BEST4ROAD

Quick scan method for risks in maintenance procurement

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Executive summary

This is the BEST4ROAD guideline to the quick scan method. The quick scan allows NRAs to quickly and easily gain insight in the risks of procuring maintenance works. In this respect, also a risk checklist is established and presented. Using the quick scan an NRA is able to identify an appropriate procurement strategy given these risks as input. Recommendations are provided regarding the required competences for these strategies.

The quick scan works towards determining which procurement risks are relevant for the maintenance work under consideration and require action from the NRA. As such, the analysis starts by determining the context and scope of the maintenance work including the corporate procurement framework and available competences at the NRA and market parties. Subsequently, NRA staff is engaged to provide input during an interactive workshop. Result of this workshop is a list of risks that needs to be taken into account during identification of the procurement strategy. First steps towards the procurement strategy to be applied may also be taken during the workshop.

Table of contents

List of Tables

List of Figures

1 Introduction

The trans-national research programme **"Call 2014: Asset Management and Maintenance"** was launched by the Conference of European Directors of Roads (CEDR). CEDR is an organisation which brings together the road directors of 25 European countries. The aim of CEDR is to contribute to the development of road engineering as part of an integrated transport system under the social, economic and environmental aspects of sustainability and to promote co-operation between the National Road Administrations (NRA).

The participating NRAs in this Call are Belgium-Flanders, Finland, Germany, Ireland, Norway, the Netherlands, Sweden, United Kingdom and Austria. As in previous collaborative research programmes, the participating members have established a Programme Executive Board (PEB) made up of experts in the topics to be covered. The research budget is jointly provided by the NRAs who provide participants to the PEB as listed above.

BEST4ROAD is a two years project aiming at the development of best practice guidelines and tools for the efficient procurement of road maintenance in a changing world. Based on a comprehensive and integrative framework for maintenance procurement, the project will bring together the extensive, yet scattered procurement knowledge and experiences at National Road Authorities (NRAs) in 9 countries including the US and Australia. It will determine the lessons learnt at the NRAs and based on that will develop a number of hands-on tools and step-by-step guidance for procuring road maintenance taking current and future challenges of NRAs into account.

The benefit of the BEST4ROAD project for NRAs lies in the integration of an in-depth study and comparison of maintenance procurement practices in different countries with the development of tools and guidelines that can be easily implemented and used at NRAs. This will allow NRAs to learn from their peers and at the same time improve their maintenance procurement practices to get prepared for future challenges such as staff turnover and shrinking budgets.

The BEST4ROAD project consists of seven work packages (WP):

WP1 – Comparison of maintenance procurement practices

WP2 – Maintenance procurement strategies and maintenance efficiency

WP3 – Quick scan method for risk in maintenance procurement

WP4 – Competence profiles and transition processes

WP5 – Best practice guidelines

WP6 – Dissemination and demonstration

WP7 – Project management

The main objective of WP3 is to develop a quick scan method for risk in maintenance procurement. After performing the quick scan, an NRA has gained insight in the procurement risks for specific maintenance work and will be able to identify the best procurement strategy given these risks. Recommendations are provided regarding the required competences for these strategies. As such WP3 is based on the results of WPs2 and WP4.

This report presents the developed quick scan method.

2 Quick scan method

Aim of the quick scan

Aim of the quick scan is to identify the risks related to the procurement of road maintenance work, to devise suitable measures for mitigating identified risks, and to select an appropriate procurement strategy. The methodology is developed for use in two circumstances:

- For deciding on the procurement strategy for the maintenance of a specific road asset or network
- For deciding on the portfolio of general strategy options for the procurement of road maintenance at a NRA

In the description of the steps in chapter 3, the perspective of deciding on a procurement strategy for a specific road asset or network is chosen. However, when the methodology is used for the strategy portfolio, the scope description in step 1.1 covers the entire road network of the NRA. The methodology in itself will be the same.

General description of the risk scan method

The basis of the quick scan method is to bring all available knowledge, information and especially experiences of stakeholders together in such a way that a founded first impression of procurement risks can be assessed. This implies that no quantitative and extensive analyses will be executed, but that the outcomes rely on the valid input of relevant stakeholders.

The Risk scan method comprises of 4 main steps:

Step 1 – Context analysis

Step 2 – Procurement risk assessment

Step 3 – Procurement risk mitigation

Step 4 – Monitoring and evaluation

The quick scan is executed in a semi quantitative manner, making use of certain likelihood and consequence classes instead of exact numbers. This requires a certain mindset of the participants. In addition, it should be stressed that the used consequence and likelihood classes are used mainly to be able to compare the different risks thus leading to a ‘top priority’ list that needs to be mitigated by choosing an appropriate procurement strategy and establishing an action plan to ensure the presence of necessary competences at the NRA.

Approach: desktop study versus use of a workshop setting

The methodology is developed for use in both a desktop and a workshop setting. In principle, all steps could be executed as a desk study, but use of a workshop has many advantages. In the table below one can see which steps can be carried out in a workshop setting and which parts should be done in a desktop study.

