, there can be a maximum of 15% shared bonus or shared penalty by the «Alliance Partners». Also, there is potential to receive a so called «*extra bonus*» for exceeding the «Key Result Areas or Indicators» (game-breaking performance), that are agreed to by the alliance. The client is also a member of the alliance team. Figure 5 shows the Northern Gateway Alliance organizational structure.

In Ross (2003) the Alliance model is a form of cooperative contracting model that contains most of the following features.

- Two or more parties (usually client/owner, designer, contractor, possibly a key professional consultant - environmental, and maybe a strategic supplier) that are confined in a single agreement and are known as an "Alliance Partners"
- The performance targets are collectively agreed upon versus individual decisions
- Payment to the non-client/owner participants by:
 - 100% of all work including project overheads
 - A fixed lump sum to account for overheads and profits
 - Equitable sharing of "**Pain & Gain**" as compared to the agreed "**Target Price**"
- Express commitment to resolve issues without litigation - cannot sue (except for willful default)
- Transactions by all parties are "**Open Book**"
- Governed by an Alliance Board and all decisions must be unanimous
- Managed by an "Integrated Project Management Team" chosen on basis of "best for project!"
- Agree to commit to agreed set of "Alliance Principles"



Source: Northern Gateway Alliance (2006)

Figure 5 Northern Gateway Alliance Structure

Typically this "Alliance Model" is chosen very early in the planning process and preferably tendered as soon after any feasibility study is completed, in order to utilize the competence, leadership skills, innovations, and problem resolution skills of the alliance team to maximize the benefits of "Value Engineering". The Alliance model can almost be considered as a "leadership model" as it requires the superior people and leadership skills at many levels within the alliance. Some of the drivers and reasons why an alliance might be used are listed as follows:

- Complex projects and interfaces
- Scope changes can be collaboratively managed
- Potential to lower overall costs - via efficiency, collaboration, & innovations

- Planning and project construction can be significantly reduced
- Desire to achieve outstanding results
- Superior problem resolution due to collaborative structure
- Usually better quality
- More aligned to public values
- Better risk management - collectively managed
- Additional focus on Life Cycle Costs (LCC)
- Motivation for best practices and results

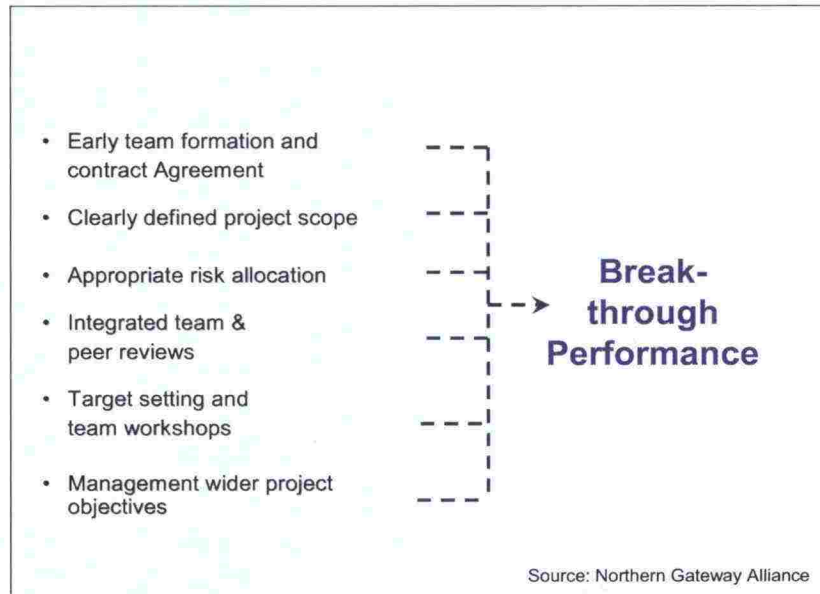
Koppinen & Lahdenpera (2004) reveal some of the benefits and disadvantages of the "Alliance Model". Table 7 highlights these benefits and disadvantages.

METHOD	BENEFITS	DISADVANTAGES
Alliance	<ul style="list-style-type: none"> • Better risk sharing • Lower bidding costs • Clear identification of service requirements • Whole-life focus leading to a better quality product • Better value for money through better customer focus • Enhanced efficiency and innovations • Client has more control over the project delivery • High flexibility • No claims • Earlier and accelerated delivery • Industry development • Cost-certainty • Time-certainty • Better problem resolution • Higher trust between partners 	<ul style="list-style-type: none"> • Difficult to determine that pricing is competitive • Lack of suitable skills in government agencies & leadership qualifications • Resistance to change • Uncertainty of process & model • Dealing with Environmental Approval • Client roles are mixed - potential decrease in transparency toward the public (authors addition to list)

Source: Koppinen & Lahdenpera (2004)

Table 7 Alliance Model Pros & Cons

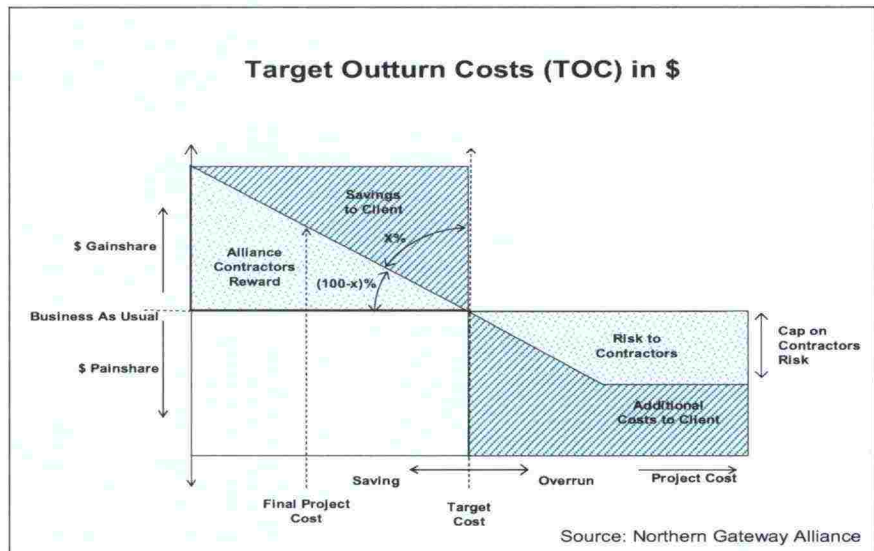
There are bonuses or potential for incentives providing that there is some type of breakthrough innovations, exceeding key performance requirements set out by the alliance, or meeting some extra special targets within the project. Some of these attributes that bring forth this so called break-through performance are highlighted in Figure 6.



Source: Northern Gateway Alliance

Figure 6 Break-Through Performance

One essential aspect of the model is the “Target Price” portion. The Alliance Team brings forth the project scope, design, and planning issues until a target price can be determined. Once the target price is verified by external experts and agreed to by the alliance team, the construction portion begins to occur and progresses until project completion. Once the project is completed, the target price is verified against the actual invoices (Target Outturn Costs - TOC) for the construction portion. The so-called “pain & gain” is now determined to verify the performance of the agreement against the target price. Figure 7 shows how this is determined and how the basic calculations are performed.



Source: Northern Gateway Alliance

Figure 7 Pain & Gain Determination

The extra value that the "Alliance Model" is expected to deliver can be considered as follows:

- Exceptional quality
- Smooth delivery process
- Better environmental considerations
- Super fast delivery (Planning process time savings is major portion)
- Superior problem resolution
- Equitable cost/profit sharing
- Greater innovation potential
- Optimized value engineering

Results from the interviews have indicated favorable quality, better environmental solutions, on-time completion, and costs higher than traditional models (does not take into consideration the potential savings of the client's own planning associated expenses). However, many of these projects are on-going and not enough data exists to make any conclusions about the "Alliance Model".

Lessons to be Learned - Alliance Model

It is difficult to determine the lessons learned based upon so few results and lack of any official reports for the alliance model. Some lessons learned from the interviews and comments from those involved in these types of projects are as follows:

- A new spirit of "team work" (seeking the best for the project instead of personal or organization gain. The relatively new "Alliance Model" is designed from this spirit - and is called the "Leadership Model")
- Co-location of the project partners is essential in the Alliance model
- Is the client able to be neutral party and assure quality practices
- How will the environmental approval processes be managed and resolved?

Recommendations - Alliance Model

Some lessons learned from the interviews and comments from those involved in alliance type projects are as follows:

- Alliance model has a potential to be a good practice
- Need motivated people and those that have leadership type qualifications
- Co-location of the project partners is essential in the Alliance model
- Model possibly could be tested with thorough preliminary investigation (minimum design developed)

2.3 Professional Services

Various types of professional services are used for different phases of a project, especially during the planning and design development phases, and during the Quality Control (QC) and inspection phases. In some instances, these are performed by the client's own work or staff, while other clients publicly tender for these services. These professional services contracts are ten-

dered primarily due to this road reform processes that lost the capability and staff experts, or due to the lack of time and in-house resources. These services may be procured separately or as an integrated package. The main services needed for road projects are highlighted in the following:

- Feasibility Studies
- Pre-Design & Planning
- General & Specialized Designs
- Construction-Ready Design (Complete Design)
- Quality Control & Assurance, Inspection, and Client Advisers

Figure 8 shows these main processes and phases that could include professional services contracts. When these services are procured in an integrated fashion, there is cohesion in the planning, development, and preliminary design phases. There is less duplication and redundancy between the phases of the project when accomplished under the same professional service providers and there is better coordination.

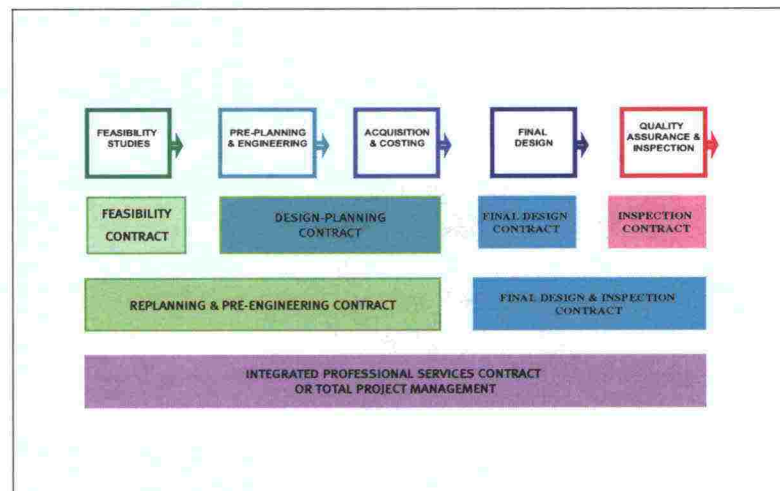


Figure 8 Professional Services Combinations

2.3.1 PROFESSIONAL SERVICES SUMMARY

It should be noted that England uses the framework model for selection of professional services for a long-term duration. This is quite unique and seems to be an “Anglo Saxon” practice that is designed to save time and tendering costs. Framework type contracts in England are not only used for professional services (design & planning), but are also used for bridges and resurfacing contracts. The main ideas of framework contracts are to reduce the amount of time for tendering, select tenders quickly for urgent projects, and reduce overall administration time and costs. Essentially the tendering process is to short list to about a maximum of 5 service providers that will be given projects based upon the skills and cost provisions, at the discretion of the client team. Prices are evaluated against so-called “dummy schemes” and there are criteria to measure past experience and competence of work. Those service providers are then provided first consideration and these service providers are given projects on a rotational type system and on a negotiated type basis. In essence this means that once a service provider obtains a work order, then the next service provider receives the next assignment, and so on, until all have received an assignment. Then if more projects are needed the rotation begins again.

Ontario and Alberta Ministries of Transportation in Canada, have similar concepts, but are quite different than "Framework Contracts". Ontario MOT uses a system, which is termed "Total Project Management" (TPM) in which the various phases of Figure 8 are procured in a single contract. Alberta, Canada has a similar type concept that is referred in their Project Administration Manual (PAM). This concept can be seen as an attempt to be innovative and retain the knowledge, learning, competence, and continuity throughout the planning and development phases of a project. Also, the Canadian Provinces in this study (British Columbia, Ontario and Alberta) use a "Professional Services" rating system which affects the ability to win future contracts for "Professional Services" as it is a part of the tendering criteria.

Also, a few countries even require a separate professional services contract to complete the final design, when it is a traditional type contract (Design-Bid-Build). This is becoming more obsolete in the most progressive countries and is not a standard practice.

Table 8 shows some of the practices for professional service contracts and what phases or services are typically outsourced. This table shows whether design development and engineering are outsourced or done by their own design/engineering experts (in-house). Also, the table shows if there are any combinations of these services and if these services are included in a single agreement or bundled together. The objective is to determine if professional services are procured in an integrated fashion, where there is cohesion and continuity throughout the entire design development phase. It is beneficial to retain the same professional services organization during design development to avoid necessary duplication of efforts and continuity of the process and reduce relearning. There would be a potential to reduce errors and omissions with the integrated approach.

	IN-HOUSE	OUT-SOURCED	FEASIBILITY (OPTION 1)	DESIGN & PLANNING (OPTION 2)	INSPECTION & QA (OPTION 3)	FRAMEWORK OR TPM	COMMENTS
Alberta, Canada		X	X				Uses Past Performance Criteria
B.C. Canada		X			X		Uses Past Performance Criteria. Proposed - Include Option #3
Ontario, Canada		X				TPM	Uses Past Performance Criteria
Estonia		X			X		
Norway	X	~50%	X	X	X		
Sweden	X	X	X	X	X		
Finland		X	X	X	X		Framework contracts being considered. Options #1 & 2 planned.
Holland	X	~90%	X	X	In-House		
Australia (VIC-Roads)	X	~80%	X	X	X		
Western Australia	X	~75%	X	X	X	Framework	Have many options depending upon project
England		X				Framework	
New Zealand		X	X	X	X		
USA (NCDOT)	X	~20%	In-House & Consultants	X	In-House		Mostly Client Inspection.
USA (MDSHA)	X	~80%	X	X	X		Mostly Consultant Inspection
USA (MNDOT)	X	~25%	X	X	MnDOT & Consultants		Mostly Client Inspection
USA (VDOT)	X	~60%			VDOT & Consultants		Both Client & Consultant for Inspection
USA (FDOT)	X	~80%	In-House	X	FDOT & Consultants		

Table 8 Professional Service Contracts Comparison
Total Project Management - TPM (includes all options in one contract) QA Quality Assurance

2.4 Contractor Selection Criteria

The selection criteria for the winning tender is also an important part of the public tendering process and can have significant effects on the project. Now that the Alliance model has been included in the mix of project delivery methods, there is a 100% quality element (other criteria than price) to the selection criteria for capital investment projects. Based upon the countries involved in the study they range from 100% price to 100% quality and is usually different for each type of model chosen and also dependent upon historical and local practices. This is demonstrated by the use of Design-Build model in the USA tendered via the "Best Value" selection process (US DOTs' in study), which means basically 50% price and 50% quality, while in Australia the Design-Build model is typically tendered at the lowest price based upon "**Net Present Value**" (NPV). Table 9 shows the typical variations in "Contractor Selection Criteria" based upon the delivery model used.

2.4.1 TYPICAL SELECTION METHODS

Another desire of this project was to summarize what the percentage of price and what percentage of quality (other parameters) should be used and what attributes should be used in the tendering contracts. Since there was not enough response and data to develop these figures, they are not included in this report. However, here was enough data on maintenance contracts and are discussed in the "Maintenance Practices" section of this report. However, based upon comments during the interviews there was a overwhelming majority not desiring to use the low-bid method.

MODEL	PRICE RANGE	QUALITY
DBB	70-100%	0-30%
DB	50-100% Also 100% & Lowest NPV	0-50%
CM	70-100%	0-30%
DBOM	~70%	~30%
DBFO	Typically Lowest Price	B.C. Canada has Included Innovations & Quality via an Upset Price
Alliance	0% (Target Price Afterwards)	100%

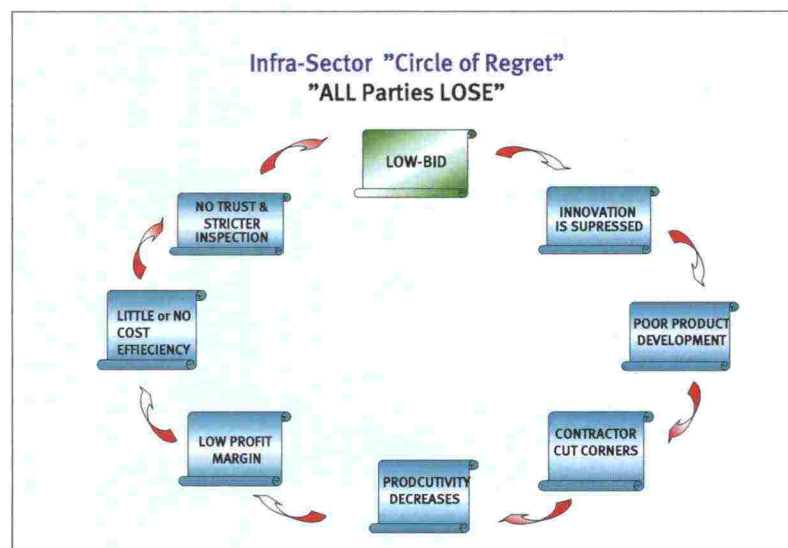
Table 9 Typical Variations in Contractor Selection Criteria

The selection process always seems to bring debate as to what should be the range of price versus other factors, tendering costs, what attributes should be measured, and the believers of the "Low Bid" system. It is very difficult (or impossible in some cases) to measure the Quality Control (QC) plans, determine the best design solution when using Design-Build, and what innovations are proposed when using the low bid (lowest price) method. The low bid method does not take into account anything but price. Therefore, the low bid method overlooks the following aspects as well as other things.

