Next Generation Scenario Expertise

Exploring the challenges and opportunities when dealing with uncertainty in the transport infrastructure sector

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Exploring the challenges and opportunities when dealing with uncertainty in the transport infrastructure sector

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Ray Evans and Jay Livingston
The accomplishment of this report indicates that the end of my MSc study in Engineering & Policy Analysis is approaching. The master thesis is the closing project of the study programme and certainly is a milestone.

I have had the great privilege of doing my master thesis research at RAND Europe, the independent European research institute for policy analysis. It is a unique opportunity to work for such a prestigious organisation and it provided me numerous experiences from which I could learn. The assignment I had was more than just challenging and demanded efforts I had never made before. Anyhow, I chose for the challenge and I am sure that the next time I get a similar opportunity, I will certainly take it.

First of all I would like to thank Odette van de Riet, who had worked for RAND Europe for 13 years and now supervised me on behalf of the faculty of Technology, Policy and Management. She made it possible for me to apply for the internship at RAND Europe for which I am very thankful. I am also very grateful to Gigi van Rhee, a research leader at RAND Europe who accepted me to do the research and also supervised me. They both continuously provided me with incentives to improve my research and the report. Bert Enserink, my second supervisor, and Prof. van Wee have also provided professional feedback and instructions to support my progress. You all have put efforts in the education of a young man… a noble deed!

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Leiden, 3 October 2006

Omid Aazami.
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Summary

Framing the Problem

Introduction
Intensified uncertainty challenges policymaking. The horizon of policy plans often exceeds the forecasting horizon, which calls upon decision-makers to anticipate. Policymaking around transport infrastructures is commonly confronted with this, due to the involved large irreversible investments and lengthy lifecycle of projects.

Since the Second World War, many different approaches to deal with uncertainty have been developed. Scenario analysis is a fundamental approach that is being used by many organisations worldwide and it is done in many different ways. By considering (multiple) plausible futures, policymakers can develop robust policies: policies that result in satisfying outcomes in any of the scenarios. RAND is one of the founding fathers of scenario analysis and still makes endeavours to continue its development.

Recent developments of RAND’s expertise include ‘adaptive policymaking’. The key principle is that flexibility has a value, since changing circumstances demand re-adjustable policies to maintain desirable outcomes. When policymakers maintain options within their policies, those policies can adequately be adapted to circumstantial changes.

Research Goal
RAND Europe\(^1\) (hereafter called RAND) requested to explore whether there is a need for their scenario expertise – which includes adaptive policymaking - among transport policy advisors. This is referred to as the ‘next generation scenario expertise’. They also requested to find out what is required to improve the utilization of that expertise. This is based on the presumption that certain expertises are hardly applied by policy advisors although there is a need for it when making policies for transport infrastructures. This is called ‘underuse’ and is presumed to be particularly present among the expertises for adaptive policymaking.

The resulting central research question is:

“How strong are the needs of transport policy advisors for the next generation scenario expertise when doing studies for infrastructures and how can possible underuse of that expertise be alleviated?”

\(^1\) RAND Europe is the European affiliate of the RAND Corporation in the U.S. It is a not-for-profit research institute that serves the public interest and offers expertise in policy science.
Research Approach
The research is subdivided into five phases. The five phases are each depicted below.

Defining the Next Generation Scenario Expertise
The goal of the first phase was to determine what types of scenario expertises can be offered by RAND to transport policy advisors. This is achieved by two sequential research activities, namely an explorative literature research and a set of two expert sessions.

The explorative literature research was done with a main focus on the various ways by which scenario analyses can be conducted. This resulted in a comprehensive collection of types of expertise that can be applied for policymaking in general. The two expert sessions were done with the aim to determine which of the types of expertise found in the literature research can be offered by RAND. In those sessions the results from the literature research were presented to two experts from RAND, after which they provided feedback to eventually define the ‘next generation scenario expertise’.

This resulted in a framework representing the next generation scenario expertise (see Figure S-1 “Framework representing the Next Generation Scenario Expertise”). The framework has a hierarchic structure which enables to group the scenario expertises in certain categories. The five main categories are: the principal characteristics of the scenarios that are developed, the approach that characterizes the analysis, the scenario results that are presented, the participation in the analysis and options of adaptive policymaking.

![Figure S-1 Framework Representing the Next Generation Scenario Expertise](image-url)
Those categories (also called ‘attribute groups’) are further subdivided into the ‘attributes’ of scenario analysis. Among these attributes, policy advisors can choose between various expertises.