	Desktop study	Workshop
Step 1 – Context analysis		
Step 1.1 – Scope of the maintenance work	X	
Step 1.2 – Current maintenance procurement framework of the NRA	X	
Step 1.3 – Current maintenance procurement competences at the NRA		X
Step 1.4 – Current maintenance procurement capabilities in the market		X
Step 1.5 – Identification of procurement strategy options		X
Step 1.6 – Identification of decision criteria	X	X
Step 2 – Procurement risk assessment		
Step 2.1 – Risk identification		X
Step 2.2 – Risk analysis; scoring impact of risk		X
Step 2.3 – Risk evaluation		X
Step 3 – Procurement risk mitigation		
Step 3.1 – Identify procurement strategy with low risk profile	X	X
Step 3.2 – Ensure competences at NRA	X	X
Step 4 – Monitoring and evaluation	X	

Advantages of a workshop setting are:

- In order to conduct a good risk assessment several disciplines will be involved. All disciplines can be invited to participate in the workshop.
- A workshop setting will create support for the chosen procurement strategy. As such it will also work for team building purposes.

Execution of the scan

The scan is developed to be used by staff of the NRA. It is recommended to consider presence of the following disciplines at the workshop:

- Contract manager
- Procurement specialists
- Technical specialist
- Asset managers
- Road inspectors
- Possibly people from contractors themselves or with experience from a contractor perspective

3 Description of steps

Step 1 – Context analysis

Objectives of the step

The goal of this step is to establish the context in which the quick scan will be performed. This breaks down to establishing the scope and "rules" that will be used in the risk assessment in step 2.

Proposed sub-steps

To achieve the above mentioned goal, the following sub-steps are recommended:

Step 1.1 – Scope of the maintenance work
Step 1.2 – Current maintenance procurement framework of the NRA
Step 1.3 – Current maintenance procurement competences at the NRA
Step 1.4 – Current maintenance procurement capabilities in the market
Step 1.5 – Identification of procurement strategy options
Step 1.6 – Identification of decision criteria

General recommendations for this step

Please note that these steps are to be executed partly as a desktop study and partly within a workshop setting. In some cases, it may prove inefficient or too difficult to perform the desktop study (steps 1.1 and 1.6) without help of workshop participants. Therefore, these may be (partly) executed in a workshop setting as well.

Step 1.1 – Scope of the maintenance work

a. Objectives

Characterization of the maintenance work that will be studied during the scan, including all related contextual aspects that may have influence on the optimal procurement strategy.

b. Data collection

The following data may be interesting to collect (BEST4ROAD1.1, 2017):

- Objective of the maintenance work
- Type of road (local, national, international)
- Type of assets to be maintained
- Number of assets to be maintained
- Scale of required maintenance work (number of kilometres, stretch, section, network)
- Type of required maintenance work (regular, rehabilitation)
- Functional requirements, PINs
- Planning
- Cost estimation
- Infrastructure peculiarities (traffic intensity, asset design and material)

- Climate zone
- Organisational policy
- State of the economy; status of work capacity in infrastructure sector

c. Method

The gathering of the scope of the maintenance work basically are simple steps. No specific guidance is provided here.

d. Output

Output will be the scope of the maintenance work for the risk scan.

Step 1.2 – Current maintenance procurement framework of the NRA

a. Objectives

Most likely, a corporate procurement framework is in place at the NRA and it will not be possible (or tolerated within the NRA) to identify procurement strategies outside the corporate boundaries. As such, the corporate framework provides the boundaries between which procurement strategies can be developed for the specific maintenance work as described in step 1.1.

b. Data collection

The corporate maintenance procurement framework of the NRA forms the input into this step.

c. Method

In BEST4ROAD2.4 (2017), eight criteria are proposed for describing a procurement strategy. These are:

- Outsourced activities
- In-house activities
- Contract design
- Performance specification
- Payment mechanism
- Contract duration
- Tender evaluation
- Performance monitoring

The existing and allowable procurement options need to be determined for each of those criteria. For more information, reference is being made to BEST4ROAD2.4 (2017).

d. Output

Output is a list of possible procurement options at the NRA for all eight criteria, given the scope of the maintenance work. As such, the different possible procurement elements are identified without forming strategies.

Step 1.3 – Current maintenance procurement competences at the NRA

a. Objectives

In order to use a certain procurement strategy, specific competences are necessary at the NRA to successfully use this strategy. The objective of this step is to determine which procurement competences

are currently present at the NRA.

b. Data collection

If an overview of competences at the NRA exists, this can be used as an input for this step. Most likely though, such a list will not exist. Information gathering then will be a matter of brainstorming.

c. Method

As a starting point, the overview of procurement competences presented in BEST4ROAD4.3 (2017) can be used. Here, the competences are grouped into three categories:

- Contractual competences
  - Monitoring and surveillance skills
  - Procurement knowledge
  - Understanding contract documents
  - Safety management skills
  - Quality management skills
  - Contract coordination skills
  - Commercial knowledge
- Relational competences
  - Communication skills
  - Negotiation skills
  - Understanding of roles and responsibilities
  - Stakeholder management skills
  - Human resource management skills
- Technical competences
  - Maintenance planning and programming skills
  - Understanding of asset condition data
  - Understanding of asset performance and system behaviour
  - Understanding of durations and costs of maintenance activities
  - Understanding of technical peculiarities of local networks
  - Understanding of maintenance techniques and technologies
  - Engineering knowledge of unique structures

In order to assess the extent of the available competences at the NRA, it is recommended to give a scoring of 1-5 on each of the competences with the following meaning:

1. Competence is not present at the NRA
2. Competence is developing but not well present at the NRA. Deployment for the maintenance work is not likely.
3. Competence is moderately developed at the NRA. Deployment for the maintenance work is limited.
4. Competence is well developed at the NRA and can be deployed for the maintenance work if necessary
5. Competence is completely developed at the NRA and is readily available for the maintenance work.

d. Output	Output of this step is a list of competences, assessed regarding their presence at the NRA.