- Evaluating best design solution proposed
- Innovations or Alternative Technical Concepts (ATC)
- Project Manager's skills (extremely important)
- Environmental considerations
- Technical skills
- Traffic management & proposed traffic diversion
- Supply chain management & skills
- Allocation of risks
- Evaluation of "Quality Plans"
- Ability to perform project and proposed solution or methodology
- Early completion

There is another aspect of the low bid system that can easily be understood in Figure 9. The purpose is not to make extra work for the contracting industry or to change the marketplace, but to find the better forms of teamwork, getting quality work (see section 2.5) done right the first time, better innovations, problem resolution versus problem escalation attitudes, partnering, good leadership practices, accountability, and most importantly a good value for the public users and taxpayers (getting *Value for Money* versus lowest first time costs). Also, many clients around the world realize that in order to have a competitive and viable contracting industry for the future, the industry must now begin to make a reasonable profit margin to retain future marketplace survival (beneficial for all parties & supply chain). Then the issue becomes how to measure subjective information objectively. This is a key point and the clients could work together with the industry to determine real and excellent means to measure these "Quality Criteria" in the selection process. It should be fair, measurable, appropriately weighted for each attribute, transparent, and applicable to the local legal requirements. One observation from several contractors in the study was that of accountability. Accountability for each organization's role is important and includes the client being responsible too.

Most understand that DBB and CM models are easy to tender, and the commercial transaction cost are quite low. This may be one reason why the construction industry desires the DBB method as it is easy to bid and easy to evaluate as it is the lowest price for a viable submitted tender. It is a simple system and quite easy to understand and tender. However, there is not enough satisfaction especially with clients and Figure 9 also shows some of the issues with the lowest bid method.



Source: Finnra (2003)

Figure 9 Low-Bid Circle of Regret

2.4.2 ALTERNATIVE METHODS

A few countries have developed alternative forms of tender evaluation that are not specifically mentioned in this report and these alternative methods are shown in Table 10. These practices are not widely used in many countries and are mainly practiced in the USA. Some of the main reasons for using the following practices are to complete projects faster, address traffic congestion problems during construction, seek better quality, and reward better performance. These have been used for DBB projects in the USA, when approved to use alternative methods. These include A+B bidding, incentives & disincentives, lane rental, and warranty contracts. Warranty contracts are simply having some form of warranty of a part of the project that will be warranted for a given duration. However, these have been more of an exception than a normal practice. The details of these methods are depicted in the Table 10 and are summarized as follows.

- A+B+Quality (Optional) Bidding
- Lane Rental
- Warranty Contracts
- Incentives & Dis-incentives
- Upset Price (used by BC Canada - state maximum price & what quality levels are promised)

	Description	Potential Benefits
Cost Plus Time Bidding A + B + Quality (Optional) (USA)	<ul style="list-style-type: none"> • "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 • The "B" cost minus the A portion, determines the value and awarded to the lowest price • Optional Use of Incentives & Disincentives • Optional Use of Warranty 	<ul style="list-style-type: none"> • Minimize delivery time • Reduce road user impacts on highly congested roads • Usually has cost savings • Better quality when warranty included in agreement
Lane Rental (USA)	<ul style="list-style-type: none"> • 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 are to include the lane rental as part of the bid and determine the low bid via the A+B method. 	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Provision to reward or penalize for completion milestones • 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 	<ul style="list-style-type: none"> • Complete projects on time or ahead of schedule • Traffic delays & congestion are minimized

Source: Pakkala (2002)

Table 10 Other Alternative Contractor Selection Methods

2.4.3 TENDERING COST

The commercial cost to the contracting industry during the tendering phase is another concern especially with the more progressive models and all agree that the PPP model is very expensive and that tendering costs are very high. There are so many combinations and quantifying the large number of variables is virtually impossible to isolate the components that influence costs directly and fully objectively as stated in Hughes e. a. (2006). Furthermore, Hughes e. a. (2006) states that "the most important factors that influence whether firms adopt different working practices are not associated with the commercial costs of tendering or of winning tenders". This is a very important finding as costs for tendering do in fact increase when using newer forms such as Design-Build, Design-Build-Operate-Maintain (DBOM), and PPP practices, but they are not the driving forces or most important factors in the overall outcome of the project. Some of the contractor's viewpoint during the interviews stated that the tendering costs are extensively higher when using progressive procurement methods. Table 11 via Hughes e. a. (2006) shows the relative influence of commercial costs versus the procurement route chosen.

MODEL	MARKETING COSTS	AGREEMENT COSTS	MANAGEMENT COSTS	DISPUTE COSTS
DBB	Very Low	Low	Medium	Low
DB	Medium	Medium	Very Low	Very Low
CM ⁽¹⁾	Very Low	Low	Medium	Low
DBOM ⁽²⁾	Medium	Medium	Medium	Very Low
DBFO	High	Very High	Very Low	Low
Alliance ⁽³⁾	Very Low	Medium	Medium	Extremely Low

Source Hughes e.a. (2006)

Table 11 Relative Commercial Costs to Contractor

- 1). Estimated & added - assumed to be similar to DBB (by Pakkala)
- 2). Estimated & added - assumed to be similar to DB (by Pakkala)
- 3). Estimated & added - assumptions based upon drivers & benefits (by Pakkala)

2.5 Quality

Quality is an important part of the process and an important aspect especially in new construction projects. Quality can also be quite subjective and depends upon the "eyes of the beholder". Especially when the "road user" is concerned quality can be quite subjective. Most road authorities have some form of quality systems in place especially when Quality Assurance (QA) is concerned. Quality Control (QC) procedures are quite common and more clients are demanding ISO 9000 quality requirements or some equivalent form. Quality is also determined in the scope of the work and is sort of an input during the planning process.

When QC is relinquished to the contractor, then QC plans are essential, as it will determine the standard of practice used by the contractor for that entire project. In most countries the QC led by the contracting authority is working

reasonably well, but in some countries it is a learning process which requires a great deal of experience and practical applications.

From the first author's perspective quality can be basically attributed to three categories within the process. Quality can be considered as:

- Quality of the technical, performance, and "Level of Service" standards
- Quality of the design & planning processes
- Quality of workmanship

The first two categories have significant research, experience, and long history of understanding and practices. However, the quality of workmanship lacks quantitative measurements, which are important factors that contribute to the overall quality of project results. QC systems are systems that assist in the quality procedures, but don't necessarily address the workmanship and practice of care. The workmanship is one area that needs further development and research.

In the USA, QC by contractors is difficult and most contractors in DBB contracts prefer the "Road Authority" to make the QC decisions, as it requires competence and knowledge of Quality Control systems. However, typically there is very strict inspection done by the "Road Authority" in the USA to monitor the quality during the construction process. In some cases the "Road Authority" uses professional consultants to assist QC and Quality Assurance (QA) when there is a lack of own QC personnel or when the "Road Authority" has the lack of experts or has been downsized substantially. In Finland, Sweden, and in many Anglo-Saxon countries, most of the inspections are done by professional consultants as there is insufficient staffing. Sometimes there can be "spot checks" to verify contractor's quality, but even these are being relinquished to the professional consultants. These are usually tendered via normal professional service contracts. Sometimes it can be the same professional consultant that participated in the design and planning process and is quite beneficial as the knowledge and continuity of project is retained.

Quality Control (QC) covers many practical issues and practices. The following shows a listing of practices and developments to assist quality performance that were collected during this study.

- ISO 9000 practices or equivalent quality plans
- Contractor rating system - with effectiveness (post project evaluation affects future rating)
- Professional services rating system - with effectiveness (post project evaluation affects future rating)
- Some form Contractor Quality Improvement Program (CQIP) - feedback of project performance
- Some clients have a sophisticated ICT project management database that tracks risks, quality issues, all requests, information queries, project status and critical path progression, environmental issues, and all related standards and specifications
- Quality based selection criteria for winning contractor (aligned with better quality)
- Project based web site
- Strict penalties for non-performance (no excuses)
- More involvement by client's "Project Manager" to actually determine the perceived quality

- Good open communications
- Lots of informational meetings prior to contract award
- Some form of partnering in the process (both project & strategic level)
- Dispute resolution process
- Good Information Management tools (billing, scheduling, and QC)
- Using interoperable systems or common data models, which can reduce the possibility of errors and omissions). This is under development in Norway & Finland
- Training programs & QC of the sub-contractors in the supply chain
- Having a "Lessons Learned" system or database
- Using the "Designer of Record" throughout the project (provides consistency & continuity)

There is also an easier solution to improve quality, but it is an expensive alternative. Simply raising the minimum technical and performance standards would provide higher quality levels. The other alternative is to increase inspection to verify that the quality demanded is actually being implemented. Both these simple solutions would cost more and probably be difficult to gain acceptance in the client organizations and amongst the funding authorities. Also, since the most road authority organizations are downsizing, gradually losing experience and expertise, and lack the resource, this simple alternative is probably not realistic.

2.6 Conclusions

Traditional procurement such as the Design-Bid-Build (DBB) method continues to be the main form of contracting for capital investment projects for roads. The only full exception is England's Highways Agency, which does not use the DBB method. Recently, several countries have been procuring medium and larger sized projects via Design-Build (DB) and Design-Build-Finance-Operate (DBFO) or PPP models. These innovative models have some common advantages such as quicker completion, value for money, usually some savings, alternative concepts that would not be normally be realized, better project coordination, and more aligned to public values.

The Design-Build-Operate-Maintain (DBOM) is seldom practiced except for Finland and has not really become a model of choice, but merely an exception. Many of the contractors interviewed in study indicated that the DBOM model would cause them to practice better quality and be more attuned to LCC thinking. It might be interesting to determine if there is future acceptance of this model and if the risks can be managed by the private sector. Also, the DBOM model requires a significant amount of performance requirements to be developed and most road authorities have not developed these performance requirements to a significant level yet.

It is interesting to note that the Design-Build-Finance-Operate (DBFO) or PPP model seems to be progressing forward as compared to the similar study by Pakkala (2002). More and more countries have tested and tried the PPP model and many more other countries have been interested in this model. One of the main reasons for the increase in popularity and acceptance of the PPP model has been the lack of public funding for new projects. Also, some countries are testing the efficiency of the PPP model to determine the perform-

ance against traditional and Design-Build models. It is a very wise decision to thoroughly evaluate and conscientiously study all aspects of the PPP model for any proposed projects. There are so many dynamics involved and securing a project over a long-term period. It requires much research, wisdom, and a huge learning process for the client as well as the service providers. Also, each country has differing cultural reference points and each country needs to decide whether the PPP model is appropriate for projects in their country.

The "Alliance model" appears to have impressive concepts and interviews have indicated good results and alignment to public values. There is not enough evidence and quantitative data to make any further conclusions, but the leadership characteristics of this model seem to be theoretically excellent. This model requires a totally different attitude and may be too difficult step forward, especially if the personnel in the entire alliance are not aligned to superior communication, trust, excellent innovative practices, and better leadership principles.

Despite the economic efficiency of Design-Build and PPP projects being rated higher than DBB according to Koppinen and Lahdenpera (2004), the better results from partnering and collaborative type projects as mentioned in Hughes e. a. (2006), and more **Value for Money**" (VfM) from innovative methods, these innovative methods appear to account for a minor portion of the project delivery methods used for road projects. However, they probably will be used for larger projects and when there are bold champions among the decision makers. It appears as if change is very slow and of course, it is difficult to change the mindset of people.

Some significant concepts can be concluded from this study and are listed below:

- Practices that have early involvement of the contractor
- Some type of consultants & contractors rating systems
- Limiting the amount of design development before tendering
- Optimizing risks
- Continuous improvement and re-engineering of the models
- Fully developed performance measures
- Client and industry learning process
- More quality based approaches

Finally, there is a great deal of effort and time required when moving to these newer models and practices, but the potential to achieve better results has been realized in many countries. Some of the achievements have been to develop a contracting industry, savings compared to the traditional model, better quality in most instances, globally more competitive, increasing exposure to foreign markets, reducing administrative burden, and delivering projects at a faster pace.

Capturing the effectiveness of each of these models is a challenge and requires a great deal of international networking, research, and applicability to the local practices and obligations. It should be the objective for road authorities to find the best methods and continually search for those practices that will achieve the results in meeting better roads for the valued customers - the road users.

3 MAINTENANCE PRACTICES

This section contains information and main results for this international study relating to "*Maintenance Projects*", which includes routine maintenance and the resurfacing aspects of periodic maintenance. Bridge contracts are a specialty in itself and usually tendered as a separate contract and this report does not cover bridge contracting practices.

Also, this section of the report is not intended to repeat the findings from the same first author as in Pakkala (2002), but to expand on these and try to highlight newer experiences and findings.

3.1 Background Information

Maintenance is usually one of those practices that do not receive much attention, recognition, glory, or interest amongst the decisions makers until something goes wrong or if safety is compromised. Sometimes maintenance functions are not a significant priority for some road authorities which may lead to budget reductions, lowering the Levels of Service (LOS), and reducing the satisfaction levels of the traveling public or road users. In cold climate countries such as Scandinavia and Canada, winter maintenance is an important part of maintenance as it has a potential to become a safety issue or can cause accidents when roads are not maintained at proper service levels. In other countries the main concern is with pot holes, excessive road roughness, bumpiness, texture, and other non-desirable conditions that affect satisfaction from the road users. Most countries are using some form of customer service audits (road charters) to determine if the roads are in satisfactory condition, to assist in determining the customer satisfaction perception. Also, customer satisfaction surveys can become one tool to determine results of any outsourcing practices and determine if the perceived quality of service is increasing or decreasing.

Over time, the attitude towards maintenance has changed somewhat and is becoming more of an issue and important aspect for taking care of the road network. Maintenance is also a new market for the private sector in those countries that outsource maintenance. Recently, there has been a focus or strategy in many countries for pavement preservation, asset management, and taking care of the existing road network as a first priority. This is true especially in some of the European countries and a few of the Anglo-Saxon countries where the actual road budget is determined by investing in maintenance as the first priority, and what is left in the budget is then applied to other needs or capital investment projects. Maintenance has gained more attention in Finland, for instance. In Finland the road budget is prioritized by winter maintenance, second is routine maintenance, then periodic maintenance and the remaining is applied to capital investment projects.

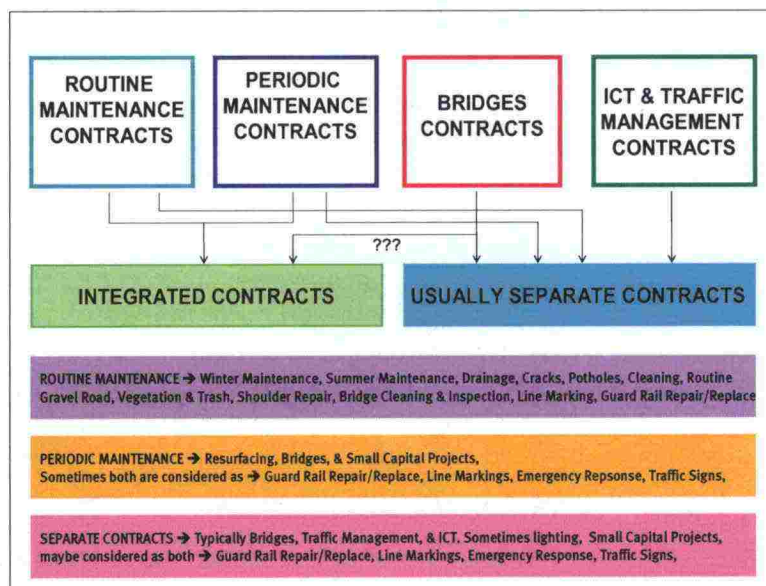
Routine Maintenance

Routine maintenance can be defined by those maintenance activities that occur every year on a routine basis or of a cyclic nature. These activities may include such aspects like winter maintenance, summer maintenance, pot hole patching, minor gravel road repair or patching, minor drainage cleaning, road cleaning or sweeping, crack repair, vegetation control, cleaning (signs, bridg-

es, roads), and trash removal. Figure 10 shows the difference between routine and periodic maintenance aspects and typical shows how they can be organized in a typical outsourced contract.

Periodic Maintenance

Periodic maintenance can be defined as those activities that occur infrequently or every so often and can be termed as “upkeep and improvements”. Throughout the history most periodic maintenance tasks have been typically tendered as separate contracts and can include such activities as resurfacing, bridge habilitation/reconstruction, safety improvements, and other major improvements. Figure 10 shows some of the differences between routine and periodic maintenance, as well as those activities that are typically procured via separate contracts. These vary between countries and some even inter-mix the activities within routine or periodic maintenance. This is not a significant issue as to what activity is used for routine or periodic maintenance, but the most important issue is to what works best under the specific culture, environment, local market, and which practices delivers the best value to the road authority.



Source: Pakkala (2006)

Figure 10 Routine & Periodic Maintenance

??? - Bridge rehabilitation is seldom used in maintenance contracts, but option is available

Typically throughout the history of most road authorities, resurfacing type contracts have been tendered via separate contracts and are usually considered as periodic maintenance or “upkeep and improvements”. Even in the past some of the resurfacing practices were done by “in-house” or own works, and sometimes used combinations of outsourced and self-performed, depending upon resources and budgets. Recent outsourcing and development trends in some countries have resulted in the integration of surfacing activities that are included into the maintenance contracts. However, most countries typically tender the resurfacing activity as a separate contract. By integrating the resurfacing portion into the maintenance contract, it was expected to achieve better results for the road authority.

Another objective of this study was to determine if there have been any trends or movements towards separate long-term resurfacing contracts that had warranties of over 10 years. PIARC (2002) article provided a few examples from Quebec, Canada and South Africa that included an extended warranty included in the resurfacing contract. Since then, there have been very little developments and news about these long-term pavement warranties and this study was to evaluate the situation in these target countries. This topic will be addressed in the resurfacing results section.

