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CEDR Technical Report 2021-01

A comparable analysis of procurement of maintenance

CEDR Working Procurement and Finance

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CEDR Working Group: Procurement and Finance
A comparable analysis of procurement of maintenance

CEDR Technical Report 2021-01 is an output from CEDR's Working Group Procurement and Finance. The Working Group's main task is to provide NRAs with relevant input after analysing any new developments and policies on public procurement with significant implications for road networks.

The report was drafted and finalised by technical experts from Belgium (Flanders), Denmark, Germany, Malta, Netherlands, Poland and Sweden. It presents the results of a comparable analysis of procurement of maintenance in CEDR member organisations. It also gives an overview of the different ways NRAs procure their maintenance works. The aim of the report is to give insight in the different decisions NRAs have to make while preparing for and procuring maintenance, and to also present relevant best practices to all CEDR member organisations.

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Executive summary

Maintenance of our assets (roads, bridges, tunnels, roadside equipment) is part of the daily business for all NRAs. It is not the part of our work that usually attracts most attention, but it is crucial to keep our road networks safe and available to the users and to make improvements when necessary. In most countries political attention for maintenance works was, and still is to some extent, low. Leading to relatively low budgets for maintenance works, which in the end will negatively impact the quality of the work performed.

Many National Road Authorities (NRAs) are nowadays also confronted with issues of aging assets, assets that are now reaching their technical end of life point. Because of this most NRAs experience that political attention for maintenance works is rising.

The challenges we face are large. Our road networks have an important function within our societies as a whole and more specific in our economic systems. Problems with maintenance can lead to less availability of roads or even to road closures and may impact the accessibility of cities and other economic centres, like ports or airports. As NRAs we have to keep them up to the functional and technical standards set by our governments and demanded by our users. These standards and demands may relate to the capacity of the roads, user safety, environmental impact, or the use of modern digital techniques. These standards and demands define our maintenance challenges. And they affect the way maintenance can and needs to be procured.

In this report we focus on issues related to the procurement of maintenance. Procurement is not a standalone activity, it is the result of decisions taken about asset management, budget prioritizing, outsourcing, technical standards and political demands concerning availability, sustainability, and other social aspects. Between countries there are also large differences in geographical circumstances and climate, which strongly influence the kind of maintenance and frequency needed. Take for instance the differences in winter maintenance between countries with a cold and a much hotter climate. This makes procurement a complex process of trade-offs between many options in which national policies often play an important role.

During the meetings of the working group Procurement and Finance we discussed different topics related to maintenance. From policy assumptions to procurement procedures to contract forms and contract management, as well as issues and future developments related to maintenance. Usually, the topic was introduced by two presentations of group members about their national approach or experience, supplemented by an inquiry on the specific topic of the other group members. In the group meetings the different approaches and solutions were discussed. The results of these discussions, illustrated with (best) practices, can be found in this report.

Asset management forms the basis for defining a maintenance strategy, since maintenance focuses on the way assets are kept up to standard. In this report maintenance is defined as being the set of activities required to keep the required function(s) of the infrastructure available at the agreed level. As already mentioned, both political attention and budgeting affects the way maintenance is procured. However, also considerations of availability, risk management and efficiency play an important role. Another policy decision affecting maintenance is the strategy a country chooses related to outsourcing of maintenance. Most NRAs experience that the decision whether or not to outsource (parts of) maintenance works is highly related to the extent to which there was/is a political desire to downsize the public administration and to stimulate the private sector with tasks they are able to carry out in a better or more efficient way. The scale to which maintenance works is outsourced differs highly amongst NRAs, some

NRAs only partly outsource the execution of maintenance, others fully outsource the execution of maintenance and might also outsource the ownership of equipment, the planning of maintenance works and inspections.

In general, the overall goal of public procurement, and therefore also the procurement of maintenance, is achieving smart, sustainable, and inclusive growth while ensuring the most efficient use of public funds. Yet most NRAs also have to take societal goals into account. with the most prominent being sustainability, innovation, and consideration of SMEs. All NRAs have developed their own ways of dealing with these political and policy decisions and the incorporation of these specific goals in their procurement processes.

Keeping both the political and policy decisions and the goals of procurement in mind, NRAs can make several different decisions when setting up a procurement strategy:

1. <u>When and how often do we want to procurement maintenance works?</u>
   An NRA can choose to procure all of its maintenance works at the same time, so the market can bid on more than one contract and take advantage of the possible synergies between tasks, or an NRA can choose to procure its maintenance works spread over time, in order to enhance the competition.
2. <u>What will be the scope of the maintenance?</u>
   Do we procure small works, or do we choose to put all maintenance activities in a corridor or a certain region in one contract? And will we contract those activities one by one or do we choose to have a contractor for a period of one, three or maybe five years? Do we choose for a technical assignment or do we use functional specifications with a performance-based contract? And how do we relate to the contractors available? Do we decide to put small local contracts in the market to stimulated smaller local contractors or do we look for economies of scale by putting large contracts in the market?
3. <u>What procurement procedure do we choose?</u>
   An open procedure, which is mostly used for unit-price contracts or a restricted procedure, competitive dialogue or negotiating procedure which are mostly used for contracts based on a functional program?
   a. When an NRA wants to stimulate and procure specific innovations it can also choose to set up a Pre-Commercial Procedure or an Innovations Partnership.
4. <u>What award criteria do we want to use?</u>
   Unit-price contract are mostly awarded based on ‘lowest price’, whilst contracts with functional programs are mostly awarded based on ‘best price-quality ratio (BPQR)’.
   a. For stimulating sustainability, the Dutch NRA makes use of the Environmental Cost Indicator value (ECI value) as a BPQR criterion.

When setting up maintenance contracts NRAs also have to make several decisions:

1. What scope do we choose for our maintenance contracts?
   NRAs need to make decisions about the geographical size and the amount of works to combine in one contract. All NRAs experience that the policy related to the consideration of SMEs highly influences these decisions.
2. How long do we want the contract to last?
   Lengthy contracts (10+ yr.) can make that contractors are stimulated to think in terms of cost effectiveness, make for more stable cooperation between NRA and contractor and will reduce the amount of procurements to be dealt with by the NRA. Yet, they can also lead to a lack of flexibility with regard to new developments, barriers for SMEs to compete and impoverishment of the market, leading to price increases.
3. What type of contract do we choose?
   There are three main categories NRAs mostly use for maintenance works in regard to types of contracts:
   a. Framework contracts
   b. Unit-price contracts with a detailed description of the performance
   c. Lump-sum contracts with a functional description of the performance
4. Do we want to add requirements or clauses to the contract in order to stimulate sustainability or innovation?
   Three examples how this can be achieved:
   a. Adding sustainable requirements to the contract
   b. Bonuses for sustainable execution of the works
   c. ‘Learning space’ in contracts

After contracts are formed and procured the execution phase commences. Meaning an NRA needs to shift its focus from procurement to contract management. Where quality control needs to be performed in order to validate payments and incentives can be used to further stimulate good performance by the contractor. Regarding these matters NRAs also have to make several decisions in which strategy to use:

1. What type of quality control method do we want to use?
   In general, three different methods for quality control can be distinguished, testing by the NRA, self-testing by the contractor and testing performed by third parties (or a combination of these three methods).
   a. Next to the three methods of quality control mentioned above, the Dutch NRA makes use of ‘system-based quality control’.
2. What payment mechanism do we choose?
   Fixed costs or variable performance costs
   Unit-price payment or lump sum payment
3. What payment scheme do we choose?
   Two general payment schemes can be distinguished:
   a. timely based payment
   b. payment according to the achievement of certain milestones.

4. Which incentives do we want to include in the contract?
   An NRA can choose from a variety of incentives to include in the contract. Some examples:
   a. Penalties or price reductions
   b. Bonuses
   c. Option to extend the ongoing contract
   d. Using performance in the past as a criterion for awarding in future contracts

The process of maintenance as described will also change the next decade due to several developments. Three of which are:

- Renovation of aging infrastructures: most countries are facing decisions about investing in aging infrastructures which are now reaching their technical end of lifetime. This means a shift from the traditional fixed maintenance contracts for small and regular maintenance to large scale renovations or even replacement investments. Factors that make this challenging:
  - Lack of data about the current state
  - Knowledge has left the organisation
  - Low budgets
- Condition based maintenance: the growing use of sensors and data enables NRAs to have continuous real time information about the state of the assets. Acquiring and analysing these data will help NRAs to make a shift from preventive and corrective maintenance towards predictive maintenance. 3D-modelling techniques can help NRAs in the administration of the construction process and the later operation and maintenance of the infrastructure
- European green deal and innovation: the challenge will be to convert current infrastructures to sustainable infrastructures, using clean technologies to make this transition. Procurement will play a crucial role facilitating and stimulating the private sector to come up with the necessary innovations.

This report shows that maintenance is not a standalone activity, but part of the broader decisions a NRA has to make about managing their assets. It also shows which decisions NRAs have to make regarding the procurement of maintenance and the varies ways the different NRAs make these decisions. By sharing knowledge and (best) practices NRAs are able to learn from each other which can be of great help in regard to the new challenges and developments most NRAs will be facing in the near future.

Contents

1.Introduction

Maintenance of our assets (roads, bridges, tunnels, roadside equipment) is part of the daily business for all NRAs. It is not the part of our work that usually attracts most attention, but it's crucial to keep our road networks safe and available to the users and to make improvements when necessary. Many National Road Authorities (NRAs) are confronted with issues of aging assets. After World War II countries invested in new infrastructure: new roads, railroads, waterways with the necessary bridges, tunnels, and lock systems. Many of these investments are now reaching their technical end of life point. This does not only mean a higher level of regular maintenance, but also the need to make decisions about renewal or replacement.

In this report the focus will be on decisions made about maintenance of assets owned by NRAs and how to procure this maintenance in an efficient way. We also discuss in which way new demands can be incorporated in the procurement process. Demands for innovations, sustainability, social return, and circularity bring new dimensions to the procurement process.

All NRAs have experience with the procurement of maintenance, but that does not mean they all work in the same way and use the same types of contracts. NRAs can learn a lot from each other. That applies even more for the new demands on procurement. Many maintenance contracts are still tendered on lowest price. When you are asked to stimulate innovation or green procurement, tendering on lowest price might not be the best way to go. Here our experience is less obvious. This report shows some practices from several NRAs, without suggesting they are already experts in this field.

One of the important things in CEDR working groups is to address an issue, discuss it and see what the working group members can learn from each other. This working group decided to address a large number of issues related to maintenance of existing assets and see what different approaches and solutions are found by different NRAs. The results of the presentations that were held during the meetings and the discussions about the different solutions form the basis for this report. In this report these discussions are illustrated with (best) practices. After the first version of the report was drawn up, the report was sent to other CEDR members in order to receive feedback and additional examples.

There is a development in the issues that are addressed, in the procurement methods and contracts that are being used and last but not least in the expectations about the use of procurement to resolve social problems. Like for instance the expectation by politicians that the government will use its buying power to implement sustainable solutions.