Step 1.4 – Current maintenance procurement competences in the market

a. Objectives	The purpose of this step is to gain insight in the competences available in the market. An NRA can implement a procurement strategy, but if market parties will not possess competences that complement or mirror the competences of the NRA, the strategy is likely to fail.
b. Data collection	Most likely, availability of data as input for this step will be problematic. However, experiences of NRA staff with market parties gained in previous maintenance contracts can be used as basis to identify and assess the available competences. A brainstorming exercise is recommended.
c. Method	This step is basically meant to encourage thinking about the competences of the market. In order to allow the assessment of complementary and/or mirrored competences. The same competence categories and assessment scale that was used for step 1.3 should be applied here as well.
d. Output	Output of this step is a list of competences, assessed regarding their presence in the market.

Step 1.5 – Identification of possible procurement strategies

a. Objectives	Purpose of this step is to find the range of possible and implementable procurement strategies, given the maintenance work to be done and the competences available at the NRA and in the market.
b. Data collection	In the previous steps information has been gathered around the following questions: • Which procurement strategies may be chosen for the maintenance work? An answer to this question can be found on the basis of the characteristics of the maintenance work to be done described in step 1.1 and the procurement options identified in step 1.2. • Which procurement strategies can be implemented given the competences of NRA and market? An answer to this question can be found on the available competences at NRA and market identified in steps 1.3 and 1.4.

c. Method

Which procurement strategies may be chosen for the maintenance work?

As mentioned in step 1.2, in BEST4ROAD2.4 (2017) different procurement options are proposed and categorised based on eight criteria. These options can be combined to form different procurement strategies. Since several combinations and thus strategies are possible, in BEST4ROAD2.4 (2017) three generic strategies are proposed (Table 3.1). More detail on these strategies is presented in appendix 2 and in BEST4ROAD2.4 (2017).

Output of step 1.2 are the possible strategies, given the corporate procurement strategy. It is proposed to select possible strategies in the table. For instance, by marking green those options that are in line with the general framework and the maintenance work and/or marking red those options that contradict the general framework and the maintenance work.

Which procurement strategy can be implemented given the competences of NRA and market?

As mentioned in step 1.3, in BEST4ROAD4.3 (2017) an overview of procurement competences is presented. These competences are grouped into key competences for each strategy in table 1 of the competences report (BEST4ROAD4.3, 2017). A summary of these lists can also be found in appendix 3 of this risk scan report. Based on the scoring from step 1.3 and step 1.4 one can mark certain strategies being difficult to implement due to insufficient competences present. These can again be marked in the table, for instance using the colour orange (later in step 3.2, reference is made again to competences in terms of risk mitigation).

	Strategy B	**Strategy C**	**Strategy D**
Outsourced activities	*Single maintenance tasks* are bought from *separate contractors*	*Single and integrated maintenance tasks* are bought from *separate contractors*	*Single asset management tasks* are bought from *separate contractors*
In-house activities	*All asset management tasks* and *single maintenance tasks*	*All asset management tasks*	*Single asset management tasks*

Contract design	*Discrete contracts, unit based framework contracts*	*Framework and integrated contracts, usually appearance driven*	*Framework contracts for the performance monitoring and integrated contracts for the maintenance tasks*
Performance specification	*Task-related*	*Asset-related*	*Service-related*
Payment mechanism	*Unit price*	*Lump-sum*	*Cost plus incentives*
Contract duration	*Short-term*	*Medium-term*	*Long-term*
Tender evaluation	*Price-only*	*Price and quality*	*Quality and costs*
Performance monitoring	*Direct and frequent*	*Direct but infrequent*	*Indirect but frequent*

Table 3.1 Generic procurement strategies (BEST4ROAD2.4, 2017)

d. Output

Output of this step is a list of possible procurement strategies to be applied for the maintenance work.

Step 1.6 – Identification of decision criteria

a. Objectives

The goal of this step is to determine which criteria are to be used for scoring the consequences of a risk.

b. Data collection

Maintenance objectives

NRA objectives

c. Method

Maintenance procurement is related to certain objectives to be achieved with the procurement. Procurement risks are thus risks of not achieving these objectives. From the objectives, the criteria for scoring the consequences of risks are derived. General procurement objectives are (BEST4ROAD1.1, 2017):

- Maintenance effectiveness
  - Road quality
  - Level of service
  - User satisfaction
- Maintenance efficiency
  - Cost savings
  - Time savings

Depending on the policy of the NRA the objectives and criteria can be more specified. This may include, for example, availability and safety as

level of service criteria or reputation as a user satisfaction criterion. Some maintenance work may have specific objectives that need to be taken into account.

After the criteria have been identified and discussed, the criteria can be given a weight/ importance. This can be done in several ways like putting them in a logical order of importance, scoring points or using AHP principles (https://en.wikipedia.org/wiki/Analytic_hierarchy_process). This should eventually lead to normalized weights per criterion.

If the most important criteria are already known and should time be restricted and/or when a much simpler approach is beneficial, the quick scan can be performed using only these consequence criteria.

It is recommended to provide definitions of the various consequence classes per criterion. An example of consequence classes is provided in the example below. Obviously, these classes may be altered according to the requirements of each case.