Also, it was desired to determine the latest status and developments with Pavement Management Systems (PMS) and to determine if there have been any further achievements and innovative solutions. Many countries seem to be using the latest automated equipment and technology to gather road condition data for the inputs into the PMS to determine a strategy for which roads need to be resurfaced. Tradeoffs or optimization tools can be used to determine a resurfacing strategy according to the available budget.

PMS systems are used and appear to be continuously improved in order to achieve better decision making by the road authorities. Some progressive countries even have developed performance criteria and indicators that indicate how well the resurfacing goals have been achieved. This development has not fully matured, but these practices and concepts are in process in many countries. The "Anglo-Saxon" countries seem to be the fore-runners in this practice. Some of these concepts are discussed in Section 4.0 called "Performance Indicators", but are usually used by the road authority to assist in developing better road management practices. It should be noted that these developments are not specifically used in the contracts with the service providers, but performance indicators are used as a management and accountability tool.

Other impacts include budget fluctuations that road authorities experience, the recent oil price increases, and greater amount of roads that need to be resurfaced. These have caused concerns to the road authorities because the vision and goals are to take good care of the existing road network. Since many road authorities are struggling with these recent budget deficiencies, caring for the existing road network can cause compromises. Optimization of the PMS can assist in making these tradeoffs. This issue has been confirmed in many countries, where there are insufficient funds to maintain the entire road network at normal standards and often report the amount of deficient or unsatisfactory roads.

There are similar issues with the bridges in Finland as well as several other countries, and bridge conditions are becoming a concern too, but this study did not evaluate bridge contracts. In Finnra (2006) the condition of the bridge network has been decreasing on a yearly basis and needs extra funding due to the large number of bridges due for rehabilitation. This is a common situation amongst most of the countries in this study. Bridge contracts are so specialized and usually administered in very traditional ways.

3.1.1 ROAD REFORM AND ROAD DEVELOPMENT BACKGROUND

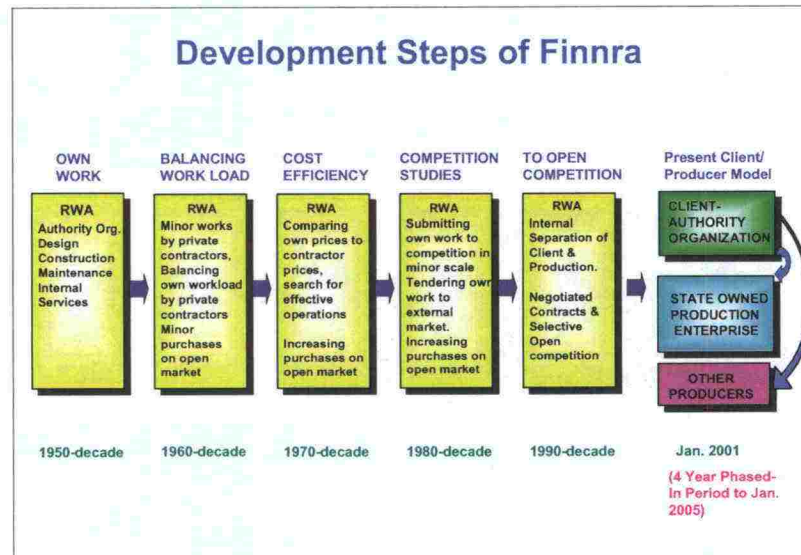
One of the main drivers for maintenance contracting practices has been the issue of "road reform" or "road development" or even known as the "*Client/Producer model*". A majority of the countries in this study has experienced a similar process or at least has relinquished performing actual physical works of maintenance activities. They have sort of become contract managers because most if not all works are publicly tendered. Not all countries have gone through this process and these include USA, Victoria (Australia), and Estonia. Sweden tenders all these contracts, but their "Vagverket Produktion" is a business unit still inside the Swedish Road Administration and full transparency has not been achieved.

The following example from Finland will highlight the "*Client/Producer model*" concept and as an example of how road development has progressed and can be an example for others. Finland has quite extensively followed the "New Zealand model" of road reform and from guidance material from the "World Bank" list of recent practices. The following highlights the progression and brief history of developments in Finland.

In Finland, the Finnish Road Administration (Finnra) is the governmental agency responsible for the management of the public road sector. Before the 1960s Finnra kept all maintenance aspects with their own work force and in-house capabilities. Since the 1960s Finnra began purchasing various activities and services such as winter maintenance for lower volume roads and grass mowing. These types of practices continued and increased throughout the decades and were a "stepping stone" toward outsourcing the entire road network. As a result of these practices and slowly opening activities for the private sector organizations, this has made it possible for Finnra to place more and more activities to the private sector. Today all routine maintenance and periodic maintenance are outsourced via open public tendering. Routine area maintenance contracts for the public road sector began open competition in January 2001, and continued gradually via a four year phased-in transition period through the year 2004. Fully and complete open public competition was achieved in January 2005. Other countries have followed similar processes and this is sometimes called road reform or as the "*Client/Producer model*". Road reform in Finland is one interesting example of how outsourcing can be successfully achieved via diligence and good management practices and implementation. As mentioned previously, Finland did have a model to follow and some of the same development and procedures from New Zealand were pursued and adapted. Finland did not stop there and has continued to develop its procurement practices and good practices and boldly continue along the innovative path. As a result, Finland has achieved significant savings, awards, and has been closely followed by other countries. Even Norway has also implemented the "*Client/Producer model*" into its practices in January of 2004. Salminen & Viinamaki (2001) highlight some of the objectives, issues, benefits, and struggles in transforming a public agency.

Some even consider this as a form or process toward privatizing a portion of the government organization. This has been the Finnish model for many such organizations in the past and appears to be model that has proved satisfactory. De Jong (2002) also analyzes the movements and changes in the Nordic countries and has shown that Finland has had a successful process.

Figure 11 shows the development stages of Finnra since the traditional in-house, production work force.



Source: Finnra (2004)

Figure 11 Development Steps of Finnra

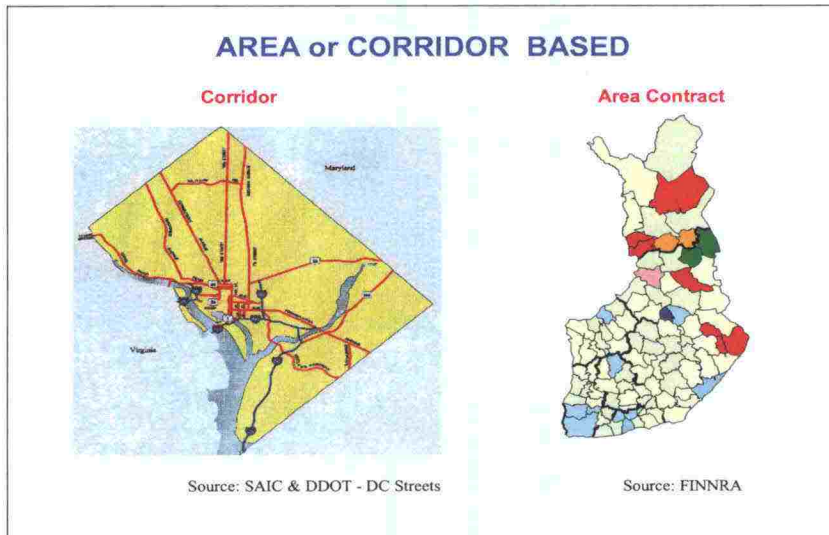
Finland has followed global developments which have led to the interest and desire for more integrated and longer term maintenance contracts. Some countries have used performance-based maintenance contracts for a long-term, and include many aspects of routine and periodic maintenance activities as part of the agreement. This has been seen as an interesting and unique approach and has sparked the interest of Finnra to investigate and adapt long-term, performance-based maintenance contracts into the strategy. We can refer to Finnra (2003) which shows the development of the maintenance contracting strategy. Also, Finnra has not stopped there and continues to follow global and innovative practices in maintenance contracts and are presently renewing their maintenance strategy. Finland is not the only model to follow, but merely one possibility model or example to follow. England and other Anglo-Saxon countries have implemented more integrated contracting forms.

The Finnish model of development can be seen as an effective and highly recommended process that gradually outsourced routine maintenance activities until the present client-producer model was achieved. This has made adaptation relatively easier to implement. However, change is never easy and it should be understood that approval is needed at high levels of government, key champions for the process, diligent effort, and much diffusion of knowledge and expertise from the client organization to the private sector. One key and challenging aspect for road authorities that have outsourced the maintenance activities is the ability to transfer public values to the private maintenance contractors.

3.1.2 ADDITIONAL MAINTENANCE DETAILS

Another interesting aspect of routine maintenance outsourcing is whether the contracts are area based or corridor based. In practical terms “**Area Based Contracts**” means that all the roads within the designated area are included

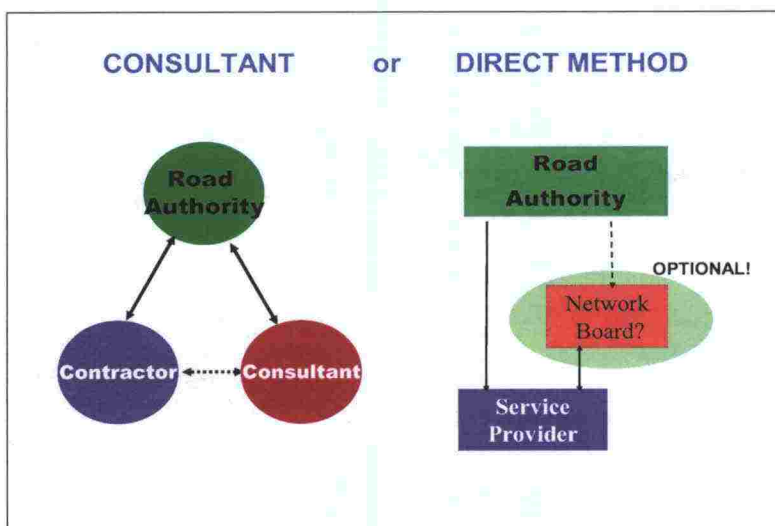
in the contract, while “**Corridor Based Contracts**” are for certain designated roads, stretches of roads, or highway sections that are included. Most countries in the study utilize the area based configuration and hence many contracts are referred to “*Area Based Maintenance Contracts*”. Figure 12 graphically shows the difference between the two types.



Source: Pakkala (2006)

Figure 12 Area versus Corridor Based

It is also worth mentioning that there have been basically two forms of organizational practices within these contracts. These can be either direct agreement with the “service provider” or by utilizing consultant agreements. Some of the Anglo-Saxon countries began with this type of concept by using consultants to assist and manage the many aspects of administration, tendering, and professional advice and expertise in maintenance management. The objective of this strategy is to allow the road authority to focus and concentrate on its core mission. This allows a choice for the road authority of which concept to use and implement into any given practices. Figure 13 displays this concept.



Source: Pakkala (2006)

Figure 13 Consultants or Direct Method

3.2 Terminology

There has been so much terminology regarding these various forms and names applied to maintenance contracting that it can be quite confusing or overwhelming at times. The goal is to clarify these terms and simplify the concepts. It is interesting to note that many countries refer to different names for these practices, but essentially refer to the basic concepts. Some examples of various terminology used is as follows.

- Asset Management Contracts
- Asset Maintenance Contracts
- Performance Specified Maintenance Contracts (PSMC)
- Long-Term Maintenance Contracts
- Long-Term Performance Contracts
- Managing Agent Contracts (MAC & E-MAC)
- Area Maintenance Contracts
- Maintenance Area Contracts
- Term Maintenance Contracts
- Term Network Contracts
- Maintenance By Contract
- Performance-Based Contracts
- Performance Contracting
- Total Maintenance Contracting
- Alliance Contracting

The names used basically refer to the outsourcing of either routine maintenance, periodic maintenance, both routine and periodic maintenance, or all maintenance services, that are using some form of outcome-based criteria (performance levels) or "Level of Service" for a long duration (often 3-10 years). Some of the terminology used in many cases describes a new philosophy and attempts to minimize the deterioration of the asset through lower "Life Cycle Cost". Some of these contracts may even include improvements or rehabilitation, and hence use the term called asset management contracting.

Performance contracting is also used to describe the level of performance or desired level of service. It should be illustrated that there are no true "pure performance" contracts to the authors' knowledge that pay according to the actual measured performance as done in various sporting events. The higher performance achieved, the better the rewards and the lower the performance the lower the rewards. These may have been some of the desires or initial thoughts, but to pay for "true performance" is difficult and most road authorities are at the discretion of the yearly budget, which makes a "true performance" difficult or unlikely to arrange. There have been various forms of incentives and disincentives used in these contracts, and are usually limited to a minimum bottom level and a maximum amount for the top level.

As a summary, there are various forms of terminology used and they vary from country to country, and the main idea is to achieve a contract that provides client derived performance requirements, some flexibility, describes the maintenance activities incorporated, and determines contract duration. The outcome should be a contract that provides opportunities for innovation, incentives, a spirit of cooperation or partnering, maximizes LCC for maintenance, flexibility (describing the performance and not technical or rigid details), and a balanced agreement that would sustain a competitive maintenance industry.

3.3 Maintenance Models

There are basically eight different main types of maintenance models that can be used to deliver maintenance by contract activities that have been identified in the course of this study. These models attempt to describe the main features and have "coined" new names to identify each model. These models will be discussed in the subsequent pages which describe the attributes and other particulars.

3.3.1 IN-HOUSE MAINTENANCE MODEL - "TRADITIONAL MODEL"

Many Departments of Transportation (DOTs) in the USA, some provinces in Canada, some states in Australia, and several countries in Europe still retain a large percentage of their own workforce to perform various routine maintenance type activities. This is considered as the "***In-House Maintenance Model***" or known as the "***Traditional Model***", in which either a portion of public sector or the entire organization carries out the routine maintenance services and activities. Those using this model are District Department of Transportation (DDOT), Maryland State Highway Administration (SHA), Minnesota Department of Transportation (MNDOT), North Carolina Department of Transportation (NCDOT), Virginia Department of Transportation (VDOT), Florida Department of Transportation (DOT), Estonia, and VicRoads in Victoria, Australia. Most of these organizations have some or even substantial, in-house workforce for carrying out various routine maintenance services.

It is important to note that some countries retain a portion of their own workforce to perform routine maintenance activities, while at the same time outsource certain activities via competitive public procurement. For example, Estonia outsources about 63% of routine maintenance, while Florida Department of Transportation (FDOT) outsources approximately 80%, Maryland SHA outsources a large portion of routine maintenance, and VicRoads in Australia outsources about 50%. These are discussed further in the subsequent models.

The countries that outsource all or essentially all the maintenance activities and retain no in-house workforce are listed as follows:

- Western Australia
- Alberta, Canada
- British Columbia, Canada
- Ontario, Canada
- England
- Finland
- The Netherlands
- New Zealand
- Norway

It should be pointed out that Sweden outsources essentially all the routine maintenance activities via publicly tendered contracts, but the "Vagverket Produktion" is still a business unit inside the Swedish Road Administration and full transparency has not been achieved.

At times the road authorities have procured maintenance services through other local public authorities, but this is becoming very uncommon (this can be termed as Public-Public-Partnerships). History has also revealed that this in-house model has been the common form for most, if not all countries, in which routine maintenance has been carried by internal workers. Even some peri-

odic maintenance activities, such as resurfacing, small bridge work, and small work packages were previously done by the public authorities own workforce. However, outsourcing of routine maintenance activities seems to be a trend.

3.3.2 ACTIVITY BASED MAINTENANCE MODEL - "SALESMAN MODEL"

The next model in the development phase towards outsourcing of routine maintenance activities is called the "**Activity Based Maintenance Model**" or what is now coined as the "**Salesman Model**". This model refers to those road authorities that outsource various routine maintenance activities. The reason can be either to balancing the work load, not having the resources, or work can be more efficiently performed by the private sector. This "**Salesman Model**" is usually based upon the lowest price, based upon unit prices (sometimes hourly rates), and usually for 1 year or seasonal duration. The activities vary and have been typically utilized for snow removal (winter maintenance), grass mowing, line marking, rest areas, cleaning activities, sanitary works (trash removal) and other routine activities. Even resurfacing contracts are considered in this model.

Almost all road authorities at some point in time have used this type of contract to meet the maintenance requirements and most countries will continue to use this model.

3.3.3 PARTIAL COMPETITIVE MAINTENANCE MODEL - "CAUTIOUS MODEL"

Some countries like the Estonia and Victoria (Australia) and a few others not included in this study, place a certain percentage of maintenance contracts into open public competition. The countries using these models retain a certain percentage of their own workforce to perform various routine maintenance type activities, while openly tendering the other part of the road network. Estonia and Victoria, Australia practice this model and allow their own work force to publicly tender against any private sector competitors. This is considered as the "**Partial Competitive Maintenance Model**", or what is now called the "**Cautious Model**", which carries out maintenance contracts for some areas and the remaining activities are done in-house. As mentioned earlier, Estonia outsources about 63% of the contracts via routine area maintenance contracts, while VicRoads (in Victoria, Australia) is at a level of about 50%. This model is not very common, and might be considered as a form of competition that is an interim phase before going forward to fully open competition.

Victoria, Australia uses the lowest price with a lump sum payment and duration of about 1-3 years. Estonia uses about 75% price with a lump sum payment and recently went forward with 7 year contracts.

3.3.4 ROUTINE MAINTENANCE MODEL - "COLD CLIMATE MODEL"

The "Routine Maintenance Model" or what is now named as the "**Cold Climate Model**" is the outsourcing of basically all routine maintenance activities and usually included in an area based network. The main reasons for call-

ing this the “**Cold Climate Model**” is due to the commonality between the northern located countries and the difficulty to include periodic maintenance activities (especially resurfacing) in one contract. The reasons why periodic maintenance is not included can be attributed to the short mild season and because the markets in the northern countries are quite small and well established. Attributes of this “Cold Climate Model” can be explained as follows.

Sometimes small capital investment projects can be included into the contract and prices are usually agreed upon or else it can be tendered as a separate contract.