In many countries the political focus has not been on maintenance. The result is that maintenance contracts are often much more traditional than the construction contracts. This report tries to show which modern ways of contracting will be helpful to make maintenance more efficient and at the same time will provide public clients instruments to use procurement for political goals like sustainability and circularity, stimulating innovation or making better use of data and digital methods.

2.Maintenance in general

This chapter focuses on what is meant by maintenance in this report. There are many definitions and layouts of maintenance as used by organisations and in literature. First of all, it is important to notice that maintenance is a phase in the life cycle of an object or infrastructure. We distinguish 4 phases: design, build, operations and maintenance and finally demolition. This report fully focuses on the operations and maintenance phase of the infrastructure.

2.1 Asset management

Maintenance focuses on the way we keep our assets up to standard. And our assets (bridges, tunnels, roads) are part of a larger system, our (road)networks. That means that our maintenance policy should always be related to the goals we set for the network as a whole. Those goals can be availability or safety of the roads but will also be influenced by additional technical and environmental impact standards. And the standards or the intervention levels for maintenance will be related to the budget available. The way we make those decisions in a coherent process, we call asset management. In March 2017, the CEDR Executive Board has adopted a technical report regarding asset management in which asset management is defined as: “the discipline that provides techniques for converting the fundamental aims of an organisation into the practical implications for choosing, acquiring (or creating), operating and maintaining appropriate assets to deliver those aims; while seeking the best total value approach (the optimal combination of costs, risks, performance and sustainability”).

This means maintenance is part of larger asset management decisions. Those decisions will primarily be made at a political level. Do we need more capacity, or do we need to invest in maintaining our current network? Will there be more budget for new projects, or will we give more priority to maintenance because of an aging infrastructure? Will we use maintenance investments to improve the performance or safety of the infrastructure and what impact do we allow on the availability of the road?

We will also make decision on an organisational level. Will we plan maintenance investments for a longer period ahead or will we do inspections and corrective maintenance as soon as problems occur? This makes strategy and planning a key element of an effective asset management in the long term-approach regarding the assets. It involves a description of the (current) status of the assets and the (future) status of the assets, but also the level of service the NRA wishes to obtain by its assets. Given the large needs in maintenance and the limited budgets in general, it involves an identification of the risks, a prioritization and decision making.

2.2 Life Cycle Costing

Asset management and maintenance policy in particular can be influenced by the consideration of the Life Cycle Costing (LCC) of infrastructure. LCC can be used as a decision-making tool for long-term budget forecasts for maintenance. LCC is a tool to calculate all the costs and benefits over the full lifetime of an investment. The consideration of LCC includes the initial investment, the operating costs, the maintenance, the earnings, and the end-of-life costs, as e.g., the removal costs. LCC can help to make policy decisions on future investments in roads by analysing and comparing different options. In this context, LCC can be part of a political social-economic cost-benefit analysis, in which non-financial aspects, like environmental impact, traffic impact or safety aspects will also be respected. Hence, at the policy level LCC can also be used to compare the long-term effects of an investment in a new infrastructure with maintenance or replacement of an existing infrastructure.

2.3 Different assets open for maintenance

Regarding the different assets that are open for maintenance, distinction can be made between:

- Pavements
- Road structures (bridges, tunnels, viaduct etc.)
- Road equipment (safety and noise barriers, road signs, road markings etc.)
- Roadside equipment (CCTV, traffic counters etc.)
- Greenery (plantations etc.)

Due to geographical differences the amount and scale of assets to maintain for each NRA participating in this working group differs.

Due to these differences, but also due to differences in climate, market conditions, budget availability or specific political ambitions regarding the procurement of maintenance processes, each NRA is confronted with specific maintenance issues. Which in the end also leads to different ways of approaching maintenance issues and ways to make use of contractors to perform maintenance. Due to these differences not, all issues can be addressed in a similar way by all NRAs. Nonetheless we can learn a lot from experiences other NRAs have with the use of certain methods of programming, contracting, and assessing the maintenance works.

2.4 Definitions of maintenance

When talking about maintenance we can use narrow or broad definitions. Narrow definitions can focus on the activities to make sure an object or an asset can be used:

> *Contribution of all technical, administrative, and managerial actions during the life cycle of an item intended to retain it in, restore it to, a state in which it can perform the required function (CEN).*

Or the focus can be on a business economical approach. For example:

> *The reason of maintenance is to minimize the quantified risk of serious safety, environmental, adverse publicity of production incidents that can reduce the viability and profitability of an organisation, both in the long and the short term, and do so at the lowest total cost (Dutch Central Planning Agency).*

In this report we will use a broad definition of maintenance. That means we will not only look at the activities to keep an object or parts of infrastructure available, but we will also include the activities that will certify the asset is working according to the agreed functional quality level. Additional activities we think of are:

- Clear roads from obstacles
- Performance of incidental (acute) maintenance
- Provide signage for road users
- Take care of smoothness control
- Perform incident management

Therefore, the definition of maintenance used in this report is:

Maintenance is the set of activities required to keep the required function(s) of the infrastructure available at the agreed level.

2.5 Different types of maintenance works

When talking of "maintenance works" in detail, it becomes obvious that different NRAs have different ideas of what kind of works are actually meant by this term and how the term is used. That is no problem, however it is important that if we talk about maintenance in this report, if necessary, we refer to the kind of maintenance meant.

In general, three different distinctions in the definition of maintenance can be made:

1. Execution of works:
    - daily maintenance.
    - minor maintenance.
    - structural maintenance.
    - major maintenance
2. Business operations
    a. fixed maintenance (possible in long running performance-based maintenance contracts).
    b. variable maintenance (usually bigger investment decisions)
3. Maintenance strategy:
    a. preventive maintenance (depending on condition or use);
    b. corrective maintenance (failure-dependent);
    c. predictive maintenance (on the basis of historical data)

2.5.1 Execution of works

Small maintenance (daily/minor maintenance) contracts usually consist of minor road works and the control of road conditions or winter service. These activities are of repetitive nature and are being executed in short term intervals. Examples are small pavement repairs ('black' maintenance) and cutting grass ('green' maintenance). Winter maintenance is a specific kind of small regular maintenance that involves activities that are of repetitive nature and are executed in short term intervals in the winter period. Examples are snow ploughing, purchasing, and spreading road salt.

Large maintenance (structural/major maintenance) contracts generally implicate substantial construction works on the road structure itself. These activities are not of repetitive nature and are being executed in longer term intervals. Examples are pavement resurfacing and bridge joint replacing.

2.5.2 Business operations

The distinction between fixed and variable maintenance is usually used from a budget perspective. Small maintenance is also often fixed maintenance, because these activities occur with a high frequency and the size of budget needed is predictable. Larger maintenance investments, that have a low frequency, are often also called variable maintenance. Low frequency can be pavement activities. The NRA knows that it will have to pave the roads once

or twice in every 15 years, but it has room to decide when to execute this activity. There is room for prioritising and for budget planning.

Variable maintenance where there is not a known frequency occurs when we talk about large scale maintenance or renewal. Usually this is the case when an asset is technically at the end of lifetime. For example, many bridges built after the World War II. Investments in large scale maintenance or renewal usually ask for large investments and therefor separate decision making is needed to provide for sufficient budget.

2.5.3 Maintenance strategy

For an NRA it's important to have a strategy how to perform its maintenance. Best is to have a mix of preventive and corrective maintenance. If maintenance is performed too soon or too often in a preventive planning, it can be very costly in the long run, because over time a lot of unnecessary costs are made. If you are late with larger corrective maintenance, it can give a lot of user nuisance, safety issues and possible a lot of extra costs to repair the problems. Sometimes it depends on the budget available if organisations work with an upfront planning or use a wait and see policy. With the number of data, we receive nowadays about the performance of our infrastructure, predictive maintenance becomes more popular. Data about the use and load of the road, the weather conditions and materials used, will make it easier to predict when maintenance is needed. These kinds of predictions are only possible when NRAs dispose good asset management systems, with enough relevant data to make those predictions. Several NRAs are developing or buying such systems.

2.6 Recap chapter 2

Asset management: forms the basis for defining a maintenance strategy, since maintenance focuses on the way assets are kept up to standard.

Maintenance: maintenance is the set of activities required to keep the required function(s) of the infrastructure available at the agreed level. With three different distinctions which can be made in this definition of maintenance based on:

- Execution of works: small maintenance (daily and minor) and large maintenance (structural and major)
- Business operations: fixed maintenance and variable maintenance
- Maintenance strategy: preventive maintenance, corrective maintenance and predictive maintenance.

3.Political and policy decisions regarding maintenance

This chapter looks into the different political and policy decisions influencing the maintenance strategies of each NRA. The way these decisions are made is highly influenced by the amount of political attention for maintenance. Even though the issue with political attention for maintenance is recognised by each NRA, the way this translates to decisions made regarding budgeting and outsourcing seems to differ.

3.1 Political attention

Most NRAs experience that political attention for maintenance works is low. Reasons for this can be found in the fact that maintenance is often performed on problems the road user is not aware of. Maintenance is overshadowed by construction works, which lead to new road capacity, often meaning faster connections and fewer delays. This lack of attention combined with the fact that it might be more difficult to explain for politicians why money for maintenance is needed (compared to new constructions works) leads to low budgets and budget cuts for maintenance works. Unfortunately, this puts pressure on the maintenance contracts, leading to low prices, which has a negative effect on the quality of the works performed. Severe accidents and media attention, highlighting the fact that maintenance is needed, can lead to regaining political attention. For example, winter maintenance was never discussed in the parliament in the Netherlands until ten years ago the Dutch NRA ran out of salt during a severe winter.

However, there seems to be a change towards more attention for the maintenance works in all countries. In the Netherlands, it is because a lot of constructions are getting older, reaching their end of the lifespan, and therefore need renovation. This is similar to the situation in Germany where many structures were built after World War II and need to be replaced or renovated more or less all at the same time.

3.2 Budget

Usually, maintenance work is financed by state funding. In addition to that, the Polish and Maltese NRAs make use of European funding. In the Netherlands, some large construction projects were based on DBFM (Design, Build, Finance and Maintain) contracts in the past few years. This means that the design, build and maintain phases of a construction project are combined in one contract. In these contracts private funding is used. Also, in Germany there are some projects which are financed with private funding. Recently for some projects a public-private partnership was set up.

In most countries a difference is made in budget for maintenance and budget for renovation, renewal, and replacement. In Malta and Sweden for these works there is one allocation of funds. For all NRAs it is not possible or at least difficult to shift budgets between maintenance, renovation, renewal and replacement and construction. These decisions cannot be made by the NRA itself, but have to be made by the Ministry or at the political level.

For requesting budget for maintenance works multiannual programs are made. In these multiannual programs NRAs plan the maintenance to be performed in the coming years. This is based on factors such as: historical data, the condition of the road network, the expected traffic numbers, and the desired quality of maintenance that they want to deliver to the road user. In other words, you need to have a clear view of the status of the assets. This seems to be an issue for all the NRAs, making the request for budget more difficult.