To indicate the magnitude of a risk it is also necessary to link it to the likelihood of the risk occurring. The likelihood also needs to be assessed using semi quantitative classes. An example is provided below.

Additionally, discussion of the criteria in a workshop setting leads to a shared understanding of what is meant and how the consequences and likelihood should be scored in the sub-step 2.2.

d. Output

The output of this sub-step is a list of criteria that are to be used during the scoring of the consequences of the risk.

e. Example

Availability of the road (if possible expressed in lost vehicle hours)

1. A negligible impact on the availability of the road
2. A minimal negative impact on the availability of the road
3. A serious impact on the availability of the road
4. A catastrophic impact on the availability of the road

Safety

1. A negligible impact on the user safety (light material damage), but within acceptable limits
2. An influence that reaches the boundaries of acceptable user safety, with as a consequence a number of extra accidents with temporary loss of health or injuries without absence (material damage, slight injuries)
3. An influence to such extent that the boundaries of user safety are exceeded, with as a consequence a serious increase of the number of accidents with permanent loss of health (serious material damage, heavy injuries)
4. A catastrophic influence on user safety, with as a consequence extra deadly danger during normal use (serious material damage, heavy injuries, casualties)

Reputation of the NRA

1. No to slight loss of reputation (due to proper actions); no complaints
2. Slight to moderate loss of reputation (due to inadequate actions on some aspects), notices in media with attention to (fictive) loss for road users

3. Substantial loss of reputation (due to inadequate actions on a large amount of aspects), reputation has a set-back, notices in media with attention to physical damage / hardships of road users, gets attention in nationwide politics
4. Extreme loss of reputation (due to completely inadequate acting), position of minister at stake

Likelihood

1. Very seldom to occur during the maintenance works – likelihood less than 1%
2. Seldom to occur during the maintenance works – likelihood between 1% and 10%
3. Regularly to occur during the maintenance works – likelihood between 10% and 30%
4. Often to occur during the maintenance works – likelihood more than 30%

Step 2 – Procurement risk assessment

Objectives of the step

The goal of this step is to determine the possible risks together with their likelihood and consequences, after which the risks can be evaluated. This finally results in a list of risks that need to be mitigated in step 3.

Proposed sub-steps

To achieve the above mentioned goal, the following sub-steps are recommended:

Step 2.1 – Risk identification

Step 2.2 – Risk analysis; scoring impact of risk

Step 2.3 – Risk evaluation

General recommendations for this step

It is recommended to perform these steps in a workshop setting. At first a discussion needs to take place about the context and scope that is established in step 1. If this discussion is avoided, this may negatively influence the risk assessment, since the basic assumptions underlying the approach may be questioned or misunderstood by the participants.

Step 2.1 – Risk identification

a. Objectives

The purpose of this step is to identify the elements of the possible procurement strategies that, alone or in combination, have the potential to give rise to a risk.

b. Data collection

The following information can be used as input for this step:

- Within the BEST4ROAD project a checklist for procurement risks related to different procurement strategies has been developed. This checklist can be found in appendix 1.
- In most NRAs, risk management is at the basis of every project. As such, probably a project risk analysis exists. The risks that are already identified in these risk analyses are input for the quickscan.
- The information as gathered in steps 1.3 and 1.4 about competences at the NRA and capabilities of the market can be seen as risk factors that might initiate a risk.

c. Method

Risk identification is a creative process. Generally, risk identification is about asking oneself the question ‘what if’ something happens. It helps to use different perspectives to make sure that as many risks as possible are identified. Some perspectives are provided below:

Different procurement strategy criteria (BEST4ROAD1.1, 2017):

- Type and extent of outsourced activities
- Type and extent of activities that are kept in-house

- The type of performance specifications that are used
- The way performance monitoring can take place
- Different types of payment mechanisms that can be used
- Contract duration periods
- Tender evaluation mechanisms

Perspectives from different organisations:

- The National Road Authority
- The market: industry/contractors

And finally risk with different time perspectives:

- Long term
- Short term

Risk identification can be done in a desk study using the input data as described under 'data collection'. However, due to the creative nature of the exercise, it often proves to be helpful to undertake a risk identification using a collaborative approach in a workshop setting. Benefits are that people with different experiences and different backgrounds all add to the process, resulting in a more complete list of risk at the end of the step.

d. Output

Output of this step comprises a list of risk that may influence the objectives of the maintenance work.

Step 2.2 – Risk analysis; scoring likelihood and impact of risk

a. Objectives

The objective of this sub-step is to determine which risks lead to the largest consequences for the maintenance works of the NRA. In other words, after performing this sub-step insight is gained which risks may lead to not reaching the main objectives of the maintenance works of the NRA.

b. Data collection

Main input for this sub-step is:

- Output of sub-step 1.4: the criteria that can be used to determine the consequences and likelihoods for the NRA when the risk occurs
- Output of sub-step 2.1: the list of risk

c. Method

In order to analyse the magnitude of risks, one needs to assess the likelihood and impact.

The potential consequences of risks can be determined according to the criteria that have been established at sub-step 1.6. Firstly, each risk is assessed on having any impact on these criteria. Secondly, it is estimated within which class of the criteria a relevant risk falls, e.g. a catastrophic or serious impact on the availability of the road.

To indicate the magnitude of a risk it is also necessary to link it to the likelihood of the risk occurring. Here also the classification from sub-step 1.6 can be used.