Typical Activities Included in the Cold Climate Model:

- Winter Maintenance (plowing & de-icing)
- Summer maintenance (potholes & cracks)
- Drainage
- Cracks, potholes
- Cleaning
- Routine gravel road
- Vegetation & trash
- Shoulder repair
- Bridge cleaning & inspection
- Line marking
- Guard rail repair/replace
- Graffiti removal
- Lighting
- Emergency response
- Sometimes signs & signals

Contract type:

- Lump Sum
- Hybrid - Lump Sum & Units Price

The duration of these contracts varies and the present trend is between 7 to 10 years. Initially these contracts began with 3 year duration, but soon it was realized that the duration was too short and shifted toward 5 years and more. Service provider selection criteria vary and are discussed further in the section titles “Contractor Selection Criteria”.

The countries using this model are the Canadian Provinces of Alberta, B.C. and Ontario, Finland, Norway, Sweden, Florida DOT (FDOT), New Zealand, and Holland.

3.3.5 INTEGRATED MAINTENANCE MODEL - “ANGLO-SAXON MODEL”

The “Integrated Maintenance Model” or what is now known as the “**Anglo-Saxon Model**” is the outsourcing that has a combination of both routine and periodic maintenance activities. This basically integrates all maintenance activities into one contract, with the exception of bridge refurbishment. These are usually area based networks, except for the USA which uses the corridor based approach. The main reasons for calling this the “**Anglo-Saxon Model**” is due to the fact that most countries are English speaking and typically have been fore-runners in the development of maintenance contracting. Typical activities in this “**Anglo-Saxon Model**” are as follows:

- All the routine maintenance activities previous mentioned
- Resurfacing
- Emergency response

- Signs & signals
- Smaller capital improvements
- Any design & expert consultant services
- Maintenance, pavement, and asset management systems
- Data collection and performance results

These contracts are usually "lump sum" and have unit prices included if unforeseen conditions require extra work and for maintenance outside the scope of the original contracts. The main difference in this model is that there are significantly more risks allocated to the service provider and that the duration is usually longer and has been typically used up to 10 years (USA states are using 5 year with a possible 5 year extension).

Sometimes small capital investment projects can be included into the contract and prices are usually agreed upon or else it can be tendered as a separate contract.

Those using this model are the DDOT (DC Streets contract), VDOT (via VMS contract), New Zealand (PSMC contracts), England and Western Australia.

3.3.6 LONG-TERM SEPARATE MAINTENANCE CONTRACTS - "BUNDLING MODEL"

"Long-Term Separate Maintenance Contracts Model" or what is now named as the "**Bundling Model**" is a maintenance contract model that is applied to a single maintenance activity that is secured for a long duration and usually is special, unique, or risk intensive task that takes advantage of the mass efficiency or so-called bundling. This is similar to the "activity based maintenance model", but the tendering is quite different and the maintenance activity encompasses many areas or regions and can even be for the entire country. Some examples could be a single contract for bridges, line marking, resurfacing, lighting, rest areas, and even ICT services across many areas, regions, or even the entire country. Finland is set to pilot this model in the near future for bridges, resurfacing, and already implemented for line marking contracts. The duration is estimated for 5 years, but it can vary from 3 to over 5 years. The tendering can be quite complicated and probably will be for a lump sum contract. Risks will be an extremely important part especially for bridges and resurfacing portions. In USA, there are 10 year agreements for the "rest areas", and this seems to have satisfactory results.

This model is quite new and there is insufficient data to determine any conclusions and results, but there is much interest. The bundling effect is what should provide an incentive for efficiency and hopefully lower costs at a better service level. It was especially intended or hoped to uncover long-term pavement warranty contracts, but these have not gone forward yet. Apparently the risks are so severe and extensive that it has not progressed as road authorities would have desired. This has a potential to limit the market and may cause concerns in the supply chain.

Finland and MODOT (not in study) in the USA are the countries testing this model.

3.3.7 FRAMEWORK MODEL

The "**Framework Model**" is a quite interesting and widely used model in England for bridges, resurfacing contracts, and professional services (design & planning). The main objective of the "framework model" is to reduce the amount of time for tendering, select tenders quickly for urgent projects, and reduce overall administration time and costs. Essentially the tendering process is to short list to about a maximum of 5 service providers that will be given projects based upon the skills and cost provisions, at the discretion of the client team. Prices are evaluated against so-called "dummy schemes" and there are criteria to measure past experience and competence of work. Those five service providers are then provided first consideration and these service providers are given projects on a rotational type system, on a negotiated type basis.

The duration is estimated for 3 to 5 years, but it can vary depending upon the type of framework. Prices are compared to the rates provided in "dummy scheme" to make sure they are competitive. England seems to be the only target country using the "framework model" and there is not enough data gathered to conclusively share results of this model.

3.3.8 ALLIANCE MODEL - "LEADERSHIP MODEL"

A new and recent model that has been developed and utilized is the "**Alliance Model**" or the so-called "**E-MAC Model**" (used in UK), and what is now termed as the "**Leadership Model**". At writing of this report, the only target country to tender this model for maintenance is England (Highways Agency). Some parts of the "Alliance Model" for capital projects are quite similar, but there is no virtual alliance organization formed and there are other issues since the road is already built and now needs to be maintained. The tendering process is similar to the capital investment Alliance Model" in that the service provider is chosen via 100% quality requirements and a target price is subsequently determined. The contract duration can vary and the Highways Agency model is for 7 years. Depending upon the performance of the alliance team, a pain and gain up to a maximum of 15% is applied to the contract sum similar to the capital model. The "**Leadership Model**" attempts to solve some of the relationship type issues, and the service provider is paid upon actual work plus a fixed rate of overhead and profit, which has the potential to reduce conflicts.

This model is also being considered to be used in Australia and in New Zealand, but no information is available at the time of this study. The results for this model are indeterminate and will require some follow-up and further details. However, as expected in the capital project model, it has potential and value to be piloted and experimented.

3.3.9 MODEL SUMMARY

It should be pointed out that these are the main models and there can be some variations in the models as each country adopts its own practices and deviations. It is also interesting to note that there are many combinations of models and all countries use more than one model. Some of the combinations are as

follows and list the countries that are using that particular combination.

- Traditional; (Many USA DOTs, one third in Estonia, and partially in Victoria - Australia)
- In-House & Activity Based Model; (DDOT, FDOT, MDSHA, MNDOT, NC-DOT, VDOT)
- In-House & Partial Competitive; (Estonia & Victoria Australia)
- In-House & Salesman & Cold Climate Model (FDOT)
- In-House & Anglo-Saxon (DDOT & VDOT)
- Activity Based Model & Cold Climate Model (Holland & Ontario, Canada)
- Cold Climate Model (Norway, Sweden, Finland, Alberta, Ontario, & British Columbia, Canada, Holland, and FDOT)
- Bundling Model (Finland - New)
- Framework Model, Anglo-Saxon & Alliance Model (England)
- Anglo-Saxon Model (DDOT, VDOT, England, New Zealand's PSMC, and Western Australia)
- Activity Based, Cold Climate & Anglo-Saxon Models (New Zealand)
- Framework Model (England)
- Alliance Model (E-MAC in England)

It can be quite confusing at times as there can be so many combinations of activities and models. Some activities can be outsourced separately in some regions of the country, while some can be included into the „cold climate model“ or „Anglo-Saxon model“. It basically depends upon which activities the road authority desires to include and which ones can be efficiently managed by the private sector. New Zealand and England seem to have the most variations with combinations of different models. Some countries are actually at a new decision stage, and with the introduction of the „Alliance Model“ there has been discussion of testing the Alliance model in Western Australia and in New Zealand. It remains to be seen if they will adopt this new model.

3.4 Practices and Observations

This section will summarize the results for maintenance contracting practices which are presented in Table 12. Pakkala (2002) sets the stage of practices for the early years of 2001 and this new report explains the development, new practices, and results from the study since then.

The various procurements practices differ from country to country and there are two main models that stand out, other than the traditional model. These are the „*Anglo-Saxon Model*“ and the „*Cold Climate Model*“. This is shown very easily by the similar practices used by the Anglo-Saxon countries, and those that are used in the cold climate countries in northern Europe and Canada. The USA varies from totally in-house to almost totally outsourced (about 80%) as with the Florida Department of Transportation (FDOT).

3.4.1 INTEGRATED MODELS - ROUTINE AND PERIODIC MAINTENANCE

Integrated models like the „*Anglo-Saxon Model*“ are more favorable to warmer climates and the Anglo-Saxon countries are more able to integrate routine and periodic maintenance, while it is quite difficult to integrate the routine and periodic maintenance in the northern climates. It is easy to understand that if

winter and cold weather occurs for over 6-8 months of the year, then the resurfacing component of periodic maintenance can be efficiently managed and arranged by the road authorities by separate agreements. For example, due to the limited time of warm weather the resurfacing aspects can be more effectively managed and controlled when done separately. In addition, the Northern markets are quite small, have very few suppliers, and competition in these activities is limited.

3.4.2 COPYING FROM ONE ANOTHER

Also, countries tend to follow or use a model from another country and develop the model into one suitable to their own culture. This can be said of the Finnish model and practices, which has followed the New Zealand practices, but applied other elements from other countries. De Jong (2002) shows that countries tend to incorporate practices from one country and then adapt to their own culture, internal practices, and legal systems. This can be considered as a wise practice since one form of practice from a culture does not necessarily mean that it will work in another culture. The Anglo-Saxon countries tend to have more of a partnering and cooperative approach as opposed to the strict interpretation of the contract. Another example can be seen from The Netherlands, which has actually signed an agreement with the UK Highways Agency to study the feasibility to use integrated maintenance practices into their own country. Another form of cooperation and exchange type environments is the "Nordic Road Association" and "Baltic Road Association". Both these provide a networking capacity to develop practices and share practices within the Nordic and Baltic countries, and many are joint meetings. This type of cooperation is relevant globally.

3.4.3 LOW BID OR QUALITY BASED

Another issue that distinguishes the different practices is the type of "Contractor Selection Criteria" used in the tendering procedures. A major portion of the "Anglo-Saxon" countries apply more of a Quality-based selection criterion, with the main exception of VicRoads in Victoria, Australia using the lowest price. On the other hand, there is a split in the northern countries, with British Columbia, Estonia, and Finland using more quality-based criteria, while Alberta, Norway, Ontario, and Sweden using basically the lowest price system. As mentioned earlier, historical traditions or practical considerations may play an important reason, especially if the contracts integrate routine and periodic maintenance. In such circumstances quality requirements, competence and know-how are considered more important aspects as compared to the price, because it is essential to determine the service providers' capability. Even in the USA, more quality based criteria are used in these integrated contracts. These are discussed further in the "Contractor Selection Criteria" section of this report.

However, the "*Leadership Model*" uses 100% quality criteria for selecting the winner of the tender. Only England's Highways Agency has used the "*Leadership Model*" (E-MAC), and it is too early to determine the effectiveness of this model as it is a unique form for maintenance contracting practice. It would be valuable to study the results and determine if it is worthy of implementation. It is safe to predict that the "*Leadership Model*" probably will be used in other Anglo-Saxon countries, as this has been the trend to copy practices from one another, and even New Zealand and Western Australia are contemplating testing the model.

	IN-HOUSE	OUT-SOURCED	ACTIVITIES INCLUDED	CONTRACT TYPE	CONTRACT DURATION	CONTRACTOR SELECTION CRITERIA	AREA OR CORRIDOR CONTRACTS	QUOTED SAVINGS	COMMENTS
Alberta, Canada		X	Routine Maintenance	Unit Hybrid	5, 6 & 7 Years	95% Price 5% Past Performance	30 Areas	25%	Winter Maintenance Standby receives about 35% Lump Sum Payment
British Columbia Canada		X	Routine Maintenance	Lump Sum	10 Years	60% Price 40% Other	28 Areas	10%	Line Marking & Lighting are not included. A single contractor can only win 4 area contracts
Ontario, Canada		X	Routine Maintenance	Hybrid (Lump Sum & Unit Prices)	7-9 Years	95% Price 5% Other	48 Areas	12%	16 Performance-Based Area Contracts Remainder – "Maintenance Outsourced" by the "Salesman Model"
Estonia	X	X	Routine Maintenance	Hybrid	5 Years New-7 Years	75% Price 25% Other	16 Areas	Up to 20%	Own In-house forces compete against private contractors. 63% of Maintenance is tendered
Norway		X	Routine Maintenance	Hybrid	4 Years	Lowest Price Conforming Tender	107 Areas	20-30%	Client maintains most inspection
Sweden		X	Routine Maintenance	Hybrid	3-6 Years	98% Price 2% Other	136 Areas	20-30%	New Winter Maintenance Payment Scheme based upon actual weather conditions
Finland		X	Routine Maintenance	Hybrid & Lump Sum	3, 5 & 7 Years	75% Price 25% Other	85 Areas	Over 30%	Now separate contracts for line marking, resurfacing, & bridges are Long-term duration
Holland		X	Different Activities	Lump Sum	1-3	100% Price	Many Areas	30-40%	Future – Investigating MAC model from England and will adapt to Holland Situation
Australia (VIC-Roads)	X	X	Routine Maintenance	Lump Sum	2-3 +1+1 Years	100% Price	About 50% of Network	Some	Competition between In-House Forces and Private Sector. Still quite input based.
Australia Western, Australia		X	Basically All	Lump Sum	10 Years	50% Price 50% Other	8 Areas	20%	
England		X	Basically All	Lump Sum (Unit Price For Undefined)	5 + 2 Years	25% Price/ 75% Other E-MAC is 100% Quality (Target Price)	14 Areas	Over 10%	Includes up to £500k worth of periodic maintenance (bridges or resurfacing). E-MAC is similar to the "Alliance Model"
New Zealand		X	Routine Routine Plus ALL	Unit Price Hybrid Lump Sum	3+1 Years 3+1+1 Years 10 Years	Low Bid Weighted Avg. QPTO	24 Areas	10-15%	Still using about 50% Traditional Maintenance Contracts. Very small staff.
USA (NCDOT)	X	X	Activity Based	Unit Price	1 Year	100% Price	Corridor	Unknown	Outsource those activities that are more efficiently done by contractor or balancing work
USA (MDSHA)	X	X	Activity Based	Unit Price	1 Year	100% Price	Corridor	Unknown	
USA (MNDOT)	X	X	Activity Based	Unit Price	1 Year	100% Price	Corridor	Unknown	
USA (DDOT)	X	X	Basically All	Lump Sum	5 Years	50% Price 50% Other	Corridor	Unknown	Does not include major bridge rehabilitation
USA (VDOT)	X	X	Basically All Proposed	Lump Sum Lump Sum	5 Years (New) 3+3+3	50% Price -50% Other 100% Price	Corridor	10-15%	Still basically in-house. Only 1 integrated contract (VMS). New contracts planned for routine maintenance 3+3+3 years, with low bid
USA (FDOT)	X (about 20%)	X	40% Routine Maintenance 40% Salesman	Lump Sum Unit Priced	7+7 Years Yearly	40% Price 60% Other 100% Price	Corridor	20%	Goal is to Achieve 80% Outsourced. Using a Maintenance Rating Program (MRP) to measure performance. 10 Year Rest Area Contract

Table 12 Summary of Maintenance Contracts

3.4.4 CONTRACT DURATION

The duration of the contract depends basically upon four factors. These factors include any legal restrictions, the type of maintenance model utilized, the experience of the road authority in outsourcing, and whether the contracts are integrated. Usually the development of maintenance contracting started with 1-3 year duration in contracts and now has progressed to about 7 years, with British Columbia, Canada and Western Australia setting the standard at 10 years. However, the bundling model will probably be five years or greater, which has been the duration period under discussion from the initial developing plans.

3.4.5 SAVINGS

It should be noted that the main contribution to the savings achieved was reported due to the combination of outsourcing and the long duration of the contract. Another contribution to the savings portion is the inclusion of outcome-based criteria or some form of performance requirements that allows flexibility and innovations on the methods chosen to meet the quality requirements. This allows the potential for cost savings measures and practices, although it is difficult or virtually impossible to measure.

Typically the savings from the initial years of outsourcing have ranged from 10 to 40%, but it is difficult to determine the actual reasons why some countries have achieved better results than others. It would be speculation to describe the reasons, but some of the following aspects might be contributing factors.

- Union and wage issue
- Competitive market in maintenance
- Asset distribution (any favoritism)
- Competence and know-how of the private sector
- Immediate transformation from in-house to outsourcing
- Lack of benchmarking and lessons learned
- Strong leadership in transformation process
- Marketing and working with the industry
- Contracting method used

3.4.6 CONTRACT TYPE

The main form of contract used in most of the contracts is the "Lump Sum" and the "Hybrid" (combination of Lump Sum and Unit Prices). The US DOTs use unit prices, but these are for the activity based contracts that procure each activity separately. The Hybrid model can be considered quite a wise choice for using a combination of those lump sum activities, and having unit prices for those unknown activities or risks. This helps to minimize the unforeseen risks on activities such as guard rail repair & replacement, signs, and other high risk items. However, if long term contracts are used then the risks are more balanced to compensate for those unforeseen activities.

Table 12 shows the main contracting practices used by the countries and shows the contract type, duration, typical activities included in the contract,

"contractor selection criteria", quoted savings, and any special notes or comments.

3.4.7 SMALL INDUSTRY CONCERNS

It seems inevitable that there are concerns about the effect of smaller contractors being able to sustain a healthy market. Initially there were many fears and concerns about the small businesses being pushed out of the market. So far there have not been any severe impacts upon the smaller businesses. In fact, it is the advantage of the main contractor to network with smaller businesses in order to deliver the services required. The larger contractors do not have the capability in most areas to meet the needs without the local players. The large contractors bring in the sophisticated management skills and ICT tools and try to cooperate with the local businesses.