The number of years for planning ahead varies between four to fifteen years. In all NRAs, the granting of budget is based on these multiannual programs, yet for most NRAs the budget is granted on a yearly basis and for some NRAs this budget can also be adjusted on a yearly basis. The latter can impact the way an NRA procures its maintenance. The more the budget varies each year and the more it deviates from the program made, the more flexibility is needed in the contracts and thus in the procurement of maintenance. Whether or not the budget granted is sufficient for the maintenance to be performed differs between the NRAs. For most NRAs, the budget granted for maintenance increases, except in Denmark that faces cutbacks each year.

3.3 Outsourcing of maintenance

Whether or not maintenance is outsourced and to what extend differs for each NRA. Almost all NRAs outsource the execution of maintenance works. Except for Germany, cost and performance analysis have shown that operating roads, this includes small maintenance, through public services seems to be economically advantageous and of higher quality. Hence, small repairs like fixing small holes in roads is mostly done by the public service of the federal state since they do have the competence, manpower and equipment for it. Nevertheless, the federal states are free to choose whether or not to outsource their maintenance though. However, in Germany larger maintenance is done by private contractors as they have the necessary equipment and the manpower to fulfil such tasks. Since 1 January 2021, federal highways in all German federal states and in addition to that federal trunk roads in Bremen, Hamburg and Berlin are designed, built, operated and maintained by the Autobahn GmbH, i.e. a limited liability company according to German company law that is 100%-owned by the Federal Republic of Germany.

For outsourcing the ownership of the equipment needed for the execution of maintenance the NRAs also use different strategies. When the NRA itself invests in these, the barriers to enter the market are lower, which facilitates for small and medium-sized enterprises (SMEs) to compete. As a general rule, the NRAs do not want to own the equipment as it puts a lot of investments and responsibility on them. Furthermore, economic operators can probably find use of the equipment in other contracts as well, which makes it a better investment for them than for the NRA. However, there are a few exceptions. In Denmark and the Netherlands, they argue in some special casus that the NRA should make the investment instead. If the investment in the equipment acts as a barrier for SMEs to make a bid, either because the equipment is very specialised or expensive. Therefore, in the winter maintenance contracts, these NRAs own and maintain the salt spreaders and snowploughs. Since winter maintenance in Germany is generally done by the state, they also own the equipment.

Not only the actual execution of maintenance is outsourced in some countries, but some NRAs also outsource parts of the preparation phase. In the Netherlands for maintenance so called ‘performance contracts’ are used. Within these multiannual contracts, contractors are themselves responsible for determining what kind of maintenance is needed and when. They are responsible for planning the maintenance works and are also mainly responsible for inspections. In Denmark and Sweden inspections are also outsourced. In both countries this is a combination of inspections performed by the maintenance contractor and a third party, a specialised inspection advisor. In Poland, Belgium and Malta inspections are mostly carried out by the NRA itself.

In Italy, the Anas model employs both its own personnel, who carry out supervision and surveillance over the entire network, and special teams for the execution of small maintenance works like cleaning ditches, maintenance of green works, clearing snow, and prompt

intervention. Maintenance interventions, both of an ordinary and emergency nature, are also carried out through third-party companies, which are entrusted with both contracts for works and for services such as snow clearing, which duration in many cases is set in three years.

The decisions whether or not to outsource (parts of) maintenance works is highly related to the extent to which there was/is a political desire to downsize the public administration and to stimulate the private sector with tasks they are able to carry out in a better or more efficient way. In the Netherlands for example in the early 2000s there was a political climate in which there was less confidence in government and a growing trust in the private sector. The government was perceived as little efficient and effective. The NRA at that time also suffered from a bad image due to a Parliamentary inquiry into building fraud (price-fixing in the building industry). So, in this period of time the NRA both needed to get more efficient and effective and also needed to thoroughly review its relationship with the private sector. The NRA needed to deliver more quality with fewer people. In order to do so the NRA decided to focus on its primary task of network management, which meant other tasks and work needed to be outsourced to the private sector. By outsourcing maintenance in larger contracts, they hoped to utilise the creativeness and innovativeness of the private sector. This impacted the way the NRA procures and controls its maintenance contracts to a great extent.

In Sweden, the NRA started to outsource maintenance works in 1992 due to an investigation showing that there was a possibility of cutting costs by 29-38 million EUR yearly, since the private sector would be able to carry out the works more efficient than the NRA itself. In Denmark, the NRA has been responsible for maintaining the national roads since 1998. The NRA decided that all works should be procured from private contractors, where the NRA as the contracting authority, would be managing the contracts and in general ensure timely maintenance of the roads.

In some of the countries new discussions arise due to the loss of knowledge of the road network internally. There are some concerns whether or not too much has been outsourced to the private sector. In these countries a knowledge gap is experienced between the NRA and the contractors. Contractors complain that they cannot discuss issues on a professional level with the public client anymore. This makes that some NRAs are nowadays working on regaining technical knowledge.

The Polish NRA keeps its operational skills up to standard by to maintaining a strategic reserve of its own staff, specialist vehicles and equipment, although most of the maintenance works are outsourced to external companies.

3.4 Recap chapter 3

Political attention: most NRAs experience that political attention for maintenance works is low, leading to low budgets and budget cuts for maintenance works. Which in the end negatively effects the quality of the work performed? However, there seems to be a change towards more attention for maintenance works, mostly because of assets reaching their end of lifespan, and therefore need renovation.

Budget: usually maintenance works are financed by state funding. Yet in both the Netherlands and Germany in the past few years some large projects were also funded privately in forms of DBFM contracts or public-private partnerships. For requesting budget for maintenance works multiannual programs are made. In these multiannual programs NRAs plan the maintenance to be performed in the coming years.

Outsourcing of maintenance: the decisions whether or not to outsource (parts of) maintenance works is highly related to the extent to which there was/is a political desire to downsize the public administration and to stimulate the private sector with tasks they are able to carry out in a better or more efficient way. The scale to which maintenance works is outsourced differs highly amongst NRAs, some NRAs only partly outsource the execution of maintenance, others fully outsource the execution of maintenance and might also outsource the ownership of equipment, the planning of maintenance works and inspections. New discussions arise due to the loss of knowledge of the road network internally. There are some concerns whether or not too much has been outsourced to the private sector. This makes that some NRAs are nowadays working on regaining technical knowledge.

4.Goals of the procurement of maintenance

The overall goal of public procurement is to ensure the efficient use of public funds as described in the Procurement Directive[1]:

Preamble 2

Public procurement plays a key role in the Europe 2020 strategy […] as one of the market-based instruments to be used to achieve smart, sustainable, and inclusive growth while ensuring the most efficient use of public funds.

The goals of a specific procurement will typically be an advantageous price, high quality, reliability of delivery etc. Most members include political and policy objectives in their procurement goals and/or the tender procedure. However, whether the members consider driving societal change a task for procurement differs, as does the level of focus the policy objectives are given in the organisation. This chapter discusses three main societal goals of procurement which are relevant for all NRAs taking part in this working group.

4.1 Sustainability

Sustainability is a policy in most of the members organisations. Even though NRAs do not have a single definition of sustainability, key elements in the sustainability policies are safety, health, climate, social demands, and gender equality. The element with the biggest focus in all countries is climate. There are, however, large differences between the organisations regarding ambition and the role it has in procurement. The focus on climate is a result of the general societal reaction to climate change. All the member countries have signed the Paris Climate Agreement and are therefore obliged to reduce their CO2 emissions drastically in the years to come. This has resulted in specific national climate strategies in some of the members countries.

Climate is a clear example of a policy with greater, societal objective. Therefore, it also poses a challenge for the NRA as it can be at odds with low costs and efficiency. In addition to this the inclusion of climate related goals can be quite complicated for the NRA as it requires a relatively high degree of expertise from the NRA and in some cases customised tools. Gaining the necessary expertise and tools require a lot of investments and many of the members are therefore still in the initial phase of figuring out how to include climate in procurement of maintenance and in general. There is a consensus that sustainability in relation to climate is important and will become even more important in the future. The same can be said about international treaties such as The Paris Agreement, even though there are differences between how far the members have come in acting on it in practice.

4.2 Innovation

All NRAs have a policy of stimulating innovation – both in relation to the tendering phase and continuously in duration of the contracts. The objective behind this is to use public procurement to drive the technological development forward, which is advantageous on a societal level but also specifically for the NRA itself as it in the longer run will contribute to higher efficiency,

[1] DIRECTIVE 2014/24/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on public procurement and repealing Directive 2004/18/EC

better quality, or lower cost – or all of these – in future specific procurements. The purpose behind focusing on innovation is described in the Procurement Directive as follows:

Preamble 47

Research and innovation, including eco-innovation and social innovation, are among the main drivers of future growth and have been put at the centre of the Europe 2020 strategy for smart, sustainable, and inclusive growth. Public authorities should make the best strategic use of public procurement to spur innovation. Buying innovative products, works and services plays a key role in improving the efficiency and quality of public services while addressing major societal challenges. It contributes to achieving best value for public money as well as wider economic, environmental, and societal benefits in terms of generating new ideas, translating them into innovative products and services and thus promoting sustainable economic growth.

The NRA has several possibilities to stimulate innovation by procurement. The first is to work with functional specifications and performance-based contracts for maintenance. This will provide contractors with the opportunity to organize their working processes and use new technologies. These kind of process innovations will be enhanced if the contract is awarded on the base of best price/quality ratio, in which for example quality is defined in terms of reduction of traffic hindrance or a lower environmental impact. In the Netherlands, this way of procuring has been an important driving force for process innovation in maintenance.

A second possibility is creating volume. It is important for NRAs to understand the business model of their contractors. To develop innovations investments are needed. Companies will do these investments if they know that the innovation will give them an advantage (a better solution) later on in the tender and the potential volume of work is large enough to have a healthy return on investment. NRAs can stimulate innovation by tendering a series of (identical) projects in which they ask a certain kind of innovation upfront.

Stimulating innovation is especially important if the NRA is in a situation where the market does not have the drive to be innovative without interference from the NRA. This could be the case if relevant contractors do not have the resources due to their size or do not have the necessary incentive because of lack of competition on the market. Especially in cases where the NRA is the only customer that is in demand of a very specific good, service or type of construction work, the market might be very limited (sometimes even non-existent) or unwilling to make the necessary investments in new technology, if the NRA does not ensure to make it advantageous for the market to do so. For this kind of innovations, the Procurement Directive has 2 specific procedures: Pre-Commercial Procurement and the Innovation Partnership. They will be addressed in chapter 5.