Determining how risks score on criteria and their likelihood can be done

according to various methods. For a quick scan, expert judgement would be most suitable method due to relatively limited capacity and time needs. Expert judgement is a method in which judgement is made, based on expertise knowledge and experience that is available to an organization. This knowledge can be combined with other data and/or previous experience to form an optimal decision.

It is therefore recommended to use a workshop setting for assessing likelihood and consequences of the risk list. The works of this sub-step 2.2 then break down to scoring of the consequence-criteria and likelihood for each risk, according to the classification in step 1.6.

d. Output

Output of this sub-step comprises the consequences and likelihoods of the identified risks. This can be put in a table-format.

Step 2.3 – Risk evaluation

a. Objectives

Risk evaluation concerns comparing the results of risk analysis with risk criteria to determine whether the risk is acceptable.

b. Data collection

Main input for this sub-step is the output of sub-step 2.2: the list of risks together with a score on likelihood and consequence.

c. Method

One can develop an overview of the degree of potential risks by placing them in a risk matrix according to their likelihood and consequences. An example of a risk matrix is provided in Figure 3.1.

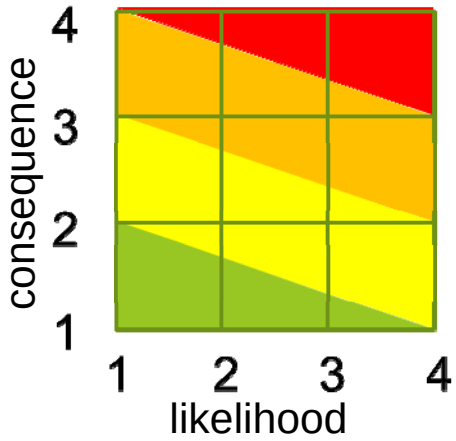

Figure 3.1 Risk matrix example

Risks can be evaluated in several ways:

- In step 1.6 different classes are formulated for scoring the consequences. One could agree that a certain score on these classes is not acceptable. For instance, a score of 4 could be unacceptable. This acceptable level may differ between the different criteria. High consequences related to some criteria can be more important high consequences to other criteria.
- Disadvantage of the above methodology is that likelihood is not taken into account. It is not logical to have the same tolerable levels for all likelihoods. Therefore, the risk matrix may be used. Usually a colour scheme is present in such a matrix, providing

information about whether a risk is acceptable (green meaning low risk (acceptable), red meaning very high risk (unacceptable)).

- To conclude it is recommended to compare different perceptions of people that are involved in the scan. When people agree on the scoring of the criteria, a discussion is not necessary, but when they disagree probably there is a rational behind which may influence the risk evaluation.

The colours and labels for the different cells in the risk matrix of Figure 3.1 are an example of a risk evaluation and can be tailored according to the situation. For example, department A and B may have a different opinion on what type of risks will be critical or high, or might classify risks according to a different terminology.

d. Output

An overview of the risks is visualised by using a risk matrix.

Tolerable classes of risk criteria related to the priorities and risk tolerance of the organisation.

A list of unacceptable risk that need to be mitigated.

Step 3 – Procurement risk mitigation

Objectives of the step

The main objective of step 3 is to determine an appropriate procurement strategy that fits within the context of the maintenance work, and given the risks that has been identified in step 2. Specific attention goes to the presence of the necessary competences related to the procurement strategy. When a lack is identified a specific action plan needs to be established to overcome this issue.

Proposed sub-steps

To achieve the above mentioned goal, the following sub-steps are recommended:

Step 3.1 – Identify procurement strategy with low risk profile

Step 3.2 – Ensure competences at NRA

General comments

Please note that these steps partly are to be executed as a desktop study and partly within a workshop setting. It is recommended to use the workshop setting to have a first impression and to build support for the decision that will be made. A further detailing can be done after the workshop in a desktop study.

Step 3.1 – Identify procurement strategy with low risk profile

a. Objectives

The purpose of identifying and selecting an appropriate procurement strategy is to obtain the required maintenance results based on the most advantageous pricing and contractual conditions while ensuring achievement of overall risk mitigation.

b. Data collection

The following information will be analysed:

- The list of unacceptable risk from step 2.3
- The possible procurement strategies from step 1.5

c. Method

Risk can be mitigated in two ways:

1. The procurement strategies have been defined according to eight criteria, as mentioned before. For every criterion, a decision needs to be made regarding the suitable strategy, given the risk profile from step 2.3. It could be the best option to choose that strategy with the lowest possible risk profile. From step 1.5 it is known which options are available with the used colour scheme (red: not possible within corporate framework, orange: competences not available at NRA)
2. Some procurement risks are valid for all procurement strategies. Also, it can be envisaged that a certain procurement strategy might have the lowest risk profile, but still is not chosen due to other reasons (e.g. corporate strategy is not the strategy with the lowest risk profile). In those cases, specific requirements need to be derived that mitigate the risks.

	It is deemed efficient to discuss the first point during a workshop session. The second point can be shortly discussed in a workshop setting but mainly will be a desktop study.
d. Output	The choice for a procurement strategy with a low risk profile, plus specific requirements that mitigate risks.