Any sensible contractor will do everything possible to retain the existing local knowledge and know-how as it is readily available, as, mentioned by Frost (2001). It is necessary and commercially effective to continue with the local smaller contractors and try to teach newer concepts and management practices. That is why continuous improvement and training sort of go hand-in-hand. Even contractors in other countries say just about the same responses, as no contractor has the sufficient staffing or capacity to perform all works by themselves. It is basically the medium sized contractors that might be in jeopardy, if they do not wish to be subcontractors.

3.5 Contractor Selection Criteria

The selection criterion for the maintenance service provider is also an important part of the public tendering process. Now that the "Alliance Model" has been included in the mix of maintenance models, there is a 100% Quality element (other criteria than price) to the selection criteria.

The results of the project shows that selection criteria vary from 100% price to 100% quality and are usually different for each type of model used and with the country practices. Table 12 also shows the typical variations in "Contractor Selection Criteria" from each country.

Of the countries utilizing the "Cold Climate Model" there is a split between the lowest prices to about 75% price. FDOT and British Columbia Canada are exceptions as FDOT uses 40% price and British Columbia Canada uses 60% price for the selection of the maintenance service provider. Of the other "Cold Climate Model" countries Estonia and Finland use the 75% price as the others (Alberta Canada, Norway, Ontario Canada, and Sweden) are using essentially the lowest price.

In countries utilizing the "Anglo-Saxon Model" there is more consistency in the selection criteria, as they are using what is sometimes referred to as "**Best Value**", which uses about 50% price or less for the selection of the maintenance service provider. This may be due to the fact that resurfacing and other highly skilled activities included in these types of contracts require some evaluation of the service provider's competence and ability to perform integrated mainte-

nance activities over a long duration. The "Alliance model" (E-MAC model) is used in England and has the 100% quality criteria for the contract award. Even some countries have utilized or included "risk elements" into the contract. This can be quite beneficial as the risks are already determined during the procurement process. This is one of the lessons learned from PPP projects, and it has the potential to be added to the innovative maintenance contracts.

The selection process seems to bring debate as to what should be the range of price versus other factors. Some concerns have been voiced such as tendering costs, what attributes should be measured, using "Low Bid" systems, and complaints about the fact that tendering system does not seem to be transparent. Most do not realize that the innovative contracting forms usually need to incorporate the measurement of competence, project management skills, expertise in Pavement Management Systems (PMS), and other required skills. These are usually issues of people's competence, skills, and know-how, which cannot be measured on a low price basis. Also, because the area maintenance contracts are spread across the areas of the country, the people skills typically tend to vary. Another concern is that some contractors would like to use the reputation of the company as one the determining criteria for competence, but that is flawed because the technical staffing or expertise, varies from location to location and the know-how is different because the people are different.

Methodology is another issue that should be included because the service provider is now responsible for managing and planning the maintenance strategy, practices, forward planning, and coordinating the supply chain. How is it possible to measure the various skills and competences (subjective details) on a lowest price basis? Maybe in the future there might be further development and make the procedure more objective. It is however possible to measure the subjective values in an objective manner as long as the details are prescribed before the tendering process and the weighting factors are provided in advance. In addition, when using quality based criteria it is quite transparent to determine which service provider has offered the higher quality levels when all tenders are measured and compared against each other. It is easy to verify what choices, solutions, and project management skills are being offered when a "head to head" comparison is made and it becomes quite clear as to who has offered the best quality practices.

Also, it is very difficult (or impossible in many cases) to measure the Quality Control (QC) plans, determine the best skills and know-how, and what innovations are proposed when using the low bid (lowest price) method. One objective of this study was to determine what attributes should be measured and what practices are used in the actual contracts. Some of the attributes used in the maintenance contracts are listed below.

- Quality plans & QC measures
- Methodology
- Project Management skills (extremely important)
- Environmental considerations
- Technical skills
- Traffic management
- Relevant experience
- Past experience

- Supply chain management
- Types of equipment used (resources)
- New - introducing risk matrices are part of tender

3.5.1 CLIENT RECOMMENDED ATTRIBUTES

It was also desired to determine what attributes client's desire and what should be actually considered, and what factors should be used to measure the winner of a maintenance contract. Figure 14 shows the results of the clients' survey and are designated from most important criteria to least important. Not all countries replied to this part of the questionnaire, but a significant majority responded.

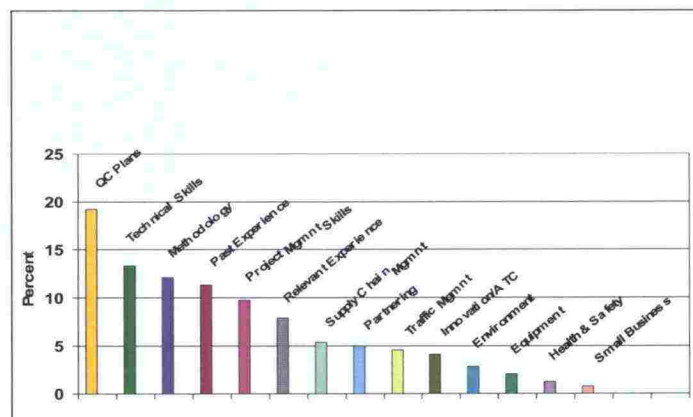


Figure 14 Clients' Survey on Quality Selection Factors

Client's perception is that the most important single issue is the QC plans that are submitted by the service provider. Then there is a significant gap to the next important factors which are technical skills, methodology, past experience, and project management skills. These top five attributes account for approximately two-thirds of the most important factors that should be determined when selecting the winner of a publicly tendered maintenance contract.

What is quite surprising is that partnering and innovations are not considered so important, but when these topics are discussed they appear to be an important part of the maintenance contracts. Also, surprisingly and even less important were environment and equipment attributes which were not considered as being as significant and maybe this is due to the already required environmental standards that must be achieved under any contracting arrangements. The equipment factor was quite interestingly low too, because most of the Nordic countries using the "**Cold Climate Model**" do in fact measure the type of equipment used, especially for winter maintenance. These results may be swayed by the fact that several countries do not have significant winter maintenance operations and equipment issues may not be that significant to warmer climates. However, when looking at the Nordic country responses there was no broad consideration of equipment being a significant factor either.

3.5.2 SERVICE PROVIDER RECOMMENDED ATTRIBUTES

Further, it would be appropriate and interesting to show the results of the service providers' survey and these results are shown in Figure 15. These figures are presented based upon the replies received from the questionnaires.

The service providers' perception is that the most important single issue is the "methodology". The service provider's main concern is to demonstrate how the plans, equipment, and strategy are to be utilized to meet the maintenance requirements stated in the contract. There is a somewhat significant gap to the next important factor which is the past experience of the service providers'. This factor is a measure of past performance of the service providers from past contracts and is seen as an important indicator by the service providers'. This factor demonstrates the accountability, trust, and performance of the service provider. This is an important observation, which makes sense to the obvious observer. However, there are very few contracts that have an interactive past experience rating system, which would affect the potential to win contracts. This may be due to labor, union issues, and the legal implications of this type of practice.

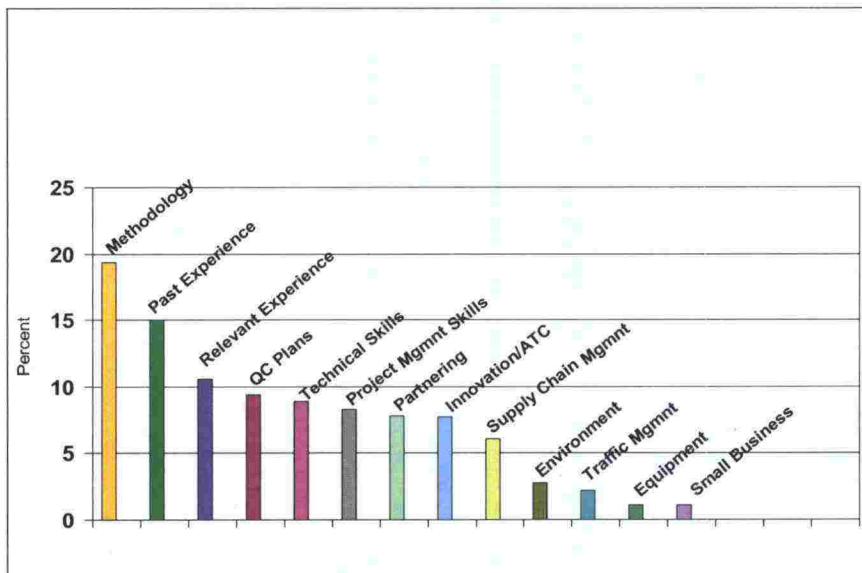


Figure 15 Contractors' Survey on Quality Selection Factors

There is another gap to the next important attribute which is the relevant experience, which indicates that lack of experience is not desired and may have a negative influence on performance. These three attributes account for approximately 42% of the most important factors when the winner of a publicly tendered maintenance contract is to be determined. Then the next important aspect is QC plans, followed closely by technical skills, project management skills, partnering, and innovation.

It is quite interesting that these top five factors account for about 63% of the criteria. It can be assumed that these are core issues encountered by the service providers when a contract is tendered and what issues are needed to actually perform the works.

Also, similar to the client response, such parameters as environment, traffic management, equipment, and affect on small business were not considered as being so significant. However, the contractors did not consider traffic management as important compared to the client's response.

3.5.3 COMPARISON BETWEEN CLIENT & SERVICE PROVIDER

The results from the survey on "contractor selection criteria" do however show similarity in that the following attributes were rated as the top six most important by both the clients and the service providers.

- Quality Plans & QC Measures
- Methodology
- Project Management Skills
- Technical Skills
- Relevant Experience
- Past Experience

Even though the importance of each attribute (or weighting) was different it was interesting to note that these top six attributes were the same. This might be a lesson learned that these six attributes are to be considered when including non-price issues in the public tendering process.

Also, the weighting differences between these attributes probably differ from the main role of each organization. Clients desire to receive best quality at a certain designated price and have a strong belief that QC is an accurate reflection of quality, while the service providers need to determine how to configure their organization and supply chain to meet the needs of a given contract that is competitive amongst all those offering a valid tender.

Another difference is that traffic management is rated higher by the clients than contractors. This also depends upon the maintenance type activity being performed and the need not to disturb the traveling public as much as possible. Resurfacing and bridge repair are good examples of the impact of traffic management versus grass mowing, sign replacement/removal, and cleaning. The road authority is the public entity responsible for most of the complaints and feedback from the road users.

3.5.4 OTHER CONSIDERATIONS

At times the public procurement changes and any new laws or regulations can affect the consideration of the factors discussed above. Even the new recent EU procedures are no exception, which can determine how and when these attributes can be applied. It is important to identify these legal issues and determine what aspects can and cannot be included in the selection of maintenance providers. Some states in the USA require the low bid as a mandatory requirement when procuring maintenance contracts.

As mentioned earlier, it is the institutional and cultural practices that sometimes determine why there are differences between the methods applied in different countries. It appears that there is no universal standard while some coun-

tries are willing to consider other factors than price. For construction projects Hughes e. a. (2006) concludes that selection should be based on other than price, but the same philosophy can also be applied to maintenance type contracts, where other factors should be considered and what added "value" can be gained. Selection based upon value and other attributes is difficult and requires accountability in the public sector. There needs to be a demand or desire away from the well-worn traditional procedures.

3.5.5 PRICE VERSUS QUALITY

In addition to what attributes were suggested it was also good to determine what percentage of price versus quality should be used in these maintenance contracts. As mentioned this can be a very sensitive point, but many experts, reports and results do indicate that there are better results when there are more value or quality aspects. How to determine the correct balance might be considered a key lesson to be learned when pursuing these types of practices. The results from this survey are summarized in Table 13.

	Client Range	Service Provider Range
Range	20% Price to 80% Price	20% Price to 70% Price
Average	57% Price	57% Price

Table 13 Price Range for Maintenance Contracts

These results are extremely interesting even though there were more clients responding to the survey than service providers. Also, from a research point there are not enough data, but the figures are astounding. On average the client and service provider perception were essentially the same even though the range and direct answers were totally different. Even the first author is surprised and thought that there would be a significant difference between client and service provider perspectives.

Again it does depend upon the type of contract model as the "**Cold Climate Model**" average is 65% price and the "**Anglo-Saxon Model**" averages 45% price. It would have been better to have more data, but even some statements can be affirmed from the limited data. It is certain that most clients would desire to get away from the lowest price situation and the same goes for the service providers. It appears that both agree that there should be some method to measure competency and performance.

3.6 Resurfacing Summary

The separate resurfacing contracts are still tendered very traditionally and almost all these contracts are low bid, with very strict technical specifications and details. During the course of this study no country has developed fully performance based specifications for resurfacing contracts. These are still under development and many clients are not able to establish a true perform-

ance based specification. In Frost (1997) the development of true performance specifications is a slow, tedious, and frustrating process and will take substantial time and effort to change this traditional mentality. It appears that the additional risks to the resurfacing contractors are probably too much to manage and still favors a traditional approach.

In Finland and in most Nordic countries resurfacing contracts have a shorter window of opportunity to resurface the roads before the next cold and winter weather approaches. Most of the asphalt is recycled and usually hot mixed ("**recycling train**") and it is easier to have a corridor approach to resurfacing. Also transporting all the equipment across different regions is not cost effective or efficient. In practicality it would also be difficult to resurface all the roads desired in the road network during the short mild/summer season and it would significantly affect the congestion to the traveling public, freight, and commercial transport.

Table 14 highlights some of the main issues in resurfacing contracts and many details are not mentioned as resurfacing is a case by case issue, and technical details are numerous. The main summary from this table is that just about all resurfacing contracts are awarded to the lowest bidder (New Zealand is the exception), most countries recycle or reuse the asphalt over as much as possible (except contaminated or differing types), and the normal warranty is between 1-3 years, with the exception on Ontario Canada, which has a few pilot test case for 7 years. New Zealand is the only country that has the option to use either lowest price or a weighted average of about 70% price and 30% other factors. It was sort of a surprise to learn that the most countries do not have extended warranties or that they are not cost effective, but one can understand that the risks are so great that it is difficult for the asphalt companies to manage traffic and external risks. In order to increase the durability and quality it is a matter of costs, determining the right solutions for that road, the road structure of good quality, finding local quality materials, proper equipment/workmanship, and performance at nominal weather conditions. There are other variables too and achieving higher quality is one issue, while the other risks may even be more extensive.

	Warranty (Years)	RECYCLING	LOWEST PRICE	COMMENTS
Alberta, Canada	1 3 Extended	YES	YES	Extended Warranties are not cost effective
British Columbia Canada	1	YES	YES	
Ontario, Canada	1 3-7 Years	YES	YES	No results from long-term warranties
Estonia	1	YES	YES	
Norway	2 Main Road - 5	YES	YES	Accepts alternative bids
Sweden	2	YES	YES	Triggers Values are impor- tant
Finland	2 Main Road - 5	YES	YES	
Holland	3	YES	YES	Pavements known to last 7 years
Australia (VIC-Roads)	2	YES	YES	Usually Recycled – Off Site. Yearly Resurface 10%
Australia Western, Australia	N/A	N/A	N/A	Included in Term Network Contract & Usually chip seal
England	1	Very Little	Derived Prices	Included in MAC or Works Framework Contracts
New Zealand	1	YES	70% Price 30% Quality	PSMC includes resurfacing (Usually Chip Seal)
USA (NCDOT)	1	YES	YES	
USA (MDSHA)	In-Situation - Pass/ Fail Criteria	Off Site	YES	Demand Superpave & Usu- ally Nighttime Paving.
USA (VDOT)	None	NO	YES	Usually off Site Recycling
USA (FDOT)	3	YES	YES	Usually off Site recycling. Yearly resurface about 6% of the network

Table 14 Resurfacing Contract Summary

Note: PSMC refers to Performance Specified Maintenance Contracts

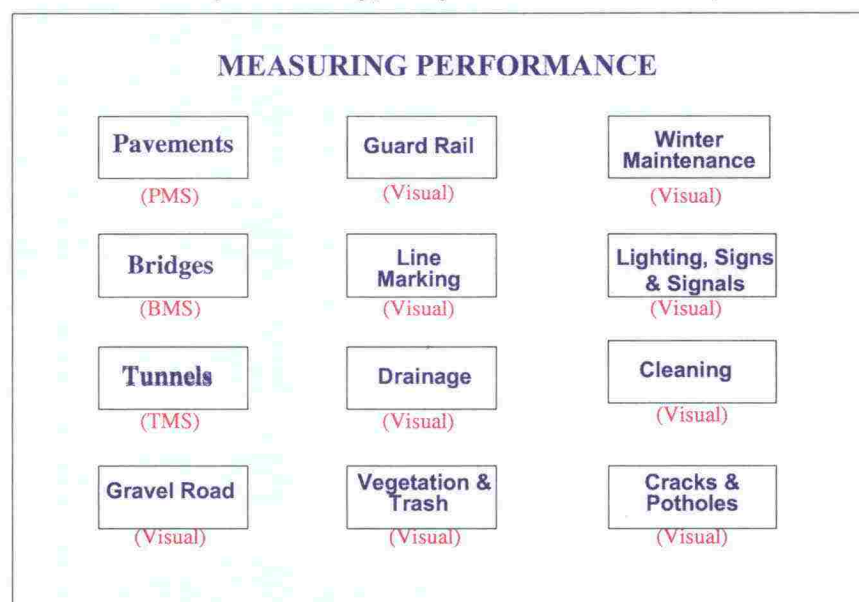
3.7 Quality

Quality is an important part of the process and the maintenance aspects do not receive the same level of care as capital projects. Quality can also be quite subjective and depends upon the "eye of the beholder", especially when the "road user" is concerned. Customer perception levels are quite often at a different level as compared to the perspective of the road authorities. Most road authorities have some form of quality systems in place and specify the "Level of Service" (LOS) or often known as the "Performance Specifications or

Functional Requirements". In routine maintenance contracts it is very difficult to measure all the actual service levels achieved, because it would require an extremely large amount of data collection and analysis, and these are usually obtained via visual type measures. This is especially true for the winter maintenance and it is not feasible yet even though it is a very important safety issue.