4.3 Small and Medium Sized Enterprises

In order to realise these goals NRAs should stimulate and enhance competition. One way of doing so is to adapt public procurement to the needs of SMEs. Consideration of SMEs is perhaps the most widespread policy across the members of the working group as it is a policy directly imposed on the members by the Procurement Directive and not only in maintenance procurement but in general:

Preamble 78

Public procurement should be adapted to the needs of SMEs. Contracting authorities should be encouraged to make use of the […] 'European Code of Best Practices Facilitating Access

by SMEs to Public Procurement Contracts', providing guidance on how they may apply the public procurement framework in a way that facilitates SME participation. To that end and to enhance competition, contracting authorities should in particular be encouraged to divide large contracts into lots. Such division could be done on a quantitative basis, making the size of the individual contracts better correspond to the capacity of SMEs, or on a qualitative basis, in accordance with the different trades and specialisations involved, to adapt the content of the individual contracts more closely to the specialised sec tors of SMEs or in accordance with different subsequent project phases.

The objectives behind this obligation are both to stimulate competition and to make public contracts more accessible to smaller companies, as public contracts traditionally have been won by larger companies because they have had better prerequisites for meeting the high financial and technical requirements and been able to grasp the formal requirements in public procurement. Therefore, this policy can be said to fall into both categories described in the introduction; the objectives behind it is both to drive societal change and in the long run make the competition for specific procurements broader and thereby hopefully get better results.

The members have reacted to this obligation in different manners, but all include considerations of SMEs in the procurement of maintenance. Belgium, Malta, and Germany have specific policies concerning SMEs. Denmark, Sweden, and the Netherlands do not, but do abide by the obligation in other ways. All three countries try in different ways to procure maintenance in a manner that makes it possible for SMEs to submit bids by lowering the barriers.

In the review the Icelandic NRA noticed that their market for contractors is small compared to most EU countries and almost all domestic contractors fall under the definition of SME's. That is why there is a limited capacity for larger functional contracts.

Some members experience that the consideration of SMEs sometimes is prioritised lower than other priorities such as cost, efficiency etc. This is perhaps a result of how the obligation is stated in the directive e.g., that a member can choose not to divide into lots, but must explain why, and that a member can choose to set higher requirements regarding financial capacity than two times the value of a contract if there is a reason for it. But it can also be seen as symptomatic of a general tendency where it is difficult to implement policies that might impose a higher cost or administrative extra work for the NRA, where the objective of the policy does not appear obvious to the individual employee handling a specific procurement – especially if the management of the NRA is not very keen on the policy. It might be the case because the policy stems directly from the EU and not from decision making by the own Parliament or the management of the NRA itself and therefore perhaps is seen as less prestigious.

4.4 Recap chapter 4

Overall goal public procurement: achieving smart, sustainable, and inclusive growth while ensuring the most efficient use of public funds.

Sustainability: sustainability is a policy in most of the members organisations, with the biggest focus on climate. It poses a challenge for NRAs, as it can be at odds with low costs and efficiency. Also, it requires a high degree of expertise for the NRA, which in itself requires a lot of investments. Most members are therefore still in the initial phase of figuring out how to include climate in procurement of maintenance and in general.

Innovation (sub-goal): the objective behind the policy of stimulating innovation is to drive the technological development forward, which is advantageous on a societal level, but it will also contribute to higher efficiency, better quality and/or lower cost. Stimulating innovation is especially important if the NRA is in a situation where the market does not have the drive to be innovative without interference from the NRA.

Consideration of SMEs (sub-goal): consideration of SMEs is perhaps the most widespread policy. The objectives behind this obligation are both to stimulate competition and to make public contracts more accessible to smaller companies. All NRAs include considerations of SMEs in the procurement of maintenance. In general, there are two ways this is done: 1) by adapting the size of contracts to the needs of SMEs (see example below) and 2) by making contracts less general and splitting them depending on different technical specialisations.

5.Procurement

Although all NRAs try to find the 'best price-quality-ratio' among the offers that have been submitted and though their procurement laws are all governed by the same European Directive, their procurement methods in the procurement of maintenance contracts differ widely. To a certain degree this depends on the different approach how maintenance is done in the different NRAs. That again depends – first of all – on political decisions and policy decisions (chapter 3) that may influence the choice of a certain contractual model and/or a certain procurement procedure.

Preamble 89

The notion of award criteria is central to this Directive. It is therefore important that the relevant provisions be presented in as simple and streamlined a way as possible. This can be obtained by using the terminology 'most economically advantageous tender' as the overriding concept, since all winning tenders should finally be chosen in accordance with what the individual contracting authority considers to be the economically best solution among those offered. In order to avoid confusion with the award criterion that is currently known as the 'most economically advantageous tender' in Directives 2004/17/EC and 2004/18/EC, a different terminology should be used to cover that concept, the 'best price-quality ratio'. Consequently, it should be interpreted in accordance with the case-law relating to those Directives, except where there is a clearly materially different solution in this Directive.

5.1 Procurement strategies

When setting up a procurement strategy NRAs have to make several decisions. One of them being to decide when and how often it wants to procure maintenance contracts. In Denmark for example all the small maintenance contracts are tendered out at the same time. The reason behind this is to make it possible for the market to bid on more than one contract and take advantage of the possible synergies between tasks. In addition to that, the Danish NRA has started to use dynamic purchasing systems for renovation works, which makes it possible to tender out specific works quite quickly.

The Swedish NRA makes sure that the tender periods for the different kinds and geographical areas are not overlapping to enhance the competition. For making these kinds of tender strategies the Swedish NRA has formed category teams. These category teams write strategies of procurement and contract management, having low total cost as one of the main goals. In the overall road maintenance team, they synchronise the contracts in terms of which technical/functional specifications to use, requirements in the tender documents, answering of questions during the tender phase and splitting the tender period of the different contracts in order not to advertise the tenders at the same time. These teams also have regular contact with the economic operators within their category.

Next to when and how often to procure maintenance also other strategic decisions can be made by the NRAs. For example, in Denmark due to uncertainties in budget the NRA sometimes asks interested companies to make a bid for three different options (high standards, medium standards, low standards). The contract then is awarded on price only, where the total bid is calculated by multiplying the bids for the different options by a percentage. This percentage is based on the likeliness of the option becoming the final assignment. The choice of which option is going to be the final assignment is done after the bids are in.

As mentioned in paragraph 4.3, preamble 78 of the Procurement Directive states that public procurement should be adapted to the needs of SMEs. This can also be of influence when setting up a procurement strategy. The Danish NRA for example uses expressive tendering of multiple contracts, which means that the economic operators can select how many subcontracts/areas they are interested in tendering for. The tenders are evaluated based on lowest price per contract. If the economic operator bids for more than one contract they will get a discount of the total price, (e.g., price for contract 1 + price for contract 2 - %-ual discount of two contracts or price for contract 1 + price for contract 2 + price for contract 3 - %-ual discount of three contracts etc.).

In Sweden, most pavement renovations are tendered in a similar way, one tender that results in multiple contracts. However, there is not always a discount in the evaluation phase as in the example of Denmark. This model (multiple contracts in one tender) facilitates bids from SMEs as well as reward economies of scale. In addition, it facilitates the contractor to make the packaging according to their liking, instead of the NRAs.

5.2 Procurement procedures

According to the contract in question, the NRAs choose different tender procedures for the procurement of the desired maintenance works. While a unit-price contract is usually procured in an open procedure, in which the price will be the main award criteria, a contract based on functional specifications generally is set out in a restricted procedure, a competitive dialogue or in a negotiated procedure.

As mentioned, unit-price contracts with a detailed description are mostly procured in an open procedure. Combined with a standardised catalogue for the contractual description of the performance, the procurement process and the tender documents can achieve a maximum of standardisation – that can be used to facilitate the participation of SMEs in the procurement process. In a unit-price contract with a detailed specification of the demanded performance, the reasonable use of quality criteria seems to be limited. As with the detailed description the contracting authority states clear what, in their opinion, is essential to the necessary maintenance works. So, there is less room for dissenting technical solutions and individual design efforts. Therefore, for these contracts price is usually the main awarding criterion.

Without a detailed specification of the demanded construction works on the other hand, it is necessary to distinguish in-between the offers of the different economic operators and their solutions. The total price of the maintenance works offered is not sufficient to evaluate the different bids. Therefore, in this case it is necessary to assess the bids according to their offered quality, in order to find out the offer with the best price-quality ratio (BPQR) “Quality criteria” as award criteria become indispensable. The German NRA just recently promoted the use of quality criteria besides the price criterion. Therefore, it recommended its contracting authorities the use of additional qualitative award criteria in the tender process besides the price criterion, such as “reduction of construction time”, “quality management”, “energy use”, “reliability of Work Schedule” or “quality of key personnel and construction management”.

According to the example of the Dutch NRA, we can distinguish between different types of “quality criteria”. There are “Performance Criteria” (PC) that are directly measurable. They can be quantified in certain units, so that there is no particular assessment needed. Examples for performance criteria can be an early delivery (measurable in “time units”), an extended lifespan (measurable in “time units”) or some added functionality (measurable in “function units”) as well as the number of complaints in the course of the construction process (measurable in

"amount units"). Besides that, we have "Quality Criteria" (QC) in a stricter sense. These are aspects of the bid that increase the value of the bid. These aspects are not directly measurable but have to be assessed and evaluated by professionals. Examples hereof can be the comprehensibility and reliability of an offered risk management, the durability of an offered solution or the aesthetics/design of the solution. Finally, we can see "Price/cost criteria" (CC). While the Price itself (as a quantity) can be read directly in the bid, the "Price/cost criteria" may for example consist of direct and explicit savings on related costs (maintenance costs, replacement costs, etc.) of the offered solution.

With regard to that distinction, we can classify the quality criteria in maintenance contracts into three categories. Each category highlights different aspects of the solution offered by the economic operator. In the assessment of the bid, these different aspects have to be respected and evaluated:

1. Aspects of the environment
    a. Client satisfaction (PC)
    b. Traffic hindrance/accessibility (PC)
    c. Sustainability, reducing CO2-emissions (QC)
    d. Sustainability, circular economic solutions (QC)

2. Primary aspects of the solution
    a. Maintainability (CC)
    b. Total cost of ownership - TCO (CC)
    c. Energy (CC)

3. Secondary aspects of the solution
    a. Social return (QC)
    b. Risk management (QC)
    c. Optimisation of prescriptions (QC)

Through the emphasis and the weighting of these aspects in the evaluation process of the offer, NRAs can use such a scheme to implement and steer their maintenance strategies and policies in the market.

5.3 Using procurement to stimulate sustainability and innovation

There are different strategies for stimulating sustainability and innovation through the procurement of maintenance. For example, in order to stimulate sustainability, in the Netherlands a BPQR criterion is used based on the Environmental Cost Indicator value (ECI value). The ECI value indicates the environmental impact of a particular design. The calculations behind the ECI value are based on life cycle analysis (LCA). A software program called DuboCalc can calculate the ECI value of infrastructure works with using input such as the amounts of materials used for a particular design. By making use of functional specifications the economic operators are able to make their own most optimal design. For these designs the ECI value can be calculated. In a tender the ECI value can be translated in a fictional price reduction, the lower the ECI value the higher the fictional price reduction will be. By then subtracting the fictional price reduction from the actual price of the offer a "corrected price" is determined. In the end the offer with the lowest "corrected price" will win the tender. In short, the lower the environmental impact of a design the higher the fictional price reduction and the lower the "corrected price" of an offer will be.