Step 3.2 – Ensure competences at NRA

a. Objectives	Given the chosen procurement strategy in the previous step, purpose of this step is to explicitly check whether all necessary competences are present at the NRA.
b. Data collection	The following information is analysed: - The procurement strategy from step 3.1 - The list of necessary competences for different strategies as presented in BEST4ROAD4.3 (2017) and the scoring of the presence of the competences at the NRA at step 1.3
c. Method	In step 3.1 a procurement strategy has been derived. From step 1.3 it is known which competences are present at the NRA. Now a final comparison needs to be made between the derived procurement strategy from step 3.1, the necessary competences as identified in [3]/appendix 3 and the presence of the competences at the NRA for the maintenance works at stake from step 1.3. For those competences that are lacking, remediating measures need to be chosen. Detailed recommendations in this regard can be found in BEST4ROAD4.3 (2017).
d. Output	Assurance that the necessary competences are available for the maintenance work or otherwise an action plan to arrange that competences will be in place when the contract commences.

Step 4 – Monitoring and evaluation

It is recommended to evaluate the procurement strategy during the execution of the maintenance work. Possibly risks might be added or removed from to the list of risks as derived in step 2.1 of the risk scan when new information or experiences arise. If still possible within the procurement strategy, remediating measures can be taken during the maintenance work. In fact, this can be seen as an iterative loop in which again the risks are assessed (step 2.1, 2.2), evaluated (step 2.3) and risk mitigation measures (steps 3.1 and 3.2) are identified.

Furthermore, during the workshop it was identified that lessons learned on operational level need to be assembled for evaluation on a higher, strategic level in the organization of NRAs. Therefore, it is recommended to continuously update the checklist in appendix 1 when new risks have been identified. As such, the risks will be also assessed for other maintenance work. In addition, it would be beneficial if NRAs share the emerging list of identified risks with each other, in order to learn from each other's experiences.

4 Conclusion

Following general risk management procedures, the proposed quick scan method can be used to assess risks associated with the procurement of maintenance works while taking into account their situation and corporate procurement framework. The assessment includes risk identification, evaluation and prioritization. For risk identification, a risk checklist has been established.

The most important risks are mitigated by selecting a procurement strategy with a low risk profile, as well as by identifying the need for specific requirements.

As a prime boundary condition for successful maintenance works, in the scan also the necessary competences are identified and compared with existing competences at the NRA. If necessary a specific action plan can be derived in this respect to ensure the presence of these competences.

Furthermore, lessons learned on operational level need to be assembled for evaluation on a higher, strategic level in the organization of NRAs. Therefore, it is recommended to continuously update the risk checklist in appendix 1 when new risks have been identified. As such, the risks will also be assessed for other maintenance work. Also, it would be beneficial if NRAs share the emerging list file with each other, in order to learn from each other's experiences.

References

BEST4ROAD1.1 (2017). Framework for Analysing Maintenance Procurement Practices, BEST4ROAD project, Deliverable no. 1.1, June 2017.

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BEST4ROAD4.3 (2017). Competence Profiles and Transition Processes, BEST4ROAD project, Deliverable no. 4.3, June 2017.

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Appendix 1: Procurement risk checklist

In this appendix, a list of procurement risks is presented. This list has been assembled by making use of the risk identification that was performed in a maintenance procurement workshop (BEST4ROAD, 2016), organised by the BEST4ROAD project team. The list is extended, based on the country information that was gathered within the project (BEST4ROAD, 2016). In the workshop, the general impact of the risk was assessed by the participants. The risks in each sub-chapter below are arranged from high-impact-risk to low-impact-risk. It should however be noted that this is a general order and project specific impact assessment might cause another ranking of the risks.

A1.1 Identified risks for all strategies

Outsourced activities

- No balance between scope, quality of asset information, required performance and handover requirements.
- Area knowledge is not transferred between contractors when the contract is handed over from one contractor to the other.
- Lack of quality in deliverables, which is not detected by principal.
- Competition between contractors, resulting in less value for less money and lower maintenance standards.
- Contractors develop their own knowledge base, resulting in a distribution of knowledge over too many parties.
- Payment not linked to global performance of maintenance (numbers of alarms, reducing costs of annual maintenance, etc.) but only to time expired.
- Reputational risk for NRA when contractors do not deliver the desired quality.
- Risk of cost overruns.
- Arms-length approach and very little flexibility to react to emergency issues (very limited partnership working)
- Weather risks

In-house activities

- Responsibility remains at NRA, but the possibility of delivering results diminishes (e.g. less budget to keep leading innovative techniques)

Performance specifications

- Performance specifications give room for interpretation. For the right interpretation of the specifications, knowledge is necessary.
- Not being able to specify technical criteria to check on realisation of technical design life shortly after completion of the maintenance work.
- Assuring a service life, without actually choosing a contract of the same length.
- Extensive paperwork for both parties, that does not increase road performance.
- NRA is unable to set adequate performance specifications, due to outdated knowledge.
- Performance specifications are hard to measure.

Performance monitoring

- Contract obligations for the contractor are not enforced due to the fact that the NRA or its consultants do not have enough (specific) knowledge to see the contract deviations and/or focus on process tests instead of product tests.
- Inadequate monitoring due to capacity/money limits.
- Structural quality may deteriorate imperceptibly, without visible signs of distress.

Payment mechanism

- Too high minimum payment avoids SMEs to tender.

Contract duration

- Contract duration and maintenance duration do not align.
- Contract duration is shorter than asset life cycle, preventing contractor to invest or be innovative.
- No good arrangements for state of maintenance at the end of the contract duration when the NRA is again responsible for the maintenance

Tender evaluation

- Tenders are evaluated on writing skills instead of content.
- Tender evaluation choices are determined by corporate policy while not being appropriate for the project/situation.