Figure 16 shows an example of the large amount of visual activities needed and one can visualize the large amount of data needed to collect from these various maintenance activities. Several countries do in fact measure the performance of routine maintenance activities and typically evaluate approximately 10% of the data to extrapolate statistical performance results. Often statistical analysis tools assist the assessment of the various maintenance activities to determine a condition survey of these assets. Some even publish road and asset condition evaluation in some form of maintenance condition survey and reports. Also, some countries determined that it was not important to measure these parameters, and apparently reverted to the results of overall customer satisfaction surveys. For example, Finland uses a Pass/Fail system along with a customer service survey and national telephone complaint system to report any deficiencies.

There have been good systems and maintenance management tools developed for tunnels, bridges and pavements. There are systems that are very objective and include Bridge Management Systems (BMS), Tunnel Management Systems (TMS), and Pavement Management Systems (PMS). These are periodic maintenance aspects that typically are tendered via separate contracts.



Source: Pakkala (2005)

Figure 16 Large Amount of Visual Data Needed

Based upon the surveys and interviews from the various road authorities and service providers there have been very innovative practices and approaches to retain the public values and quality. Some of these are quite simple and may outwardly appear obvious, but they can really affect the quality levels when implemented correctly. The subsequent list highlights the main techniques and practices that were used to retain the public authorities' quality values.

- QC and quality plans by contractors (contractual agreement)
- In order to Increase quality - increase inspection (costly)
- Simple solution - raise the quality specifications or standards
- Training of contractors & subcontractors (pre-season & kickoff meetings)
- Strict penalties for non-performance after repeated failure (however - creates lack of trust)
- Using Quality Based Selection (QBS) criteria for contract award
- Automated customer complaint feedback system automatically directed to the service provider
- Customer surveys
- Good communication - meetings, problem resolution, & focus groups (or road charters)
- Partnering - project level & strategic level or partnering board
- Guidance handbook
- Maintenance Rating Program (MRP) or statistical evaluation of assets
- Some form of interactive web-based, automated, & flexible "Maintenance Management System"
- Good software tools (billing, scheduling, & inspection)
- Monitoring the performance of the subs
- UK - Performance Review Improvement Delivery (PRIDE)
- Western Australia has a performance review framework to measure and assess the contractors performance against contract objectives (can use also to drive performance & decision making)
- Having some type of Continuous Improvement Process (CIP) - UK
- Post performance evaluation of service providers
- Contractor rating system that includes post evaluation
- Semi-annual or annual evaluation of assets (client & contractor)
- Have a modern/innovative Road Weather Information System (RWIS)
- GPS systems for monitoring snow plow activities (Finnish Keiju system)

When QC is relinquished to the contractor, then the QC plans are essential as they will determine the standard of practice used by the contractor for that entire project duration. This also becomes a contractual obligation. In most countries the QC led by the contracting authority is working reasonably well, but for others it is learning process and requires some degree of development and fine tuning.

As noted above, there is also a simple solution to improve quality, but it would be an expensive alternative. Simply raising the minimum technical and performance standards would provide higher quality levels or the other alternative is to increase inspection to verify that the quality demanded is actually being implemented. Both these simple solutions would probably cost more and it would be difficult to gain acceptance in the client organizations and amongst the funding authorities. These alternatives are probably not likely since the most road authority organizations are downsizing, gradually losing experience and expertise, and lack the resources.

3.8 Conclusions

Most road authorities in this survey are outsourcing a major portion of their routine maintenance activities except for a few states in the USA, with Florida DOT (FDOT) being the main exception. Maintenance via some form of con-

tract varies between countries and activities included in the contracts. Cultural and local differences appear to be the single most apparent deviation for using different approaches to maintenance contracting. Next, there are two forms of maintenance models that seem to be the most commonly practiced and these are the "Cold Climate Model" (routine maintenance activities) and the "Anglo-Saxon model" (more integrated maintenance contracts). These were discussed in detail in Section 3.3 and Table 12 shows the main characteristics. Also, many countries can simultaneously use several types of models, depending upon the advantages and better value for money.

For those other countries that are not outsourcing performance-based maintenance contracts it will be a significant challenge, on how to open the market to contract maintenance. It would be wise to investigate the progression of successful and advanced countries, and learn those practices, potential pitfalls, the lessons learned, and by having a deliberate process in achieving the vision set forth.

One significant finding is that there have been no new 10-year Performance Specified Maintenance Contracts (PSMC) type contracts in New Zealand or other Anglo-Saxon countries. Based upon the observations during the interviews these types of contracts have not produced successful results as expected. Otherwise, if they were successful they may have continued the progression and influence elsewhere. We believe that this may be due to integrating periodic maintenance with routine maintenance into one contract, and not the duration of the contract. Apparently the affect on the supply chain management is not as beneficial when using the "Anglo-Saxon model".

Another significant trend is that most countries have extended the contract period duration with most agreements being between 7-10 years. In the progression of advanced countries, the trend started at three year agreements, and then progressed toward 5 years. The next phases of contracts are seen between 7-10 years, and a few are contemplating longer agreements, but it may take time to implement them. These agreements seem to be favorable both to the road authority and service providers/contractors. In Pakkala (2003) it was anticipated that there might be a future potential to increase the duration of maintenance contracts to 25 years or even more. However, this has not occurred even though there is some consideration of longer term arrangements. After all PPP contracts already include a provision for about 20 years or more for both the routine and periodic maintenance.

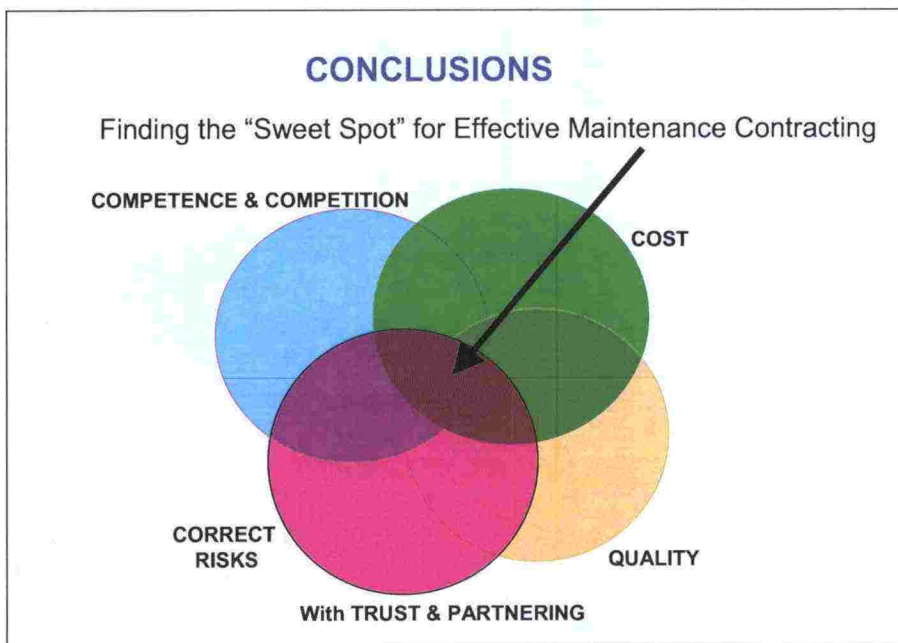
A new model called "Alliance model" (called E-MAC in England) has been recently utilized in England. This is seen as the potential replacement for the PSMC model, as several "Anglo-Saxon" countries are discussing the feasibility of implementing the "Alliance model". This new model appears to be promising and lots of equitable features have positive characteristics, but there are no results to date or data that support any conclusions. The alliance model may be seen as a replacement for the PSMC where results are not as expected.

Most of the maintenance models can be characterized with the following:

- Savings in these contracts during the early years of adaptation vary from 10-40%

- Most are performance based or contain Levels of Service (LOS)
- Contract durations are now about 7-10 years (BC, Canada is now at 10 year duration)
- Most contracts are "lump sum" or "hybrid"
- There is a split in the contractor selection criteria between lowest price and "best value"
- Bundling of activities varies, but routine maintenance seems to be the most common
- Equipment and project management innovations appear to be the most dominant
- Partnering and trust are still important throughout the supply chain
- Writing clear and concise contracts is difficult (especially when including public values & ethics)

One final thought relating to maintenance contracting can be seen in Figure 17. It is difficult to get all the aspects perfectly correct during the first stages of outsourcing and implementation of maintenance contracts. It is a learning process that needs to find the "Sweet Spot" for effective maintenance. Finding this "Sweet Spot" requires wisdom, good management, understanding the maintenance market, and the ability to determine and apply a balanced risk.



Source: Pakkala (2006)

Figure 17 Sweet Spot from Effective Maintenance

4 PERFORMANCE INDICATORS

When it comes to "Performance indicators" terminology is quite confusing as so many different countries are using different names and there is no common standard. Some countries use terminology such as Performance Indicators (PI), "*Key Performance indicators*" (KPI), asset level indicators, strategic level indicators, and the list goes on. It really depends upon which administration level of "Performance Indicators" is being referred. It is intended that the following information will attempt to clarify the meaning of "Performance Indicators" and demonstrate how they are referred to in this study.

The following set of explanations and visual aids will attempt to show some logic and reason behind the schemes when discussing indicators. When discussing issues at the highest level of government, usually the Ministry of Transport or Department of Transportation, the "Performance Indicators" are defined as those measures at the highest level or "Strategic Indicators". These are usually aligned to society goals, road user concerns, political, and sometimes key stakeholder demands. This strategic level usually includes mobility, accessibility, safety, environment, customer satisfaction, cost effectiveness, organizational excellence, and even security is being added due to global terrorism. The term used in this study to describe these PI is being termed as "Strategic Indicators". Many countries are already using these measures and they usually include an objective, outcome, and a target level. Obviously, these "Strategic Indicators" need to be measured objectively or in some logical manner. It takes time to develop these and requires a few years of practice in order to determine if the "Strategic Indicators" have been achieved or not.

Usually, the next level of government or responsibility for the roads is the road authority or road administration. Some of the potential indicators for the road authority might be operational safety, efficient delivery of services, cost effectiveness or accountability, road user satisfaction, environmental consideration, quality or service levels, organizational excellence, program delivery, communications, and key stakeholder relationships. These indicators are called "Operational Performance Indicators" (OPI).

Then the next level down could be termed as "Asset Performance Indicators" (API), which measures the asset condition of the various road assets. Usually the road authority manages the data collection and many even have a condition assessment report that describes the status of the assets at that period in time. For example: network condition, bridge condition, road condition, quality, and environmental

However, as time goes forward the asset condition can change and is important to determine the deterioration of the assets so that there is intervention before any particular asset fails. This data is also important to demonstrate the budget needs and requirements and how the asset condition is affected.

These different levels of indicators are shown in Figures 18 and 19 which attempt to describe the relationship between the different indicators. Some indicators like environment, safety, and customer service tend to be common at all levels and there is a strong correlation of these measures from the lower to the strategic level indicators. Also, many measures have no commonality between them and it is significant to notice that there are "**missing gaps**".

One objective of this study was to determine if any "Strategic Indicators" were used in the contracts for either capital projects or maintenance contracts. The results of the international study reveal that there are some missing gaps between these higher-level performance measures and those performance measures that are used in the contracts. None of these so called "Strategic Indicators" were used in contracts, as it is difficult for any service provider to meet them, nevertheless it is important to understand the meaning, and all the details included. However, these "Strategic Indicators" are incorporated or attempted to incorporate the translation of these measures into understandable technical and performance requirements. These requirements or standards are what are typically used in the actual contracts. These are at a lower level than Strategic Indicators, OPIs, and APIs accordingly.

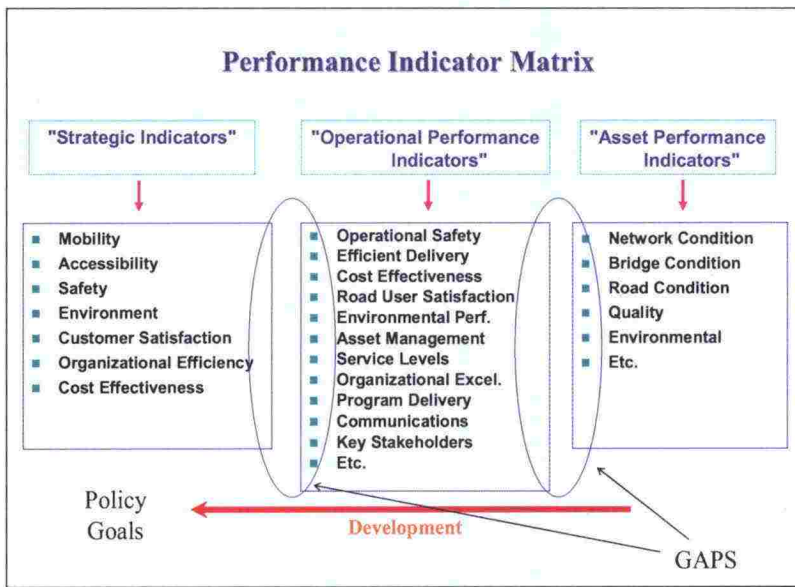


Figure 18 Performance Indicator Measures

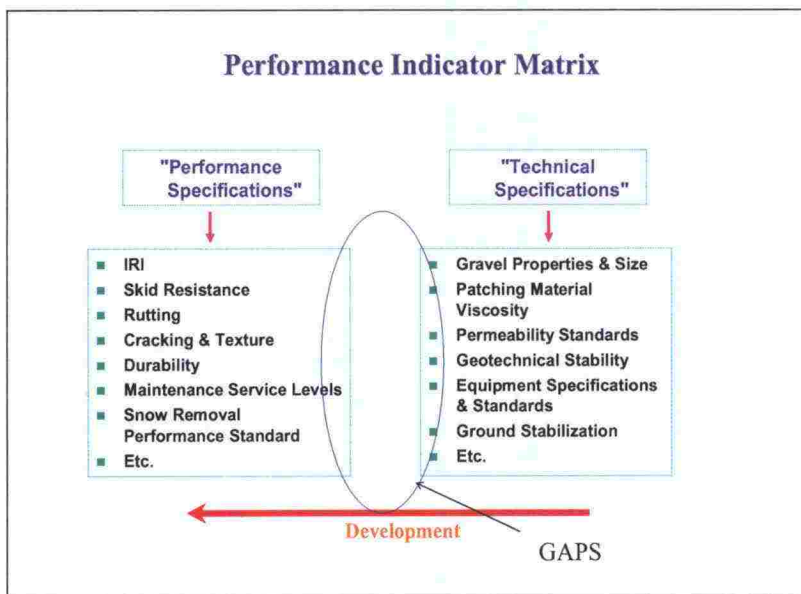
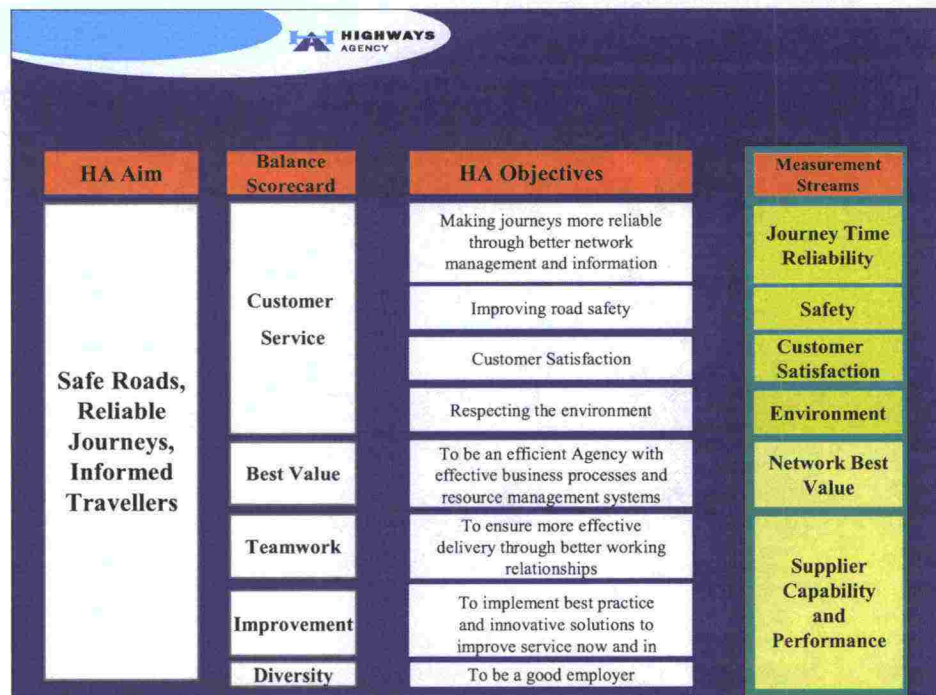


Figure 19 Performance & Technical Standards

It might be easier to understand the continuity of Performance Indicators and measures from another example from the Highways Agency in England. See Figure 20 which shows a correlation between many aspects of Highways Agency (HA) aims, Balanced ScoreCard (BSC), HA objectives, and Measurement streams.

Highways Agency (2006) has more details on how these measures can be utilized and the management plan in Highways Agency (2006) includes information on how the process has been developed through the accountability aspects within the entire organization. It should also be noted that the Balanced ScoreCard (BSC) is being used. Some countries are further ahead in the development and use of Performance Indicators and many of them utilize the BSC in some manner. Others are using a red, yellow and green light system for easy identification of the poor, good, and neutral parameters, from the BSC framework. This type of system is a nice and simplified system and can be easily understood by road users too. Although it is a more simplified system, it is able to follow the performance of many important aspects that are identified by measures and targets.