In order to procure innovations, the Procurement Directive mentions two types of procurement procedures: The Pre-Commercial Procurement procedure (PCP) and the Innovation Partnership (IP). Both procurement procedures aim at developing innovations in a separate innovation process, still in an open competition. This way research and development is stimulated to develop innovations that aim to improve public services. In both procedures public authorities stimulate innovation, share costs and risks concerning the development of the innovation, in a way that does not constitute State aid.

A pre commercial procurement is used to stimulate innovative companies to find a new solution for a certain problem or a certain need in a competition divided in three phases. In the first phase the public authority will, in an open tender, ask for ideas for solving a certain problem or question. Companies with promising ideas will get the opportunity to make a design of their solution. The two, three or maybe five most promising solutions (the number is up to the public authority to decide, based on the budget they have available) will go through to the second phase. In this phase the public authority will pay the selected companies to develop a prototype of their solution. At the end of the second phase the public authority will choose the best solutions to go to the third and final phase in which the companies selected are paid to perform an actual pilot project with their prototype solution. Again, it is up to the public authority to decide how many prototypes will be selected for a pilot project. The result is a new product or service, that has to be brought to the commercial market by the company which developed the innovation. In a PCP-procedure the government stimulates the development of the innovation by paying for the research in a tender, however the government is not obliged to buy the solution.

In the Innovation Partnership (IP) the government is selecting a partner in a tender, with whom it will develop an innovation. The difference between the PCP and the IP is that in the IP the public authority is a partner in the development and the public authority will be the first customer to buy or use the innovation. An IP also starts with a tender by the public authority to find the best partner to develop a solution for a certain need. An innovation partnership exists of three phases. In each phase the public authority can decide to reduce the number of participants. The first phase is the tender in which companies can submit proposals for innovative solutions. At the start of the tendering process the public authority will make clear what kind of process will be followed and how cost and risk sharing will take place during the process. In the second phase research and development of the innovative solution will take place and prototypes will be tested. The third phase is the commercial phase. In this phase the first products or services developed during the IP can be bought, within the context that was set at the beginning of the tender. Again, that doesn't have to be one solution developed by one partner. For example, in The Netherlands an IP-tender was launched in 2019 to find new solutions for coastal protection. A number of companies had been selected and so in a number of separate partnerships solutions are developed.

5.4 Recap chapter 5

Procurement strategies: when setting up a procurement strategies NRAs have to make several decisions. One of them being to decide when and how often it wants to procure maintenance contracts. An NRA can choose to procure its maintenance works at the same time, so the market can bid on more than one contract and take advantage of the possible synergies between tasks, or a NRA can choose to procure its maintenance works spread over time, in order to enhance the competition.

Open procedure: mostly used for unit-price contracts.

Restricted procedure, competitive dialogue or negotiating procedure: mostly used for contracts based on a functional program

Award criteria: unit-price contract is mostly awarded based on 'lowest price', whilst contracts with functional programs are mostly awarded based on 'best price-quality ratio (BPQR)'.

Stimulating sustainability and innovation:

- Environmental Cost Indicator value (ECI value) as a BPQR criterion
- Pre-Commercial Procedure (PCP)
- Innovation Partnership (IP)

6.Maintenance contracts

The way maintenance contracts are set up is influenced by the goals of the procurement of maintenance. This chapter will give more insight into how NRAs make decisions in forming maintenance contracts, while keeping the goals of the procurement of maintenance contracts, consideration of SMEs, sustainability, and innovation, in mind.

6.1 Scope of maintenance contracts

Preamble 59

There is a strong trend emerging across public procurement markets towards the aggregation of demand by public purchasers, with a view to obtaining economies of scale, including lower prices and transaction costs, and to improving and professionalising procurement management. This can be achieved by concentrating purchases either by the number of contracting authorities involved or by volume and value over time. However, the aggregation and centralisation of purchases should be carefully monitored in order to avoid excessive concentration of purchasing power and collusion, and to preserve transparency and competition, as well as market access opportunities for SMEs.

Preamble 59 summarises the decisions needed to be made when forming the scope of maintenance contracts. This paragraph contains some examples of how different countries make these decisions.

When decisions are made regarding the scope of maintenance contracts consideration of SMEs is of great influence. All NRAs make sure that the medium-sized companies are able to handle the size and complexity of the maintenance contracts. Regarding the size of maintenance contracts different decisions can be made. These decisions are related to combining different types of maintenance works in one contract and size of the area maintenance works needs to be performed. In most countries small road maintenance is combined in maintenance contracts which in size are defined by a geographic area. In the Netherlands, these geographic areas are related to the way the NRA is organized. The NRA consists of seven regions, each divided into several districts. These districts are the asset owners and roughly, each district manages one separate contract for small and large maintenance.

In Sweden we see that a combination of bundling similar types of maintenance works and size of geographic areas determines the size of the maintenance contracts for pavement works. Pavement works are combined in maintenance contracts based on how contractors are organised, which is based on the type of pavement. Within a certain geographic area, a number of works/roads having the same type are grouped into one contract. The reason behind this is to use the economies of scale and also to attract more firms.

However, when making strategies regarding the size of the contracts the size of the NRAs internal organisation also must be considered. E.g., few contracts require a small number of project managers/purchasers within the NRA and vice versa. Hence, this is a consideration of both cost and competition.

Complexity of the work does not only influence the scope of contracts regarding to consideration of SMEs, but complexity can also call for more specialised contractors. Due to low priority of the contractors, the bridge maintenance works in Sweden were separated from

the small maintenance contracts. For small and medium sized bridges in these bridge maintenance contracts both small and large maintenance mostly is combined. Bridges on larger roads are usually put together in one contract, while those on the minor road network form separate packages. This is due to the costs and complexity of safety barriers, which small economic operators usually think is of too high risk. Large maintenance on large bridges is usually handled separately due to their size. Because of that, the Swedish NRA enlarged the supplier base, signing contracts with bridge specialist firms. In addition, the priority of bridges among the contractors increased as well as the quality of works.

In the Netherlands we see something similar for tunnel maintenance. Tunnel maintenance was separated from other maintenance works. The high amount of industrial automation in tunnels makes tunnel maintenance highly complex and the Dutch NRA had the desire to contract specialised contractors to perform this kind of maintenance. Another example of contracts for which NRAs desire to contract specific contractors is winter maintenance. For these contracts' response times are strict, due to the perceived safety risks, meaning that the economic operators almost always have to be local. The later also means that the market for these contracts primarily consists of smaller economic operators. Which again influences the size of these contracts.

6.2 Length of maintenance contracts

In most countries we see that the duration or length of maintenance contracts is affected by the way budget is granted. As mentioned in paragraph 3.2 the extent to which the budget granted for maintenance varies each year and the more it deviates from the maintenance program, the more flexibility is needed in the procurement of maintenance. Also, the scope of maintenance contracts can be affected by this. For most countries, even though there is a yearly budget, the budget does not deviate much from the maintenance program. Most NRAs are therefore able to make use of multi-annual maintenance contracts. This is not the case in Denmark. In Denmark large maintenance is as a general rule tendered out as single contracts regarding specific works. This is because of uncertainties in budget. Therefore, it does not make sense to enter into long contracts and it is rarely possible to make contracts that include several different types of maintenance works.

When deciding regarding the length of these multi-annual contracts a trade-off needs to be made between the advantages and disadvantages of lengthy contracts. The advantages of more lengthy contracts (10+ years) are that they stimulate contractors to think in terms of cost effectiveness and presumably select materials and methods more wisely. It also creates an opportunity for the development and use of process innovations by the contractor. And long-term contracts enable a more stable cooperation between the NRA and the contractor. Among other advantages, this tighter cooperation facilitates productivity as well as lowers the cost of getting to know the road network. Last, but not least, more lengthy contracts mean a reduction in the number of procurements for the NRA.

The biggest disadvantage of lengthy contracts is the lack of flexibility with regard to new developments. Usually, those contracts miss a mechanism to adjust the contract for new circumstances. Then it is hard to get the contractor to implement (technical or sustainability) innovations during the contract period. Instead of saving costs by using newer and more intelligent solutions public authorities have to wait till the contract is finished or pay an additional price to get the innovations implemented. Sometimes long running contracts can form a barrier for SMEs to compete, which means that long-term contracts can lead to an impoverishment of the market, which in the end could leads to price increases.

Offering a (continuous) number of small contracts encourages SMEs to take part in the procurement process. This is also why most NRAs do not make lengthy contracts for small maintenance. Small maintenance in itself is mostly not highly complex and therefore interesting for SMEs. In accordance with the goal of procurement of maintenance to consider SMEs (see paragraph 4.1) most NRAs make not long-lasting contracts (max. 5 years) for small maintenance. Iceland, where almost all contractors are SMEs, limits the duration of its contracts to 3 years.

6.3 Types of maintenance contracts

When deciding upon the type of maintenance contracts to use, in general we see three main contract types:

1.Framework contracts
2. Unit-price contracts with a detailed description of the performance
3. Lump-sum contracts with a functional description of the performance

We see that the decision which kind of contract to use is influenced by the political and policy decisions regarding maintenance and also by the goals the NRAs wants to achieve with the procurement of maintenance.

In paragraph 3.2 it was discussed that the more the budget for maintenance varies each year and the more it deviates from the program made, the more flexibility is needed in the procurement of maintenance. This is for example the case in Denmark. The Danish NRA procures framework contracts that are valid for a certain period of time and/or a certain part of the road network. The reason for that is that it best suits their workflow and the way they get grants/funding. The Italian NRA makes use of framework agreements for nearly all types of maintenance, as framework agreements can be a tool for simplifying purchases by reducing bureaucratic requirements leading to savings in both time and recourses. Which in the end makes almost immediate implementation of maintenance works possible. Also, in Sweden for some maintenance works framework contracts are used. The reason behind this is to reduce the number of tenders. Framework agreements are used for large maintenance worth less than 930 000 EUR. Hence, these procurements can be handled in a faster way. The specific orders are either based on regional call-offs or national mini-competition, depending on the volume (in terms of money). The higher this volume the more precise the tender documents/specifications are needed for which mini-competitions are better suited than call-offs.

The Maltese NRA makes use of a dynamic purchasing system, which is comparable to framework contracts yet differs from traditional framework contractors in the way that economic operators can apply to join at any time. Following the establishment of this dynamic purchasing system ‘open calls for tenders’ or ‘mini competitions’ are used.

Next to framework contracts, an NRA can also decide to either make use of detailed technical specifications or functional specifications in its maintenance contracts. In the latter case the contractor is responsible to carry out all necessary works on a (large) part of the road network by its own.