Field Research
The previous phase mainly involved desk research. The next phase is more practice oriented: a field research is done to gather information about how transport policy advisors conduct scenario analyses and why they do it that way. The field research consists of two interview rounds with a set of 12 respondents who were selected on the basis of several criteria: they had to be involved in transport infrastructure related projects in the public sector; the projects needed to be of national scope, involve a long-term horizon and concern a diversity of modalities (rail-, road- and air-transport). Some were involved in scenario studies for specific infrastructure projects such as Mainport Schiphol and the Zuiderzee Line. Others were involved in scenario studies that are done to support policymaking for transport infrastructures. Examples are the Mobility Paper (Nota Mobilitéit) and the Dutch National Model System (Landelijk Model Systeem). The two interview rounds are depicted below:

- Explorative interviews (first round)
  The first round of interviews with policy advisors was carried out to explore what expertises they apply when dealing with uncertainty and what expertises they need. These interviews contained open questions and helped to obtain a broad impression of how transport policy advisors develop scenarios and why they do it that way. It has aided in fine tuning the research and formulating the questions of the second round interviews.

- Pre-structured interviews (second round)
  The second round of interviews was focussed on gathering information about the transport policy advisors’ needs for the next generation scenario expertise. They were also asked which of the expertises they apply in their scenario studies. The interviews were held with the same respondents. One important difference with the first round is that this time the interviews were pre-structured. Closed questions were required to ensure that the respondents were capable of giving unambiguous answers. This was necessary to obtain data that could be used in quantitative analyses afterwards. Open questions were asked about the reasoning behind their answers. Especially when they would say that they perceive a need for certain expertises but do not apply them in their scenario studies, they were asked to explain why.

Analysis of Needs and Practices
The information that resulted from the second round interviews has firstly been used for analysing the needs of the policy advisors. This analysis is done to discover to which extent each expertise within the next generation scenario framework is needed. It basically involved a count per expertise of the number of respondents who said that there is a need for it. This information was transformed into graphs with quantitative scores. The scores provide an indication of which expertises are of interest to policy advisors when they do scenario studies.

The analysis of practices was done in a similar way. This time it concerned the extent to which the expertises of the next generation scenario framework are applied by the policy
advisors. The results of this analysis are necessary for the next step: the comparative analysis, which is done to discover whether certain expertises are underused.

**Comparative Analysis: detecting the underused Expertises**

In the previous phase, especially the analysis of needs is interesting since it provides an impression which expertises are favoured among transport policy advisors. To find out whether ‘underuse’ of the next generation scenario expertise is present, it was necessary to find out whether the policy advisors always apply the expertises they need.

To achieve this, a comparative analysis is done per interviewed policy advisor. The answers about whether the respondent applies a particular expertise and whether he/she needs that same expertise are compared. It is referred to as the comparison of duplicate judgments. A framework is used to determine what each combination of judgments implies (see Table S-1 “Framework for Comparative Analysis”).

**Table S-1 Framework for Comparative Analysis**

<table>
<thead>
<tr>
<th>Categories of Appropriateness</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Needed</td>
</tr>
<tr>
<td>Practices Applied</td>
<td>Appropriate use</td>
</tr>
<tr>
<td>Not Applied</td>
<td>Underuse</td>
</tr>
</tbody>
</table>

There are four combinations of judgments possible, which are called the ‘categories of appropriateness’:

- When not applying an expertise while there is a need for it there is a case of **underuse**.
- When a certain expertise is being applied by the respondent and he/she does perceive a need for that expertise, it belongs to the category called **appropriate use**.
- In case it is being applied while there is no need for it, there is a case of **overuse**. This can for example occur if policy advisors have to use expertises due to enforced procedures for policy studies, while they prefer not to use them.
- When expertises are not applied and there is no need for them, they belong to the category **appropriate non-use**.

At first it was determined in which category each expertise belongs according to each respondent. This was counted to discover how often each expertise ends up in each category. As such it was discovered which expertises are strongly underused.

**Review of strongly underused Expertises and relating Causes**

In this phase two partial results of the research are linked to each other: the strongly underused expertises and the relating causes according to the respondents. The first partial result is derived from the comparative analysis. The second is retrieved from the second
round interviews. In case the respondents indicated during the interviews that they did not apply certain expertises whereas they expressed a need for them, they were asked to explain what the reasons are. All mentioned reasons are reviewed which resulted in a list containing the main causes of underuse.