A1.2 Identified risks for strategy B

Outsourced activities

- Lack of communication between various contractors.
- Contractors operate at different times.
- Deep operational knowledge and system integration skills are necessary to make this model work. Either in-house or by engaging a separate managing agent. If this role is not organized costs increase and functionality decreases.
- Extra management costs by contract agency.
- High administrative burden.

In-house activities

- By outsourcing single maintenance tasks separately, increased effort is required to align and coordinate maintenance activities. This may lead to problems if capabilities are not present at the contracting agency.

Performance specifications

- Unclear specification of scope of work and tasks

Performance monitoring

- Frequent monitoring by contract agency is expensive
- Lack of monitoring capacity (staff)

Payment mechanism

— Pricing mechanism may cause undesired behaviour of contractor. Contractor is benefitted by looking at ways to maximise the number of units (e.g. maintenance tasks) being executed.
— High unit prices for those tasks for which the contractor expects additional work.

Contract duration

— Materials en Technics used in short term contracts have no optimal durability.
— The contractor may speculate that certain failures or shortcomings will be revealed surface after the end of the contract.
— Contracts will be more expensive, because contractor is uncertain about future contracts.

Tender evaluation

— A strong focus on (low) price might jeopardize quality
— Not enough knowledge at the NRA to manage this strategy. Because contractors are not challenged to deliver more value than specified. It is the full responsibility of the RA to optimize every new contract based on own knowledge and experience

A1.3 Identified risks for strategy C

Outsourced activities

— Contractor bankruptcy
— Limited possibilities for preventive maintenance

In-house activities

— When the contractor is only obliged to execute certain tasks when a certain condition has been reached, this may affect the life cycle of the asset adversely

Performance specifications

— When the contractor is responsible for providing proof for quality, unclear specifications on how this proof should be delivered may lead to negative consequences for the project.
— The quality standards are set too high in relation to costs and benefits
— Some activities are difficult to specify according to performance specifications, for instance litter control (When are specifications met, and when not?) In some cases, frequencies of such activities must be specified, e.g. one inspection per week, where picking of litter takes place.

Performance monitoring

— When random controls of performance quality in practice become scheduled, an increased risk exist that quality requirements are not fulfilled in between ‘random’ checks.
— Inspections made by incompetent personnel; resulting in 'fake’ compliancy to contract standards
— Faults or shortcomings can remain undetected due to random intervals
— Without appropriate and reliable monitoring tools, the contract cannot be managed in terms of penalties and rewards for the contractor

Payment mechanism

- The contractor loses interest in carrying out maintenance tasks when the costs he has made reach the agreed fixed price
- The payment mechanism can create an incentive to "do the wrong things", i.e. that creates the largest numbers on the bottom line, not necessarily the activities that are needed to be carried out.
- Lump sum will create an incentive "to do as little as possible" and get away with it. Creates a large need for activities on behalf of the NRA to check if work is done according to specs.
- Under-pricing in case of inexperienced contractors and insufficient network data.
- Uncertain but high risk events are not covered.

Contract duration

- Too short contract periods may lead to insufficient time for a contractor to write off investments.
- Too long contracts, the market may be depleted, i.e. no contractors present in the market next time because they operate other places.
- A contractor may be a "prisoner" in a contract which does not generate profit, will try to perform under the requirements, or go bust. If they go bust during the contract, this will cause serious problems on the road until a new contractor is found.

Tender evaluation

- Innovative techniques with benefits outside of the contract specifications are not used.

A1.4 Identified risks for strategy D

Outsourced activities

- Combination of activities is not possible, risk for more hindrance and extra costs.
- With increased size of the contract, consequences of a defaulting contractor will leave a big gap in service provision. There is a high dependency on one service provider for a large part of the infrastructure. Such a gap is not quickly filled (e.g. by a new contracting procedure).
- When the size of a project becomes high or complex, multiple contractors will gather in a consortium. When no clear organisational arrangements are made, complex communication might arise with all the contractors in the consortium.
- Loss of flexibility and inability to react to unforeseen incidents.
- Loss of integration between maintenance, improvement and upgrading.

In-house activities

- Level of technical expertise required to realize these activities may be too high.
- New competences to manage the interface with the contractor on the level of asset management may not be (timely) available.
- Less competent people in the organisation due to lack of direct responsibility and/or connection to the work outside.
- Loss of special knowledge.
- Reversion to former in-house practices is more difficult.

Performance specifications

- No common of generally accepted systems, tools or guidelines for objective appreciation of the performance of the contractor.
- Functional performance criteria cannot be measured directly.
- Inadequate maintenance due to unrealistically high specifications for availability.

Performance monitoring

- Limited access to good condition history related to performance monitoring throughout the contract.
- Inspections made by incompetent personnel resulting in 'fake' compliancy to contract standards.
- Inappropriate KPIs will not challenge the performance of the contractor.

Payment mechanism

- Fixed price in combination with a long term and more integrated contract introduces the risk of loss of quality and default.
- Risk of not being able to define the "cost" if agency has little technical and hands on experience.
- Without regular and consistent capturing and reporting of costs the value for money of the contract cannot be assured.

Contract duration

- Long term contract administration burden due to long term contract.
- Lack of technical knowledge leads to wrong contract or guarantee duration.
- Long term contracts introduce the risk of not being able to introduce new policies.
- Loss of regional network knowledge.
- Contracts are too complex, combined with long contracting period. This increases the difficulty to renegotiate terms.
- Contractors cannot oversee the consequences for taking up long term maintenance contracts due to limited knowledge.