In general unit-price contracts are used when a decision for detailed technical specifications is made and lump-sum contracts when a decision for functional specifications is made. In case of unit-price contracts, the contractor is paid according to the amount of construction works they actually had to perform in that specific period. In case of functional programs, the

contractor receives a lump sum for the period of time in which the contract is valid and has to perform all necessary maintenance works in order to meet the functional specifications required. The German NRA mainly makes use of unit-price contracts with detailed specifications. The main award criterion in this case is usually the lowest bid. In Germany detailed technical specifications are used to secure the durability and lastingness of the infrastructure. The German construction market is mostly driven by SMEs which prefer detailed specifications, since it is simpler. Functional specifications are also used, but in general only for larger maintenance, in PPP (Public Private Partnership) and function building contracts (DBFM). Like Germany, in Malta they also make use of detailed technical specification. For Malta this is because the NRA has in-house knowledge and national specifications which are part and parcel of the legal framework and also because making use of detailed technical specifications is needed to ensure a homogenous road network. In Denmark and Sweden, a combination of detailed technical specifications and functional specification is used. The Swedish NRA bases their decision using technical or functional specifications on the degree of freedom they can give the contractor to perform the works. If enough freedom can be given, they use functional specifications where the NRA focusses on the functionality and capacity of the asset. For small maintenance, the Swedish NRA mainly uses a combination of both detailed technical specification and functional specification. The Dutch NRA mainly makes use of functional specifications for maintenance, for small, fixed maintenance the Dutch NRA makes use of performance-based contracts, which asks the contractor to keep a part of the infrastructure up to standard. In this way the Dutch NRA utilises the creativeness and innovativeness of the private sector and was able to downsize its own organisation.

For general road maintenance, unit-price contracts have been the preferred alternative in Portugal and, given its' nature, they present a lower potential to develop divergent methods. For the rest of the road network (mostly motorways under private concession) contracts with functional requirements of the performance are potentially more common.

In Poland, the selected contractor is signed for about 5 years. As part of the signed contract, the contractor is obliged to maintain the road of a given class in accordance with the standard established by the polish NRA. Under the contract, the service provider should provide, inter alia, current road maintenance, temporary road inspections, checking the condition and driving conditions, repair of road elements. The contractor receives remuneration for the implementation of works, aggregated to one item - maintenance works - periodically, in a monthly settlement period.

6.4 Stimulating sustainability and innovation in maintenance contracts

Functional specification, as mentioned in the previous paragraph, can be used to stimulate sustainability and innovation. This is also mentioned in preamble 74 of the procurement directive.

Preamble 74

The technical specifications drawn up by public purchasers need to allow public procurement to be open to competition as well as to achieve objectives of sustainability. […] Drawing up the technical specifications in terms of functional and performance requirements generally allows that objective to be achieved in the best way possible. Functional and performance-related requirements are also appropriate means to favour innovation in public procurement and should be used as widely as possible.

Yet, there are other methods that can be used when composing a maintenance contract in order to stimulate innovation and sustainability. For example, in order to stimulate sustainability, the Swedish NRA, for some of the small maintenance contracts, includes requirements saying that at least 20 percent of the total energy used by cars and machinery within the contract, has to include either renewable fuel, biofuel or electricity. There is also a penalty if the requirements are not fulfilled. In the contracts not having strict requirements, bonuses are used instead. The maximum sum of the bonus is 0.2 percent of the contract sum, which roughly corresponds to the same level (20 %) as the requirements in the first mentioned contracts. In the pavement resurfacing contracts, bonuses are used to stimulate the contractors to use asphalt with lower CO2-emissions than stated in the requirements. There are also several ways to stimulate innovation in maintenance contracts. For example, the Danish NRA uses a clause in their contracts to economically reward innovative and new methods during the contract phase. If the contractor finds a way to optimise, it receives 50% of the savings this optimisation results in. In this way not only, innovation is stimulated but also efficiency (decreasing expenses and costs). In the Netherlands we see something similar, in the performance-based maintenance contracts for small, fixed maintenance a 'learning space' is included. When the contractor thinks of an innovative way to perform the maintenance more sustainable or efficient it can make use of this 'learning space' in the maintenance contract to further develop and test its idea. The contractor and the NRA make agreements about risk allocation and the revenue model. When the investment leads to savings, this will be evenly allocated amongst the contractor and the contracting authority. Losses are accounted for by the contracting authority. The Swedish NRA has set up two pilots in which a somewhat similar structure is tested. Two of the small maintenance contracts are called 'innovation pilots. The aim of these contracts is to focus on joint problem solving, setting common goals as well as open books (sharing financial information regarding the works). The compensation term for these contracts are a combination of fixed price and target costs with incentive, splitting 70/30 (contractor/NRA) in one of the contracts and 50/50 in the other. Using the first mentioned as an example, if the contractor's actual costs are lower than the target costs, it gets 70% of the difference between the target cost and the actual costs. On the contrary, if the actual costs are higher than the target costs, the contractor will be charged for 70% of the difference.

6.5 Recap chapter 6

Scope of maintenance contracts: regarding to the scope of maintenance contracts NRAs need to make decisions about the geographical size and the amount of works to combine in one contract. With keeping in mind that SMEs are still able to handle the size, but also the complexity of the maintenance works at hand. Complexity of maintenance works can also call for more specialised contractors and is therefore also decisive in setting up the scope of a maintenance contract.

Length of maintenance contracts: when deciding regarding the length of these multi-annual contracts a trade-off needs to be made between the advantages and disadvantages of lengthy contracts.

- Advantages of lengthy contracts (10+ years):
  - Contractors are stimulated to think in terms of cost effectiveness
  - Room for process innovations
  - More stable cooperation between the NRA and the contractor
  - Reduction in the amount of procurements
- Disadvantages of lengthy contracts:
  - Lack of flexibility with regard to new developments

  - Barrier for SMEs to compete
  - Impoverishment of the market, leading to price increases

Types of maintenance contracts:

- Framework contracts
- Unit-price contracts with a detailed description of the performance
- Lump-sum contracts with a functional description of the performance

Stimulating sustainability and innovation:

- Adding sustainable requirements to the contract
- Bonuses for sustainable execution of the works
- ‘Learning space’ in contracts, contractors can come up with and test innovative ways to execute the work and are able to benefit from possible savings

7.Operational contract management of maintenance contracts

The execution of the contract by a contracting authority i.e., operational management, is key to a successful contract process. Both the contracting authority and the chosen contractor have the duty to ensure that the original declarations included in the bid are followed throughout the execution period. Apart from this, the quality of the materials and the performance criteria required by the tender need to be achieved and again, both contracting authority and contractor need to work together to obtain best possible results in terms of established contract requirements.

It is not always an easy task to balance the contractor's performance with the contracting authority's requirements. When defects are identified in the work and rectifications are required, it is sometimes difficult to find a solution. Contracting authorities use different tools and mechanisms to tackle this issue, hence the need for the discussion which follows in this chapter.

This chapter also considers various mechanisms of payment which also include application of penalties, price reduction, incentives, and award bonuses, guarantees and other retention of monies due, which will lead to successful contract closure.

7.1 Contractor declarations and its influence on the contract management

Once a contractor has reached contract signature stage, it means that all the requirements of the tender selection stage are fulfilled. In reality, the contractor has the obligation to inform the contracting authority of any change in its status, as previously declared. The challenge is how a contracting authority can ascertain that its status (as declared in the ESPD and in the tendering procedure) has not changed during the contract execution stage, and that such change would have precluded him from continuing the contract execution. The contracting authority would then have to see whether such change is of a serious nature that requires reconsideration of the contract agreement.

In order to assess the long-term contractor's compliance, a contracting authority may ask the contractor to re-confirm its original declarations and to advise the authority if there have been any changes since the original submission of information. This is formally done by Sweden whereby the NRA follows up upon the items related to social requirements depending on the perceived risk. Projects with high value are automatically considered as middle/high risk and the authority holds a framework agreement with auditors to audit high risk projects and in case of suspicion of something illegal. One has to note that it is difficult to assess declarations and information back on the original supplier companies (i.e., the longer the supply chain, the more difficult it is to check everything declared). In Malta, for example, even though information on social responsibility (taxes, social security, VAT etc.) is not checked at tendering stage, during the preparation of the contract (prior to signature) the recommended contractor is asked to submit compliance certificates from the respective authorities, including criminal records from the law courts. To date, from experiences mentioned by different countries, it seems that there have been no false declarations in the ESPDs submitted by bidders at tendering stage, which

have been reported by the NRAs. This may be because of the criminal consequences, which are linked to such false declarations.

7.2 Quality assessment during execution stage

All NRAs are driven to have a good quality product for the monies invested. Of course, the quality criteria for the materials to be used during execution, as well as the quality key milestones for the finished product need to be specified in the tender document. Contractors would know what sort of materials are to be used in the execution of the contract. It is important to note that the durability of the end product is the result of what the contracting authority specifies in the first place. Hence, the tricky part of the contract execution is essentially how the contracting authority is monitoring the quality of the primary materials which are being chosen by the contractor as well as the control of the processes and methodologies which the contractor is using to produce the final product (e.g., asphalt) and workmanship (e.g., installation of street furniture).

7.2.1 Responsibility for quality control

The Maltese NRA for example has a pre-established set of specifications which are part of the legal framework which covers road works. More detailed specifications are included in tender documents depending on the nature of the works included in the tender. The Maltese NRA assesses the quality of maintenance works performed by contractors, through control testing however contractors themselves are required to perform their own quality assurance and they are bound to present certificates on the quality of the work, as performed by them. This is considered to be a combined approach. The NRA checks the quality of materials and products. This is done through the national laboratory which lab is assigned to take control tests during execution of work. In countries such as Germany, Sweden and The Netherlands, the NRA relies on self-testing methods by the contractor, combined with third-party checks. A number of countries such as Germany, Sweden and Denmark, assign third-party supervision of the works during execution. Denmark will do this only when there aren't sufficient resources or expertise in-house. Malta does this sometimes, but not for maintenance.

Apart from testing, Malta (in larger works), The Netherlands and Sweden ask the contractor to present a quality management plan. This is monitored and used during the execution of the work. On the other hand, Poland explicitly does not rely on a quality system by the contractor but evaluates the real effect on the roads. Poland does not stimulate contractors to develop a quality management system themselves.

7.2.2 System based quality control

In the Netherlands during the execution phase system-based quality control is used for quality assessment. This method of quality assessment is applied on all maintenance contracts since these contracts require the contractor to have a certified (ISO 9001) quality management system. The contractor needs to proof that the Plan-Do-Check-Act cycle works for the maintenance project. This means that the contractor needs to make plans on how it is going to perform the work (Plan), the work needs to be performed the way it was planned (Do), it needs to be checked (Check) and improvements need to be made based on these checks

(Act). An important element of the quality management system is verification and validation, the contractor needs to verify whether the work done meets the requirements of the contract an whether the work is suitable for the intended use. The basis for applying system-based quality control as a form of quality assessment by the contracting authority is risk management. Each project has its own risk profile. System based quality control is aimed at mitigating the highest scoring risks, for these risks a form of quality control will be applied by the contracting authority. Within system-based quality control different quality control methods can be used; interaction, intervention or auditing. Auditing can take place on three different levels: product, process, or system. Which type of auditing method will be used is based on the risk profile. Product audits entail that the contracting authority itself performs checks and compares its checks with the checks performed by the contractor. Process audits are based on assessing whether a process (for example risk management or verification and validation) as descripted in the contractor's plans functions up to standard. During an interview performed by auditors the contractor has to show the effectiveness of the process by showing documented proof. System audits are performed in a similar way as process audits, yet system audits are aimed at assessing the effectiveness of the entire project management system. As already mentioned, the kind of quality control methods used depends on the risk profile of a project, but also on the current phase of the project. This means that for each contract a tailor-made mix of quality control methods is set up and used.