The strongly underused expertises and the relating main causes were presented to the RAND experts who also have been engaged in the earlier expert sessions of this research. This time they are engaged in reflecting on the two mentioned partial results. This session helped to draw conclusions and to formulate the final recommendations. The ultimate aim was to define how RAND can anticipate on the main causes of underuse of the next generation scenario expertise.

Main Results
The main results stem from the analysis of needs, the comparative analysis and the identified causes of underuse.

Results from the Analysis of Needs
The analysis of needs provided indicative results that concern the needs of transport policy advisors when they apply scenario expertises for infrastructure studies.

Concerning the principal characteristics of the scenarios they develop the analysis revealed that:

- There is a relative strong need for scenarios that are related to specific policy problems. Scenarios that are more generic are not sufficient for them. Most of the respondents need expertises to develop policy scenarios rather than developing scenarios about the policy environment. The time perspective is preferred to be discrete, (with either single or multiple points of time). With their studies they explore possible future states of the world, rather than determining goals and analysing how those can be achieved.

They sometimes desire to do content focussed analyses and sometimes rather focus on the process of the analysis:

- A content focussed approach is needed when developing or evaluating policies. Such studies often done in combination with cost-benefit analyses which are content-rich studies.

- The objectives to achieve consensus or to broaden the mindset are favoured among the respondents, which requires a more process focussed approach. Especially consensus is perceived as something important within the policymaking process.

Concerning the results of the scenario studies:

- Both a discrete and a continuous outlook are needed. This means that scenarios must describe discrete future states of the world and must contain continuous ranges in which uncertain factors can vary. A continuous outlook illustrates that the future is variable and avoids making plans on point estimates.
Concerning the format of the results, quantitative data is needed which is probably also related to the fact that their scenarios are often combined in cost-benefit analyses. Anyhow, this must be supplemented by qualitative information about the scenarios, to avoid ‘fixation’ on numbers.

About the participation the following can be concluded:

- All types of participants (i.e. analysts, experts, stakeholders and the problem owner) must get involved in scenario studies. They most favourably get involved by means of workshops and group sessions.

The needs for adaptive policymaking are neither high nor low. There are no great differences between any of the expertises that belong to this category. Sometimes it depends on the policy cases whether there is a need for certain ways of making adaptive policies. When sets of policy alternatives are available to achieve high level policy goals, the option to diversify is of interest to policy advisors. An example of such a goal is ‘to reduce the average travel time per citizen’. The need for that expertise is less strong when the policy study is focussed on small scale transport bottlenecks (which provide fewer alternatives). The option to phase is interesting for studies that are applied for specific transport infrastructures. For broader studies (such as analysing the transport segment of the Welfare and Environment Study) it is not relevant.

Results from the Comparative Analysis

There are seven expertises that are underused according to more than a quarter of the respondents. These are considered as ‘strongly underused’. The first four that are described below belong to adaptive policymaking.

- The option to phase

  By phasing an infrastructure project, it becomes possible to adjust the scale and the construction of the infrastructure if it seems necessary. This enables to fine tune the capacity of that infrastructure to the demands for transport. The option to phase is regarded as an underused expertise by 2/5th of the respondents.

- The option to switch

  The option to switch from one mode of transport to another - during or after the project – makes the policy robust against uncertainty. Although it may require efforts to design an infrastructure in such a way that switching is possible, the value of that option makes it worth to be considered. It is underused according to 1/3rd of the interviewed policy advisors.

- The option to grow

  Another way of making robust policies is by integrating the option to grow. Having the possibility to expand the transport infrastructure at any time reduces the vulnerability for uncertainties. Taking into account the option to grow in policy plans is underused according to 1/3rd of the interviewed policy advisors. They strongly expressed underuse of a quantitative approach for assessing growth options.
Signposting (with trigger values)

To enable adaptive policymaking it is important to pay attention to signposting. In a quantitative approach it involves the assignment of trigger values to factors that are uncertain and relevant (e.g. the oil price). In case such a factor exceeds a trigger value, policymakers are warned that their policy must be adjusted. Integrating signposting in the policy is an underused expertise as follows from the comparative analysis: almost 2/5th of the respondents explained that it is not done whereas it is needed.