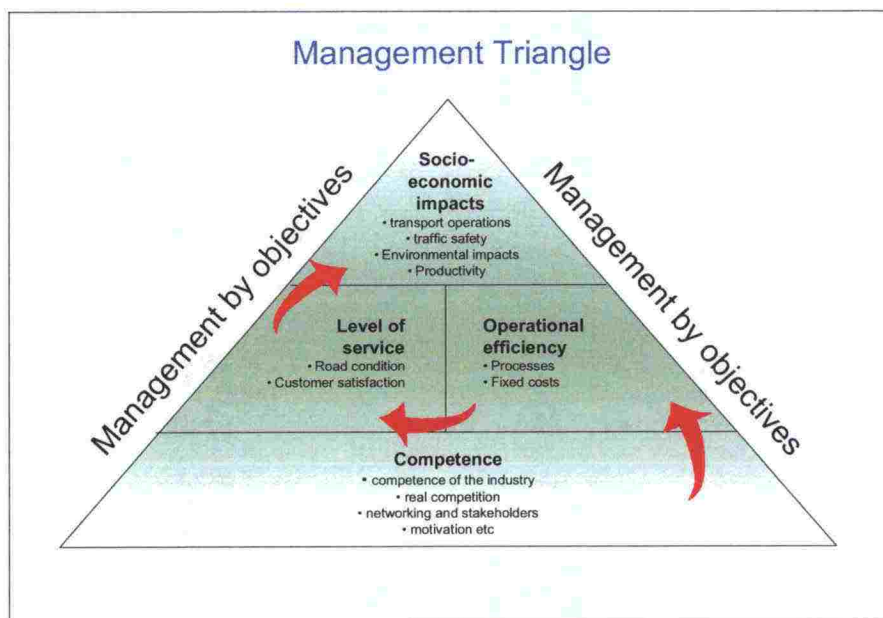
Source: Highways Agency

Figure 20 Highways Agency Performance Measures

In Finland the “Management Triangle” concept is used at both the road authority and also at the transport ministry level. This is similar to the Balanced ScoreCard (BSC) concept except that it is in a triangle form. The impacts to society and the customer service levels are the external performance criteria and the internal aspects are the operational efficiency and competence of the organization in order to achieve the requirements set out in the management by objectives. Refer to Figure 21 for visual representation of the “Management Triangle”.

These are some examples in which "Performance Indicators" are used in road authority organizations. It is more of a management and administrative so that there is an objective system to measure the performance and accountability of governmental organizations. Even though these performance measures cannot be directly transferred into the maintenance and construction contracts there is some form of benchmarking to indicate the status and performance of key objectives.

The previous examples show that both England and Finland have made a move to connect the various levels of performance indicators with each other and also that a number of missing gaps remain. It is important to note that there are also other countries that are using these or similar systems. Mapping the links between the levels and pointing out how these links could be strengthened in theory is only a first step. In order to actually implement these connections, filling in the gaps, organizing work processes along these lines and ensuring that monitoring and feedback loops will require a lot more intellectual and organizational effort. At the time of writing, the capacity for such an undertaking was not available, leaving the question whether devising a well-functioning performance evaluation system will be achieved.



Source: Finnra & MOTC

Figure 21 Management Triangle

Some of the main benefits for the use of these types of systems or indicators can be summarized as follows:

- Good internal benchmark of organizational performance
- Good benchmark on road network performance
- Accountability throughout the organization
- Determining the overall understanding of performance against targets
- Budget can be objectively related to actual conditions
- Potential for budget to drive the needs and correct deficiencies

Some of the weaknesses with this type of systems or indicators can be summarized as follows:

- Cannot be used as a benchmark against other countries systems
- Difficult to determine what aspects and why things improved or deteriorated
- Need several years of data to determine any trends, shortfalls, & results

Conclusions;

- Countries basically having differing indicators and systems
- Feedback loop is desired
- Accountability throughout the organization
- Still needs further development

5 CONCLUSIONS

The conclusions will be divided into two sections, one called "Capital Investments" and the other is termed "Maintenance Practices".

Capital Investments

The traditional or DBB method continues to be the dominating project delivery method for road projects in most of the countries. However, use of the innovative project delivery methods like Design-Build and PPP is increasing and more countries are adapting these practices. There have been numerous reports, positive results, and increased satisfaction with the Design-Build and PPP models. PPP is enticing many countries due to significant reductions in public spending and the private finance option makes it very attractive. Private finance and the PPP model should not be taken for granted, as it requires significant due diligence and understanding of all the consequences and is worthy of detailed investigation.

The main new methods uncovered during the study are the "Alliance model" and Early Contractor Involvement" (ECI). These are in the early stages and there is not enough quantitative results to make any conclusions at this time.

When progressing to these innovative models it can involve a great deal of effort and investigation because the concepts are quite new and there are significant issues that need to be considered. Results indicate that the benefits are significant; thus further development and continuous improvement of the models can be a worthy goal.

There are five main categories highlighting the practices and concepts that describe the key aspects of innovative contracting methods. Firstly, it should be realized that taking on these newer and innovative project delivery methods requires a significant learning process. The countries that have achieved those results have gone through a significant effort and process that has demonstrated strong leadership and good management practices. It should be noted that this was not achieved over night and there have been some road blocks and problematic areas, but continuous improvement should be used to determine the optimum model characteristics.

The transfer of risks is almost the most significant single issue. Most contractors are typically risk evasive and only the more advanced contractors seem to be accepting and managing these risks. This may be the reason for the somewhat deliberate process as it takes champions in the industry to begin accepting risks through these newer methods. Once risk management is beginning to mature then there can be optimization of risks and a steady practice of which party is responsible to risks to a certain level.

Involving the contractor into the project at the earliest possible planning phases is another aspect of innovating practices. This is where the constructability, cost optimization, any early impact to support innovative concepts into the design can be achieved. Usually this occurs after contract award when there can usually be very little changes to the design. Even better would be to involve the main actors in a spirit of true teamwork, partnership, and a leadership approach, which is the intent of the "Alliance model".

Quality and public values are very important and these key aspects should not be compromised. It is important to verify that the planning and design criteria are maintained to equal or better compared to traditional methods. Quality Control by contractors can be a form of monitoring quality during the construction phase, and having the correct level of performance specifications may increase the potential for innovations or alternative concepts. Also, by having significant quality elements in the tendering versus price may attract higher quality contractors as it requires a higher level of quality measurements. If allowed, a contractor and professional services interactive rating system, that is truly measuring some level of actual performance, would probably provide better results.

Finally, the road authority needs to understand that a well balanced procurement portfolio package will continue to sustain the market base of contractors and professional services. A proper strategy to incorporate the correct model for the appropriate project, compensation in the form of stipends to offset the higher tendering costs in the innovate models, non low-bid practices for these innovative models, and at the appropriate times to use restrictive bidding to maximum of three tenders for full pricing quotes after being short listed.

These can be summarized as follows:

Learning Process:

- As a logical progression, Design-Build should be the first model tested
- Takes time to implement
- Creating trust with industry takes time
- Continual learning process - reengineering the models
- Performance specifications should be developed for Design-Build and all related DB models
- Standardization of contracts & continuity amongst all regional road authorities

Risks:

- Knowledge and competence of risks
- Allocating risks to the proper party
- Risk optimization

Gains by Early Contractor Involvement (ECI):

- Using the Early Contractor Involvement (ECI) model
- Minimize design development to < 30% or less
- Potential of the "Alliance model"

Quality:

- QC by contractor
- Quality Based Selection criteria for contract award
- Performance Specifications
- Contractor rating program
- Professional services rating program

Procurement Portfolio:

- Having a proper procurement strategy & project portfolio
- Having expertise in all models & disseminated to all regional personnel
- Offset higher tendering cost by compensation via stipends
- Consider short listing to a maximum of 3 tenders for medium and large projects
- Consider the use of integrated phases for professional consultants for continuity
- No low bid tenders for the innovative models (except really small projects)

In addition to these findings and more of the authors' experience and recommendation, the following figure can help explain the need to have wise decisions made at the earliest outset of any project and one that can be delivered as quickly as possible. Many do not realize the total duration of a project can be 10 years or longer after project conception and moving through the governmental approval process, in which many events can occur before the project can be authorized and later on completed. Therefore, if it possible to use a situation where all customer needs, environmental aspects, public values, and "best for all attitude" can be used at the earliest concept then a picture might be developed as shown in Figure 22. (The light blue shaded area is the area where most decisions are finalized by the "Alliance team"). Thus, the method that comes close to this type of practice is the "Alliance model" as the key decisions are done early, has a leadership philosophy, a joint or real teaming approach, and a best for project attitude.

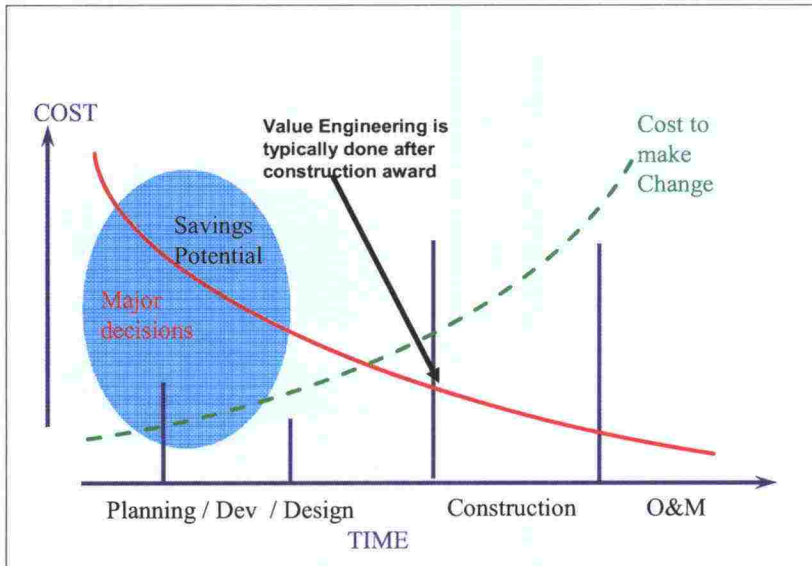


Figure 22 Effective & Efficient Decision Making Potential (VE curve)

Maintenance Practices

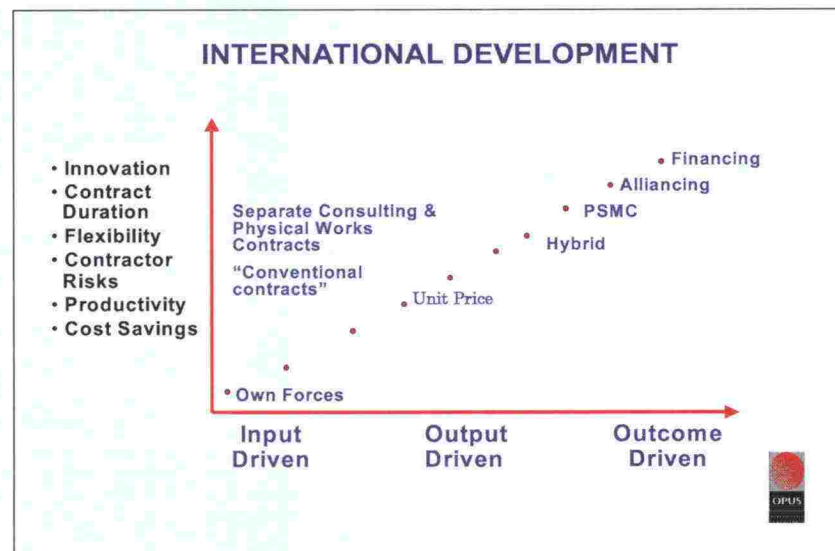
During the earlier years of procurement of maintenance activities and during the first transition to outsourcing, the services were purchased yearly or via multi-year agreements, using separate contracts for each activity, and usually with a labor rate or unit price. Next, performance-based routine maintenance contracts began with 3 year contracts with service levels for quality standards and were typically unit price or hybrid contracts. The next progression was

to longer and more lump sum type contracts. More recently there have been more integrated contracts (periodic and routine maintenance), for a longer duration, basically lump sum contracts, using performance criteria or Levels of Service (LOS), and using more of a partnering concept. Table 12 in the maintenance section of this report shows a summary of the different maintenance practice used by the countries in this study.

Figure 23 shows the international development of maintenance practices and is still the development trend in today's maintenance practices. In short the results from this study continue to verify this trend of development and continue to be a valid strategy that many continue to follow. British Columbia, Canada has somewhat pushed the development as compared to the similar study in 2001, and all the routine maintenance contracts are of 10 year duration.

The main message is to understand that it probably will require a long and deliberate process to advance from the in-house model (traditional model) directly to fully performance based routine maintenance contracts. There are so many development issues and concerns for implementation and it would be wise to progress deliberately along the upward slope of Figure 23 to the more progressive models.

The main new development is the inclusion of the "Alliance model" or what is termed E-MAC in England. This is a recent development and appears that this is a potential replacement of the Performance Specified Maintenance Contracts (PSMC) type contracts in the Anglo-Saxon countries. Also, it was noticed that the results from these PSMC type practices have not been as expected and the "Alliance Model" is being investigated as a potential replacement for PSMC.



Source: Porter (2001)

Figure 23 International Maintenance Development

In summary the following highlights the development of maintenance contracting:

- Opening the market to maintenance has been key issue and a deliberate process of development should be considered before advancing straight towards the advanced models (Figure 23)
- Outsourcing of performance-based routine maintenance has demonstrated successful results
- Longer-term agreements - about 7-10 years
- Lump Sum or Hybrid type contracts (Combination of Lump Sum and Unit Price)
- Using quality-based contractor selection methods
- Most innovations have been equipment related, ICT, and Project Management
- Alliance model appears to have good potential
- Partnering and trust are still relevant (both Client & Sub-Contractors)
- Integrating periodic maintenance with routine maintenance is suspect and should be cautiously considered

There are many national and international lessons to be learned and understood when progressing to the advanced performance based maintenance models. There are so many considerations to be taken into account and it is wise to study the developments, lessons learned, affects of outsourcing, possibly changing the market, and a paradigm change especially for the road authorities. Change is difficult (especially for public organizations), but it is necessary in keeping pace in today's society and the desire to progress into best practices that produce better services at a fair investment.

APPENDIX A - LESSONS LEARNED FROM CAPITAL INVESTMENTS

There have been numerous lessons learned throughout the progression of this study as well as those reported in other numerous reports, which contain valuable suggestions. The following summarizes some of the common lessons learned and attempts to quantify the good practices that were uncovered during the course of this project. These good practices should not be confused with those fully accepted by formal best practices procedures.

Main Theme	Lesson Learned
Communication and cooperation with Industry	<ul style="list-style-type: none"> • Good open communication is essential through the project development to its completion (many understand this issue, but it is difficult to put into practice in real projects) • Working together - client, contractor, research organizations & all main organizations in supply chain in the development of new models, innovations, systems, and practices. When moving towards new models and changing practices, it requires good leadership, a lot of time, open communication, and willingness to pursue the "greater good" for the benefit of society. • Create trust (this takes time and successful implementation - client, contractors & consultants) • Develop a procurement strategy with industry inputs via forums or equivalent • Diverse portfolio of projects delivery methods to balance the construction market • Several years forward planning of construction projects • Transparent and equitable procurement process • Coordinate projects with other infra sectors - overheating of marketplace & work • Utilize E-commerce for tendering
Road Authority Development and Implementation of Innovative Practices	<ul style="list-style-type: none"> • Understanding that moving toward innovative processes takes a great deal of time. This includes challenging new concepts, change management, key champions, bold decisions, hard and diligent effort, and a willing culture to move forward. So called good "Leadership"! • There are several successful projects for all given project delivery methods • International meetings, benchmarking, sharing information, research, visits, conferences & exchanges provide extra value that cannot normally be obtained in any form of publication • Performance specifications (functional requirements) are a vital part in these innovative models. It is a very slow process of development and is a key lacking aspect, which reduces the potential benefits of the Design-Build and its variations. • Client's experts ability or non-ability to approve innovations and Alternative Technical Concepts (ATCs) • Different practices between the regional offices in road authorities and lack of clear continuity between them. Full standardization of practices not observed. • Environmental & ROW risks are important to overcome and difficult to minimize and transfer to service providers. Many should be resolved before tender or having preliminary approval. • Bundling of small projects provides gains & efficiencies and works reasonably well

Main Theme	Lesson Learned
Road Authority Development and Implementation of Innovative Practices	<ul style="list-style-type: none"> ● Continual re-engineering of the procurement models - or continuous improvement ● Traffic management is an expertise that has not been fully developed by the private sector and requires substantial improvement ● Consider having an interactive contractor rating system ● Consider having an interactive consultant rating system ● How to effectively manage the utilities during projects
Design-Bid-Build (DBB)	<ul style="list-style-type: none"> ● Lump sum contracts provide potential benefits for contractors (avoids unit price quarrels) ● Partnering is important ● Using financial rewards and penalties ● Start using QC by Contractors ● Ability to measure Alternative Technical Concepts (ATC) ● Not Low-Bid selection criteria (includes other type measures aligned with project objectives) ● Consider other options like A+B bidding, Lane Rental, & Incentives and disincentives ● Include LCC if possible (some do after tender award) ● Consider Value Engineering as early as possible ● Utilizing advanced project management information systems & ICT tools ● Good communications, quicker responses to questions & inquiries, and better management
Design-Build (DB)	<ul style="list-style-type: none"> ● It is important to understand all aspects, implementation issues, time to develop correctly, and re-engineer the Design-Build model according to local practices. US DOT & FHWA (2006) and Koppinen & Lahdenpera (2004) are great resources for understanding Design-Build and model improvements ● There is a large gap of understanding, expertise, and knowledge with Design-Build models amongst the client organization's experts, especially at the regional level. Even greater differences were noted between the regional offices ● Develop Performance-based specifications. (Performance-based specifications have a strong relationship with Design-Build and their other variations) ● Limiting the amount of design development before tender (greater advantages with less) ● Co-location of Design-Build team with client (Quicker decisions and efficiency) ● Using Quality-based selection criteria (guideline - spread of greater than 40% is recommended) ● Develop solutions to measure Alternative Technical Concepts (ATC). Warranties are almost a natural progression from ATC ● Using real partnering and teaming concepts ● Risk matrices and analysis should be developed into DB model ● Risks are important and are not easily accepted by service providers. Also optimization takes time ● Short-Listing to 3 potential competitors ● If possible, bundling several small DB projects ● Using a two step process - Request for Qualifications with short-listing and then full tender. Prequalification system should have effectiveness "with Teeth" ● Consider the use of stipends