7.2.3 Rectification of defect

Non-conformance reports (NCRs) are issued by the contracting authority supervisors or project managers, to the contractor as soon as testing shows that the product may be defective, and the contractor would be given a timeframe during which they shall need to rectify the situation.

The works may be found to be faulty in either of the following cases:

- Poor workmanship whereby the work is therefore not to spec and needs replacement.
- Lack of finish in the work, whereby the work may not be completed to satisfaction and needs further action from the contractor.
- Poor quality material was used, and the work is not conforming to the specified performance hence replacement may be required from the contractor.

The above would lead to various consequences which may differ between the countries:

- No acceptance by the contracting authority of the performance of the works, hence there would be no compensation for the work until the defect is resolved.
- Deviations in performance are discussed during contract meetings. The contractor is given the opportunity to fix the defect and prevent it from occurring again in future. When defects keep happening, some NRAs may apply penalties.
- The works would need to be taken out and re-done in certain instances and this is insisted up by Germany, The Netherlands, Poland, and Malta.
- Germany and Malta sometimes adopt the principle of price reduction.
- In general, all countries have mechanisms to apply penalties depending on the project leader's judgement concerning the contractor's cooperation and performance.

7.3 Payment

The result of the quality assessment and the performance of the contract execution is undoubtedly reflected on the payment. Timely payment is of utmost important to the contractor's cash-flow and not all countries manage to pay on time. This may be due to various factors which may have an effect on the procedure of payment. However, all countries strive to improve this, not to incur interest fees. It is also acknowledged that the contractor genuinely would need payment so that they can pay their employees as well as procure materials and equipment which are required for the contract execution.

7.3.1 Payment mechanisms

There are various payment mechanisms:

- Fixed costs (example snow organisation) vs variable performance costs (depending on the situation – growing of the vegetation / weather conditions / traffic, etc.); this is used mainly in Sweden, Denmark, and The Netherlands.
- Unit-price payment vs lumpsum payment, which may have various aspects as follows:
    - Pre-financing (max. 30%, incl. material on site payment)
    - Interim payments:
        - Percentual payment allocation for every month of the year
        - Availability of the road (%) which defines the payment
        - Scheme set on the basis of certain milestones (delivery of big parts / submission of monthly report / etc.) hence progress related
- Retention money: about 5% of the sum is kept and only paid after completion of the contract as may vary after one year, 3 years or 5 years, which payment is kept as a guarantee.

7.3.2 Payment schemes

There are different payment schemes in use: they can work either on a timely base (fixed percentage of the whole contract sum paid in a regular period) or according to the achievement of certain (contractual) milestones. Sometimes, the payment schemes can even be mixed, i.e. there can be a basic payment of fixed costs that is supplemented by an additional payment according to the actual works performed. A certain retention money (respectively a bank guarantee) as well as the pre-financing of the intended works can be part of a payment schedule, too.

The observation shows in addition that certain payment schemes are often linked to particular kinds of contract: whereas in "traditional maintenance contracts" usually a regular (e.g., monthly) unit-priced payment based on verified works is made, in recently developed "availability contracts" a (percentual) lumpsum payment is done based on the actual availability of the road (mainly in DBFMO-contracts). Especially large maintenance and/or service contracts often work with a combination of fixed and variable performance costs.

7.3.3 Penalties and price reductions

Various countries apply penalties when contractors do not perform as expected through the contract or when the work is poor and considered not acceptable. Such penalties can be applied when:

- The contractor delays on the timeframe stipulated in the contract.
- The promised BPQR is not delivered when the contractor won the contract based on these promises (penalty of max. 1,5 times the value of the BPQR gain – NL).

It is sometimes difficult for the NRA to apply penalties since this may have effects on the following phases of the execution of the contract. It is found usual and common that contractors resist the application of penalties however sometimes it is also noted that the contractor acknowledges that they may be in default.

In instances when the specification of the contract allows a tolerated deviation in quality, the contracting authority may decide to apply a price reduction, however. In the case of Malta, this may only be considered for asphalt and concrete works and only for certain aspects of the work where the deviation is deemed to have low effect on the works as a whole. Price reductions are not applicable in cases where the contracting authority (through its own expertise) decides that remedial measures other than and/or in addition with price reduction can be taken for non-compliance to specifications.

7.3.4 Award bonuses or incentives

On top of the compensation for contractual agreements, various countries use bonuses to award the following:

- Innovation:
  - In Denmark, the contractor can propose new smaller “projects” within the contract, or other things. If the NRA accepts, the contractor earns more money, and more things are carried out;
  - Further to the point above, even though “additional work” is not officially used as an incentive on the contract, it is worth noting that when a contractor is not performing well enough during the contract execution, the contractor will not likely be given additional work during the execution of the contract.
  - In Germany, for some pilot projects, the contractor gets 50% of the savings, if they offer a technical solution that is as good as the tendered solution, but less expensive. In the same way they get 50% of the economic advantage, if they suggest a better solution than the tendered one. Similar concepts are adopted in Denmark where the country profits from contractor suggestions on new methods, less administrations, new systems, etc. are shared with the contractor 50/50. The NRA puts its share into an “incentive pool”, used on extra works under the contract (things that we would not otherwise have the money to get done).
- CO2-reduction mainly used in Sweden.
- The social aspect ratio of employment, which is a concept applied in Sweden to encourage the employment of persons who have difficulty finding work and/or trainees.
- Acceleration of the work which is used in Germany to encourage faster contract periods.

Additional to the required payment of the contractual performance, members often use financial bonuses as incentives in order to stimulate certain aspects of the contract, especially in order to promote innovations, reduce CO2, facilitate employment, accelerate works or improve the contract as such. Some members use the promise to extend the ongoing contract as an additional kind of incentive (e.g., the option to prolong the contract for additional 1-2 years). Past performance or performance measurement as a criterion in future procurement processes is used in some countries (e.g., NL), while it is legally disputed in others (e.g., GE).

7.3.5 Release of retention monies / guarantees

The various countries retain monies with interim payments as a form of guarantee of the final work. The monies are released at the end of the contract term, which may vary up to 5 years amongst the countries. In certain instances, the contractor is allowed to take out a bank guarantee of the same amount and present it to the contracting authority. In Malta, whereby the monies are released after 5 years from the provisional acceptance of the works, a number of key performance indicators are checked by the contracting authority before the actual release of the funds. This sometimes creates difficulty with contractors if the indicators are not reached and re-work is requested. Contractors contest that the road may be too heavily used during the 5-year term and/or the maintenance of the road was not properly executed by the contracting authority.

7.4 Contract Closure

At the end of the contract, there is generally consensus that a conclusion or evaluation of the contract should be carried out. Sweden is now piloting with including bad contractor performance in the past as a criterion for awarding in the future contracts. The positive side of this procedure is that some contractors in Sweden are now basing their bonuses on the performance evaluation of the agency. In the Netherlands, where a similar approach is also adopted, the negative side effect of it is that employees of the contractor sometimes ask employees of the contracting authority for positive evaluations of contract execution.

7.5 Recap chapter 7

Quality control: in general, three different methods for quality control can be distinguished, testing by the NRA, self-testing by the contractor and testing performed by third parties. Most NRAs make use of some type of combination of these different methods, yet it differs amongst the NRAs which method is emphasised.

System based quality control: next to the three methods of quality control mentioned above, the Dutch NRA makes use of ‘system-based quality control’. All Dutch maintenance contracts require the contractor to have a certified (ISO 9001) quality management system, so the contractor needs to proof that the Plan-Do-Check-Act cycle works for the maintenance project. With auditing the NRA can ask the contractor to show proof of a working PDCA cycle. Based on the risk profile of the project the NRA decides which aspects will be audited.

Non-conformance: non-conformance will lead to various consequences which may differ between the countries:

- No acceptance and no payment by the contracting authority for performed works until the defect is resolved
- Penalties
- Re-doing the work
- Price reductions

Payment mechanisms:

- Fixed costs or variable performance costs
- Unit-price payment or lumpsum payment

Payment schemes: two general payment schemes can be distinguished; timely based payment and payment according to the achievement of certain milestones. Sometimes, the payment schemes can even be mixed, i.e., there can be a basic payment of fixed costs that is supplemented by an additional payment according to the actual works performed. A certain retention money (respectively a bank guarantee) as well as the pre-financing of the intended works can be part of a payment schedule, too.

Incentives:

- Penalties or price reductions: incentive for the contractor to perform up to standard.
- Bonuses: often used in order to stimulate certain aspects of the contract; innovation, CO2 reduction, facilitate employment, accelerate works or improve the contract as such.
- Option to extend the ongoing contract
- Past performance: using performance in the past as a criterion for awarding in future contracts

8.Future developments

Maintenance is usually not in the head lights of political attention. However societal changes and political ambitions in digitalisation, environment, climate change and road safety will raise the bar for the quality of future infrastructures. In this chapter we will describe three developments that are related to these topics and will during the next decade change the process of maintenance and will influence the attention it will get. These are:

- renovation of aging infrastructures
- condition based maintenance
- green procurement and innovation

8.1 Aging infrastructures

Most countries are facing decisions about investing in aging infrastructures. Bridges, traffic systems and tunnels are built after World War II and are now reaching their technical end of lifetime. For many assets, the regular maintenance will not be enough in the near future. This aging process is influenced by the tremendous growth of the traffic intensity and especially the impact of continuous flows of heavy freight transports. Roads and bridges were not built for the traffic flows they have to carry nowadays. This means we will see a shift in attention from the traditional fixed maintenance contracts for small and regular maintenance to large scale renovations or even replacement investments.

A problem with a lot of those structures is the lack of knowledge we still have about their current state. Often our data are not up to standard to really know what kind of innovation is needed and a lot of knowledge left the organisation, because of retirement of the people who were responsible for building those assets and maintaining it for many years.

Another problem is the budget necessary for those renovations. Maintenance budgets never have a high political priority and now we need real money to invest in modernising our infrastructures.

Modernising does not only mean renovation of the assets already there, but also means an investment to make sure we create a new infrastructure that will last again for a fifty-year period and that are state of the art from a perspective of digitalisation and smart mobility developments. This often means larger and stronger structures, according to modern traffic standards. But also provided with modern traffic management systems and with sensors that collect and analyse real time data about the use and structural health of the assets.