Tender evaluation

- Some aspects of quality, e.g. sustainability, are hard to assess through a quantitative and reliable method.
- Tender evaluation is not aligned with new procurement models.
- Only focusing on price, and neglecting all other important factors.

Appendix 2: Strategy table

The table below is outcome of WP2 of the BEST4ROAD project (BEST4ROAD2.4, 2017).

	Strategy B	**Strategy C**	**Strategy D**
Outsourced activities	*Single maintenance tasks* (e.g. winter maintenance, pavement renewal) are bought from *separate contractors*	*Single and integrated maintenance tasks* (e.g. road patching, grass mowing, winter maintenance) are bought from *separate contractors*	*Single asset management tasks* (e.g. performance monitoring) and *all maintenance tasks* (single or integrated) are bought from *separate contractors*
In-house activities	*All asset management tasks* and *single maintenance tasks* (e.g. performance monitoring, performance prediction, maintenance planning, road patching)	*All asset management tasks* (e.g. performance monitoring, performance prediction, maintenance planning)	*Single asset management tasks* (e.g. maintenance planning)
Contract design	*Discrete contracts, unit based framework contracts*	*Framework and integrated contracts, usually appearance driven*	*Framework contracts for the performance monitoring and integrated contracts for the maintenance tasks*
Performance specification	*Task-related:* resources and activities that a contractor needs to allocate and carry out are specified	*Asset-related:* infrastructure asset conditions (e.g. roughness index) the contractor needs to achieve are specified	*Service-related:* value creation impacts of road assets for users and other stakeholders (e.g. availability) are specified

	Strategy B	Strategy C	Strategy D
Payment mechanism	*Unit price:* unit items of maintenance activities are priced at rate per unit and the actual quantities of maintenance units carried out	*Lump-sum:* fixed price irrespective of the actual cost	*Cost plus incentives:* reimbursement for the costs incurred plus a fee for overhead and profit
Contract duration	*Short-term*: 1-3 years without extension	*Medium-term*: 4-6 years with possible extension	*Long-term*: 7-10 years with possible extension
Tender evaluation	*Price-only*: the tender with the lowest price gets the contract awarded	*Price and quality*: the tender with a minimum quality score and the lowest price gets the contract awarded	*Quality and costs*: the tender with the highest combined non-cost and cost score gets the contract awarded
Performance monitoring	*Direct and frequent*: site inspections on a daily/weekly basis	*Direct but infrequent*: asset inspections on a yearly basis	*Indirect but frequent*: reporting of the contractor on a weekly/monthly basis

Appendix 3: Procurement strategies and summaries

The table below is a shorter version of table 1 from the competences report (BEST4ROAD4.3, 2017). Competences are ranked in order of importance for the strategy at stake.

Procurement Strategy	B (control + separate tasks)	C (control + package of tasks)	D (control + task with separate contractors)
Contractual competences	Ranking: • *Contract coordination skills (1)* • *Monitoring and surveillance skills (2)* • *Quality management skills (3)* • *Safety management skills (4)* • *Understanding contract documents (5)* • *Procurement knowledge (6)* • *Commercial knowledge (7)*	Ranking: • *Monitoring and surveillance skills (1)* • *Procurement knowledge (2)* • *Understanding contract documents (3)* • *Safety management skills (4)* • *Quality management skills (5)* • *Contract coordination skills (6)* • *Commercial knowledge (7)*	Ranking: • *Procurement knowledge (1)* • *Understanding contract documents (2)* • *Commercial knowledge (3)* • *Monitoring and surveillance skills (4)* • *Quality management skills (5)* • *Safety management skills (6)* • *Contract coordination skills (7)*
Relational competences	Ranking: • *Communication skills (1)* • *Stakeholder management skills (2)* • *Negotiation skills (3)* • *Human resource management skills (4)* • *Understanding of roles and responsibilities (5)*	Ranking: • *Communication skills* (1) • *Negotiation skills* (2) • *Understanding of roles and responsibilities* (3) • *Stakeholder management skills (4)* • *Human resource management skills (5)*	Ranking: • *Negotiation skills (1)* • *Stakeholder management skills (2)* • *Understanding of roles and responsibilities (3)* • *Communication skills (4)* • *Human resource management skills (5)*
Technical competences	Ranking: • *Understanding of durations and costs of maintenance activities (1)* • *Maintenance planning and programming skills (2)* • *Understanding of asset condition data (3)* • *Understanding of asset performance and system behaviour (4)* • *Engineering knowledge of unique structures (5)* • *Understanding of technical peculiarities of local networks (6)* • *Understanding of maintenance techniques and technologies (7)*	Ranking: • *Maintenance planning and programming skills (1)* • *Understanding of asset condition data (2)* • *Understanding of asset performance and system behaviour (3)* • *Understanding of durations and costs of maintenance activities (4)* • *Understanding of technical peculiarities of local networks (5)* • *Understanding of maintenance techniques and technologies (6)* • *Engineering knowledge of unique structures (7)*	Ranking: • *Maintenance planning and programming skills (1)* • *Understanding of asset performance and system behaviour (2)* • *Understanding of asset condition data (3)* • *Understanding of durations and costs of maintenance activities (4)* • *Understanding of technical peculiarities of local networks (5)* • *Understanding of maintenance techniques and technologies (6)* • *Engineering knowledge of unique structures (7)*