Main Theme	Lesson Learned
PPP Model Overall Ministry & Society	<ul style="list-style-type: none"> • There may be legal issues preventing private finance and may need law changes or government approval • PPP and private finance models can be used effectively, if used wisely • Buy-in from the Ministry of Finance • Need a good "Public Sector Comparator" (Benchmarking capability) • Demonstrating Value for Money – (Must be better than other models) • Selecting a good measurable, objective "Payment Mechanism" (Transparent) • Understanding the influence of banks/private finance • In PPP - consider series of PPP projects and not just one - costs of entering market is high • Financial rating of one's country • There is a limit to amount of projects that can be done via PP model • Difficult to predict into future & what are the political consequences • Influence of project size – recommendation of over 80 million Euros • Other threats to the project like environmental, protest, and political • Rumors that PPP might be a stepping stone for "Road User Charging" (RUC)
PPP Model Road Authority	<ul style="list-style-type: none"> • Understanding risks from both a legal, financial and design & construction perspective • Banks/Financiers essentially take no risk • Sharing the refinancing gains with the public clients • Underestimating market risks – causes higher premiums • Traffic avoidance and by-passing tolls or lower cost alternative routes in future • Underestimating the influence of Banks/Financiers/Investors • Developing "Performance Specifications" & "Outcome-Based Criteria" • If you have not outsourced maintenance activities via maintenance contracts, it will be difficult to include all the detailed aspects of maintenance into the PPP contract • Allowing potential for innovation – how to approve "Alternative Technical Concepts" (ATCs) • How to make long-term contracts as flexible as possible • Clear and concise contract language and standardization • Appropriate "Hand-Back Clause" (what condition is the asset is returned back to the authority) • Lack of understanding of DBFO delivery model at all levels (requires a client learning process) • Not taking advantage of the real concept of Design-Build - (it was intended as a "Teaming & Partnering" concept) • Enticing international competition – culture & language (English preferred)

Main Theme	Lesson Learned
PPP Model Road Authority (Continued)	<ul style="list-style-type: none"> • Usually for large projects - typically greater than €60 million • Ability of foreign participants to find/network with reliable national partners • Consider the use of stipends to offset the large tendering costs • Large transaction costs - Legal, technical, & financial expenses are great • Monitoring & measuring acceptance during the "Delivery Phase" (construction portion) • Future potential - no Best And Final Offer (BAFO) stage • If you have not outsourced maintenance activities via maintenance contracts, it will be difficult to include all the detailed aspects of maintenance into the PPP contract
PPP Model Private Sector Contractors & Others	<ul style="list-style-type: none"> • Competition mainly for the mega/large companies • Ability to get competitively priced private finance • Large transaction costs - Legal, technical, & financial expenses are great • Professional services rewarded for their savings/innovations in project (shared savings/bonuses) • Making too many decisions too fast with more potential errors • Lack of understanding of DBFO delivery model • Finding sufficient experienced auditors, technical professionals, & supply chain partners
Alliance Model	<ul style="list-style-type: none"> • A new spirit of "team work" (seeking the best for the project instead of personal or organization gain. The relatively new "Alliance Model" is designed from this spirit - and is called the "Leadership Model") • Co-location of the project partners is essential in the Alliance model • Is the client able to be neutral party and assure quality practices
Best Practices	<ul style="list-style-type: none"> • Design-Build and their contracting variations • PPP and private finance models can be used effectively, if used wisely • Optimizing risks in all project delivery methods • Some form of a measurable "Contractor" rating system (with effectiveness) • Some form of a measurable "Professional Services" rating system (with effectiveness) • Hiring professional services consultant to perform integrated design/planning phases (so called Total Project Management - TPM in Ontario, Canada) • Significant Quality based Selection Criteria for Contractors • Bundling of small projects • Alliance Model - potential to be a best practice, but insufficient data at this time • Sophisticated project management software tool (risks, QC, project tracking, & interfaces) • Common Data modeling (3D) of all design work - no data to support this best practice, but would significantly reduce design errors, omissions, quantities, & interface issues • QC by contractor • Short-Listing to 3 potential competitors

APPENDIX B - RECOMMENDATIONS FOR CAPITAL INVESTMENTS

The following are recommendations based upon information gathered throughout the years of understanding procurement practices. The main overall recommendation is to go forward in developing these so-called innovative practices and realize that it will take time and cultural changes, especially if these are totally new concepts. Hopefully, the benefits will overtake the development cost and eventually out perform and add value to you experiences.

The first recommendation is to develop a strategy to include a portfolio of all main project delivery methods (DBB, DB, DBOM, DBFO and Alliance model - if possible). What this accomplishes is a stage of continual development and learning the detailed intricacies while maintaining the road construction industry. These should be developed in stages and understand that Design-Build is the foundation of the remaining models and should be considered as the first development model. What may happen is that only a few contractors will be able to maintain the development progression and the remaining industry will remain at the status quo level, which means that traditional models will still be needed and it is important to retain a reasonable market for road building. It cannot be stressed enough that Design-Build should be done with due diligence and one can learn from international studies and developments.

Design-Build (DB) seems to be the most widely used innovative model and the results have been quite good, with some exceptions. Also, some countries have decided that DB will be the preferred model of choice for procurement or at least from an overall project value figure. However, development of the DB model takes great effort and considerable time to develop. Changing the behavior of all the actors involved as well as developing the model as it was intended, is a significant task and is not easy to implement as quickly as desired.

In addition, DB has been successfully used for small projects, yet the overall practice for small projects has not significantly increased. This is difficult to understand and explain, but maybe due to the easy selection process of DBB, where there is lots of competition, and maybe the culture for small projects doesn't desire integration and teamwork type approach.

As a pre-requisite to the Design-Build model development, the following may be considered a sort of a guideline for progression

- Attain a teaming & partnering concept between Design consultants & Contractors
- Study and begin to apply national and international practices to fit your culture/society
- Begin developing performance-based specifications (goes hand-in-hand with DB model)
- Begin reducing design development and attempt to limit to < 30% if possible
- Learn how to accept & reject proposed Alternative Technical Concepts (ATC) - innovations
- Important to have good communications, develop trust, & transparency
- Make sure your road authority regional experts are included in the development process

Secondly, evaluate the results of any Design-Build pilot projects and have both internal and external evaluations. This will assist in determining whether the model can be applied successfully to future projects. Also, this should address the differences, benefits, and disadvantages as compared to the traditional model, a sort of benchmark. This should include marketing and working with upper management, regional offices & internal experts, involving the contracting industry, design professionals, and other important key stakeholders.

Once Design-Build is thoroughly understood by your procurement staff/experts, the third recommendation is to begin developing the DBOM and PPP models and prepare projects for pilot testing of these models. These models assume you have expertise in the Design-Build model, because DB is the foundation of the next progressive models. (See the subsequent suggestions on improving these models).

Some essential prerequisites for the DBOM model are as follows:

- Working with the contracting industry to determine if there is a market and willingness
- Should have some degree of expertise or practices in outsourcing maintenance activities. In other words what performance or service levels are required for each activity
- Risks should be an important part and may need to study risk analysis and allocation
- Developing Handback requirement for end of contract period

Some essential prerequisites for the PPP model are as follows:

- Same issues as mentioned in DBOM
- Having a legal framework for private finance (don't assume it already exists)
- Understanding all the issues, consequences, pitfalls, and important aspects of PPP model. May have to prepare a research study on PPP)
- Understand private finance and banking/financial requirements and consequences. (may need to hire financial professionals)
- Having approval at high governmental levels - Ministry of Finance
- Having a benchmark comparison - some form of Public Sector Comparator (PSC)
- How to develop a business case for projects
- Thorough understanding of risks and risk optimization. (May have to prepare a research study on risks and categorized via different models)
- Understanding different payment mechanisms & which ones provide better value
- Assigning a client PPP team that is continuously involved from the conception of PPP

Fourthly, evaluation of the DBOM and PPP models and attempt to compare these models with the traditional forms and against the DB model. This may need to be done during the pilot testing stage so that the data can be captured and analyzed and probably be done internally and externally.

The fifth suggestion should be to re-engineer all the models used and utilize as many as appropriate best practices into each model used. For example,

one of the research studies as well as the application of risks that were revealed during PPP projects can now be potentially used into the other models as well as the traditional model. So a risk identification/matrix at tendering stage can be developed so that an equitable sharing of risks can already be made clear during tendering phases of a project. This would help minimize the costs of a project when the risks are identified as compared to traditional contracts where risks typically are priced into the contract or are billed as extra work or change orders.

The final suggestion is to trial the "Alliance model" but there should be significant background research and possibly gather data from a country that has practiced this model. If possible, it would be practical to meet with some of the clients to gather some lessons learned and determine the real implementation aspects. As with the PPP model, it should require extensive study and also determine if the contracting industry has the capability to use the "Alliance model".

According to the advertised benefits the alliance model seems to be one of the potential models for the future, and one key recommendation is to start the model as early in the planning process as possible. One of the great impacts of this model is the potential to reduce the planning process duration to only 6-8 months, which typically takes years to develop in many road authority organizations.

APPENDIX C - LESSONS LEARNED FROM MAINTENANCE PRACTICES

There have been numerous lessons learned throughout the progression of this study as well as those reported in other numerous reports, which contain valuable suggestions. The following summarizes some of the common lessons learned and attempts to quantify the good practices that were uncovered during the course of this project. These good practices should not be confused with those fully accepted by formal best practices procedures.

Main Theme	Lesson Learned
Communication and cooperation with Industry	<ul style="list-style-type: none"> ● Good open communications is essential throughout the process from the time of the tendering phase and all the way through the contract duration (especially monthly meetings) ● Create Partnering and Trust ● Consider a "Partnering" system or Partnering board ● Develop a procurement strategy for maintenance with industry ● Takes time for the contractors to find the local partners and small businesses ● Information & training meetings with contractors & road users ● Diverse portfolio of delivery maintenance methods to balance the market (traditional & innovative methods) ● Utilize E-commerce for tendering
Road Authority Development and Implementation of Innovative Practices	<ul style="list-style-type: none"> ● Copying or sharing of practices from national and international countries ● Beginning to "Outsource" usually requires decisions at high levels of government ● How you open the "Market to Maintenance" is extremely important ● Determining the opportunity or existence of a "private market appetite" for maintenance ● Understanding the reasons for failures and successes - what really works & doesn't work? To increase quality - simply raise the performance standards and/or increase inspection ● Performance-based specifications (or functional requirements) and Levels of Service (LOS) are slowly being developed and require further research ● Outcome-based criteria or performance levels are more aligned toward the road users ● Knowing what quality standard produces best economical efficiency ● Sometimes bundling of single maintenance activity for a long term duration produces better value for money (results not available from resurfacing & bridges) ● Some form of interactive web-based, automated, & flexible "Maintenance Management System" ● Some clients perceived that there is a loss of control ● Client is losing the practical know-how of maintenance works ● Contract duration 3+3+3 years is actually a 3 year contract with only a potential for extension. It does not equal nine year contract duration because extensions are at risk with no guarantee (Mainly allows client flexibility & benefit only) ● Road authorities are becoming more like contract managers

Main Theme	Lesson Learned
Road Authority Development and Implementation of Innovative Practices (Continued)	<ul style="list-style-type: none"> • 3 Key Issues with Good & Reliable Road Data <ul style="list-style-type: none"> • What are the assets – what is out there? Need reliable data! • What condition have you maintained it at? What are the service levels? • What are your past & existing costs for maintaining the asset? • It has been proven difficult to jump from in-house to performance-based contracts that integrate all aspects (it's a learning process) • Outsourcing is what provides the majority of the savings in a maintenance contract • The longer term contracts provide extra savings • Various models used will depend upon the culture and local practices in the country • Various models depend upon the expertise and competence of private sector (takes time) • There is a trend towards outsourcing of maintenance & via long term maintenance contracts • Most contracts in these progressive countries are about 7-8 years - exception being British Columbia Canada and Western Australia • Having some type of continuous improvement process or at least a system for collecting these • Securing long-term maintenance contract for the entire network provides surety for maintenance & preservation • Equipment innovations and project management appear to be the most dominant innovations • Various minor innovations have been achieved via long term maintenance contracts and depends upon which maintenance model is utilized • Those countries that retain in-house workers and have attempted performance-based contracting have benefited by adapting practices from the private industry • Cannot fix a capital expenditure with a Maintenance Contract • Can include small capital projects up to certain maximum value (differs by country)
Maintenance Contract Issues	<ul style="list-style-type: none"> • Head to head competition among service providers & an equitable procurement process • Having common standards & performance measures (outcomes) • Difficulty of writing all details into a contract • Outsourcing typically began with 3 year contracts • Most contracts began with "Unit Prices" and are now "Hybrid or Lump Sum" • Using Quality-based selection criteria for winning award • QC by contractors is working reasonably well • Strict penalties for non-performance and an escalating scale (however - creates lack of trust) • Bonuses and sanctions should be significant, able to be achieved, and balanced • Mix-matching performance and technical specifications in contract & during tender

Main Theme	Lesson Learned
Maintenance Contract Issues (Continued)	<ul style="list-style-type: none"> • Different practices between the regional offices in road authorities and lack of clear continuity between them. (Full standardization of practices has not been achieved) • Having a Maintenance Rating Program (MRP) or statistical evaluation of assets has better meaning than Pass/Fail systems • Customer surveys and possibly integrated into bonus system • Automated customer complaint feedback system automatically directed to the service provider • Utilizing maintenance guidance handbooks • Utilizing some type of auditing system • Should be some type of indexing (inflation index) in long term contracts • Begin developing & using risks allocation in tendering process • Minimizing administration & paperwork bureaucracy - unofficially not working well
Contractor Perspectives in Contracts	<ul style="list-style-type: none"> • Consideration is needed for mobilization of new contracts & equipment - in advance • Signing new contractors on time and allow mobilization to occur smoothly • Having a good software and ICT tools (Billing, Scheduling, asset database, & Inspection) • Have a Modern/Innovative Road Weather Information System (RWIS) • Pocket GPS data logging system for snow plows & trucks (similar to Finnish Keiju system) • Training of Contractors & Subcontractors (Pre-Season & Kickoff meetings) • Semi-Annual or Annual Evaluation of assets (both client & contractor) • Proving to the client that alternative concepts are acceptable
Best Practices	<ul style="list-style-type: none"> • Outsourcing of routine maintenance • Longer term maintenance contracts - greater than 7 years • Significant Quality based Selection Criteria for Contractors • Some form of interactive web-based, automated, & flexible "Maintenance Management System" • Open communications, workshops, seminars, & cooperative sharing sessions with all groups • Alliance Model for maintenance - potential to be a best practice, but insufficient data at this time

APPENDIX D - RECOMMENDATIONS FOR MAINTENANCE PRACTICES

Most of the recommendations have been mentioned at some portion in this report, but will be addressed below. The first and probably most obvious recommendation is that outsourcing of routine maintenance has been demonstrated successfully and has resulted in some benefits and some disadvantages for the road authorities. There are numerous studies that indicated this to be true.

Secondly, there are numerous means and ways on how to begin the outsourcing, but wise decisions and much background study makes for successful results. It is not the intension here to provide guidelines, but some main points for consideration are addressed as follows:

- Study and evaluate national and international practices
- Outsourcing is a political and socially sensitive decision - decision at high levels
- How to "Open the Market" to maintenance competition?
- Should have some form of pilot testing comparison of in-house versus outsourced
- Low-bid or Quality based selection criteria should be evaluated
- Should use performance criteria or Levels of Service (LOS)
- Writing good contracts (risks, sanctions, & performance expectations). Requires expertise, and concise contract language. Consider adapting existing contracts rather than creating new ones
- Some form of interactive web-based, automated, & flexible "Maintenance Management System"
- Should work together with the maintenance industry & good open communications (create trust)
- Develop some type of Partnering and trust

Third recommendation once the outsourcing has begun is to determine a strategy for the next several years. This strategy should be a client team effort working and at periods include industry/ maintenance contractor feedback. Some issues could be as highlighted:

- What areas in road of network will be placed into competition, if not entire network
- Stager or phase-in contracts over several years & possibly starting with 3 year contracts "Unit Prices". The progress toward longer durations and "Lump Sum" contracts
- How implemented into your organization (following New Zealand or Finland model)
- Attempt to go forward with 5, 7 and longer duration contracts
- Specify contract duration for the exact years desired like 5+2 or 7+2 years and retain some flexibility, but not 3+1+2+2 or 3+3+3 (it's the first value that counts as nothing else is fixed)
- Moving toward Lump Sum contracts
- Integrating more elements of routine maintenance into one contract
- Start using QC by contractors
- Developing some type of interoperable maintenance management IT systems
- How is performance being evaluated (pass/fail or based on actual performance measurements)

- Develop IT systems to include customer complaint feedback directly to contractor (with tracking)
- Determine how to evaluate the competence, ability to perform, and QC
- Consider sanctions and rewards in contracts

Fourthly, once the outsourcing of maintenance has matured enough, there should be some benchmarking. Also, there needs to be some re-engineering of the process and ideas included:

- Value for money studies
- Openly reporting the status of maintenance contracting
- Is there a healthy maintenance contracting industry
- Having some form of sharing best practices & lessons learned
- Should you have some type of continuous improvement process & benchmarking system
- Continue following international trends and development

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