This modernisation means a combination of large-scale maintenance or activities with investments to upgrade the infrastructures.

With this larger challenge and fewer technical people available in our organisations, we will have to make a move towards more efficient methods of maintenance. And with the larger use of infrastructures due to the still growing traffic demand, the maintenance process should be organised as efficient as possible. Which means at the right moment with no unnecessary traffic hindrance.

8.2 Condition based maintenance

Planning of maintenance has never been a high-tech activity. New techniques, like the growing use of sensors and data, the use of drones and satellites for inspections and the use of 3D-modelling techniques will in the near future change the traditional maintenance processes.

8.2.1 Sensors and data

Building in sensors to collect data about the traffic, weather conditions and the way the asset reacts to changing conditions, will give us the opportunity to have continuous real time information about the state of the assets. Acquiring and analysing these data and use them for maintenance decisions is often called smart maintenance. With smart maintenance we will shift our focus on maintenance from preventive and corrective maintenance towards predictive maintenance. Real time data and fast-growing data bases of historic data will enable us to predict much more exactly when maintenance is needed and what measures should be taken. Not only will this make the maintenance process much more efficient, but it will also give us the opportunity to reduce the hinder traffic will endure from road work. No early road closures, because of preventive maintenance and no safety issues, as a result of problems with the road due to late maintenance.

The enhanced knowledge about the way assets react to traffic intensity or changing weather will not only help us in the way we program maintenance but will also provide us with new insights about how we can improve the design, construction, and performance of new infrastructures. The data we will collect about our infrastructures will help us become a more intelligent asset manager. This process may also lead to a different way of contracting the maintenance. Some companies already offer maintenance as a service concepts on the base of the sensing data they collect, such as traffic density, number of heavy vehicles, weather conditions and quality of the asphalt. For the NRA this means a switch from work contracts to service contracts. And a quite different way of specifying the demands in the tender.

Another step we have to make in our contracts, if we want to be much more data driven, is to plan about the way all kinds of data are about the state of our assets are collected, stored, owned and used. Contractors have a treasure of data about our own assets, however often we don't have access to those data, or we are not able to convert those data into usable information. Nowadays we sometimes see that contractors rather pay a fine at the end of a contract then collecting the data we ask for in contracts and deliver them end the end of the contract period.

8.2.2 3D-modelling techniques

3D-modelling techniques can help us in the administration of the construction process and the later operation and maintenance of the infrastructure. The German NRA is approaching this aim by the use of BIM - Building-Information-Modelling. The long-term goal will be to cover the entire life cycle of the infrastructure – beginning from its first design to the procurement of the construction works, the operation and maintenance of the infrastructure until its final demolition in a digital way. By this, not only changes in the construction process and their constructive and financial consequences in each single project can be tracked easier, but also a more accurate precast about where necessary maintenance will be upcoming, can be made. In the maintenance process itself, the responsible NRA has detailed and specific knowledge of each part of the infrastructure and – by this – knows exactly at what point in time it has to be replaced. In this way, the responsible NRA can not only steer the maintenance process more precisely but can also precast the required budget on the long run in order to assure an

efficacious and reasonable use of the available financial resources. Additionally, the public authority doing the maintenance has precise information on the construction materials contained in the infrastructure, so that the reuse of such materials becomes easier and more efficient. By this the whole construction process gets more sustainable. Hence, Germany is promoting the Building-Information-Modelling (BIM) with great intensity and dedication. One long-term goal is to map the physical federal highway infrastructure digitally and in its entire complexity on the digital twin. For this reason, the data – not only of the design model, but also of the final constructed infrastructure, will be gathered in a single data base in order to create – step by step – a virtual road network.

8.3 European green deal and innovation

A third important development is the green deal of the European Commission. The green deal will have influence on the way we design, build, and maintain our infrastructures.

European Union will:

- *become world's first climate neutral continent by 2050*
  - *(no emission of greenhouse gasses, which means a major energy transition)*
  - *protect human life, animals, and plants by cutting pollution*
- *help companies become world leaders in clean products and technologies*
- *help ensure a just and inclusive energy transition*

Emissions in our current road networks are related to existing assets and working processes, and to the use of the infrastructures. The challenge will be to convert our current infrastructures to sustainable infrastructures, using clean technologies to make this transition. The political will and ambition will be driving these changes and our technicians will play an important role rewriting the technical standards. This means the use of new materials, at the same time taking steps in the energy transition and of course making sure that the new solutions still provide us with a safe traffic system. The NRAs are responsible to set new technical standards. The private sector will have to deliver the new, cleaner, sustainable, and circular products that are needed to reach the goals of the Green Deal in 2050. Procurement will play a crucial role facilitating and stimulating the private sector to come up with the necessary innovations.

The green deal will result in an energy transition and urge us to develop new building and maintenance methods and the use of new low carbon materials, like asphalt and concrete. We know that many of those new materials still will have to be developed over the next decade.

Procurement plays an important role in our innovation processes. Most innovations in our road infrastructures are not developed by the NRAs but are introduced by making smart use of our procurement procedures. By using functional specifications, we will be able to buy innovations developed elsewhere in the world. By setting higher standards we can stimulate our private sector partners to come up with innovations and new working methods. This means we will have to use the combined buying power of public clients to stimulate the private sector to come up with new solutions. For example, by setting higher standards and prescribe technical demands for the future use of pavement.

In some cases, we will need to initiate innovations, because there is no specific private sector interest of business case that will stimulate companies to invest in a certain solution. The procurement directive of 2014 gives us several procurement procedures to directly stimulate companies to develop innovations. Options are stimulating the innovation without necessarily

buying (pre commercial procurement) or participating in developing an innovation (innovation partnership). A challenge in procurement will be how to implement new, sustainable materials and products in existing infrastructures. For example, the use of biofuels.

Our contracts will also have to change. To facilitate a transition to low carbon dioxide materials, there should be flexibility in long running maintenance contracts. This means contract clauses that will provide contractors the opportunity to use new, more sustainable, materials. Or clauses that will demand from the contractors to improve the energy efficiency of working processes during the time the contract runs.

The Dutch NRA is now experiencing being a launching customer for innovations that will have impact in reducing our carbon dioxide footprint. In one of these experiments the NRA is working together with the private sector to reduce the carbon dioxide emission of asphalt with 50 percent between 2018 and 2030. Other experiments focus om predictive asphalt maintenance with big data, remote sensing for inspections of roads, bridges, the design of a circular bridge and an innovation lane, which provides companies with the opportunity test new materials and solutions.

At the same time there is the need for a transition to a (more) circular economy. Important steps in this transition are the reduction of waste and the use of fewer raw materials. This transition will also influence the way we maintain and the way we procure maintenance. The focus will be much more on the potential to maintain, repair and renovate instead of renewing. This means a stronger emphasis om the use of materials that can be reused. And in case of renewal, we will have to work with more used materials. This will lead to a combined challenge for procurement and technique. Technical standards for the use of materials will have to change and we will have to get in dialog with our contractors about how and when they will be able to change their working processes.

8.4 Recap of chapter 8

Renovation of aging infrastructures: most countries are facing decisions about investing in aging infrastructures which are now reaching their technical end of lifetime. For many assets, the regular maintenance won't be enough in the near future. This means we will see a shift in attention from the traditional fixed maintenance contracts for small and regular maintenance to large scale renovations or even replacement investments. Factors that make this more difficult:

- Lack of data about the current state
- Knowledge has left the organisation
- Low budgets

Condition based maintenance:

- Sensors and data: building in sensors to collect data will give us the opportunity to have continuous real time information about the state of the assets. Acquiring and analysing these data and use them for maintenance decisions is often called smart maintenance. With smart maintenance we will shift our focus on maintenance from preventive and corrective maintenance towards predictive maintenance.
- 3D-moddeling techniques: 3D-modelling techniques can help us in the administration of the construction process and the later operation and maintenance of the

infrastructure. In ideal circumstances, the whole life cycle of an infrastructure is covered in a digital way. By this, not only changes in the construction process and their constructive and financial consequences in each single project can be tracked easier, but also a more accurate precast about where necessary maintenance will be upcoming can be made.

European green deal and innovation: the challenge will be to convert our current infrastructures to sustainable infrastructures, using clean technologies to make this transition. Procurement will play a crucial role facilitating and stimulating the private sector to come up with the necessary innovations.

9.Conclusions

This report shows us that maintenance is not a standalone activity, but part of the broader decisions an NRA has to make about managing their assets. And not just management decisions, but often decisions with a political background. Our assets form our road networks, and the primary goal of maintenance is to keep them up to the standards set by our governments and demanded by our users. These standards and demands may relate to the capacity of the roads, safety standards, environmental impact of the use of modern digital techniques. These standards and demands define our challenges.

However, the broader decisions also involve make or buy decisions about the distribution of roles between the NRA and the private sector. And decisions about available budgets and the balance between investment in new capacity or maintenance of existing infrastructure. Will we only look from a direct cost perspective or also from a life cycle cost perspective? Will we incorporate the users demands?

For procurement professionals the decisions about how to involve the private sector are also important. Do we use large contracts from a perspective of efficiency, or do we use smaller contracts to get more SMEs involved in our tenders? Are we tendering with detailed specifications for the lowest price or do we ask more functional specifications and hope to get a better quality-price ratio? And what role will more general public goals on sustainability (climate change and social return) and innovation play in the way we procure?

In the report we have seen that decisions we have to make about maintenance change during the years. First of all, the methods to program our maintenance are changing. With new techniques, we will be better able to predict the need and time for maintenance, which means that in the future we will be able to do maintenance more efficient and with less disturbance of traffic flows (economic damage).

More and more, decisions about maintaining and renewing our infrastructures have to be made in a socio-political context. Government buying power is used to invoke societal changes; for example, by using green procurement in the transition to more sustainable infrastructures. In addition, the need to innovate will play a more important role in the upcoming years. This is not only because of climate change issues, but also because infrastructures are getting older and large renewal investments are needed. Because digitalisation will lead to a more options for smart mobility, this will also influence our infrastructures.

In this report we have shown that (relatively) new procurement procedures like pre commercial procurement and innovation partnership are options of working on innovations. Most NRAs are still discovering what opportunities these procedures will offer them.

This report is meant to compare the way we procure maintenance within the various NRAs, discuss the differences, and learn from each other. This is a first step in a learning process that is needed to further improve and professionalise our procurement departments. As you can read many of the examples are drawn from a limited number of NRAs. Denmark,

Germany, The Netherlands, Malta, and Sweden provided a lot of information about their maintenance processes and the decisions that have led to their current way of working. Other countries took part in some of the discussions or delivered feedback in our review process.

We hope this report will help to start the exchange of knowledge and experience with other NRAs, especially as we know that we are facing a lot of new challenges in procurement. In the upcoming period we will address issues related to green procurement. In maintenance and in construction. This report makes clear we are just setting first steps on the path of green procurement. We will have to work together and learn from each other to make procurement a strong tool to reach our green procurement goals.

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