Continuous time perspective

Generally, the interviewed policy advisors develop scenarios with a discrete time perspective. Meanwhile there seems to be a stronger need for a continuous time perspective. One third of them said it is underused. Several of them mentioned that a multiple discrete time perspective would also suffice. A continuous time perspective (or a multiple discrete time perspective) is necessary to develop adaptive policies.

Continuous scenario outlook

Scenarios in general describe few discrete future states of the world. The pitfall of a discrete outlook is that users of those scenarios tend fix their expectations on point estimates. For that reason a quarter of the respondents said that it would be better if scenarios have a continuous outlook.

Using scenario analyses to achieve consensus

Achieving consensus is more and more acknowledged as something important within the policymaking process but it is not always aimed for. This counts at least for that part of the policymaking process when scenario analyses are done, according to one third of the policy advisors.

The comparative analysis also revealed that underuse is indeed present among the expertises that belong to adaptive policymaking. Four out of seven of the expertises mentioned above belong to adaptive policymaking. Besides, all expertises belonging to adaptive policymaking are somewhat underused. The results of this analysis are not as affirmative as would have been in a statistical research due to the few respondents that have been interviewed, but it roughly indicates that underuse is present among expertises for adaptive policymaking in transport infrastructure policy studies.

Main Causes of Underuse

During the interviews, the policy advisors were also asked to indicate the reasons why expertises are underused. All those arguments were clustered, which resulted in four main causes of underuse of the next generation scenario expertise:

- Ignorance

Ignorance is the case when policy advisors are not (yet) aware of the expertise and its advantages. Would they have been familiar with it, they would most probably have applied it in their transport infrastructure studies.

Not many policy advisors are aware of the feasibility to incorporate the option to switch in infrastructures, let alone the advantages it can bring along.
Novelty

The second cause of underuse is called ‘novelty’. This arises when it is generally acknowledged that certain expertises must be applied, but its application in practice develops slowly.

Analysing the options to delay and to phase are acknowledged expertises to deal with uncertainty according to the research programme on the economic effects of infrastructures (OEEI). Underuse of the option to phase can be explained by the fact that its application for infrastructure projects is slowly and gradually being adopted.

Redundancy

Redundancy is the case when a certain expertise fulfils specific demands that can also be fulfilled by an alternative method. Many respondents mentioned that achieving consensus in the policymaking process is an important issue to create support for any proposed policy. At the Ministry of Transport ‘network analyses’ are done, involving stakeholders in a process to achieve consensus in the stage of analysing the policy problem.

Political barriers

Political barriers are mentioned various times by the respondents. They explained that the way they do policy studies has to comply with interests of higher level policymakers. Serving those interests sometimes goes at cost of adequately dealing with uncertainty since expertises are not applied whereas they should be. When interests of policymakers affect the way the way scenario studies are done we can say that political barriers cause underuse of expertises. Underuse due to political barriers occurs when policymakers strive for:

- Straightforward policies: policy plans need to be as straightforward as possible when proposed to politicians, since ambiguous policies are less likely to gain support. When an ambiguous policy is proposed to policymakers, they do not know what they can expect from it. This implies that they are not likely to accept the policy. Adaptive policymaking can lead to a policy with many ‘open ends’, which is not straightforward. Consequently, adaptive policymaking is underused even though policy advisors think it is an appropriate way to deal with uncertainty.

- Simple policies: a policy plan that appears very complex and contains numerous considerations is also not likely to gain support. Therefore, policies are kept as simple as possible. This implies that the attention that is paid to complex aspects such as uncertainty often fall short. A continuous time perspective is hardly considered in scenario studies since policies that are based on those scenarios will include multiple calculations. Also a continuous outlook is not applied in scenarios because it makes it complex to build policies on them. For the same reason, policy studies do not focus sufficiently on adaptive policymaking.

- Low transaction costs: the objective to keep transaction costs low restricts policy advisors to acquire expertise with which they are not yet familiar. Although they realize that applying the expertise will improve their policies, they do not acquire it because it involves great efforts to familiarize with it. This is an issue which
concerns any type of expertise, but mostly adaptive policymaking since that is applied by less than half of the respondents so far.

- Deterministic policies: policymakers often desire to implement deterministic policy plans to avoid possible adjustments in the future. Keeping open the option to exit implies that at later stages the policy may be cancelled. The actual reason why such adjustments are avoided by policymakers goes beyond this research, but it is a common topic of discussion. Applying the expertises to phase-, switch- and grow is in conflict with the objective of deterministic policies which explains their underuse.

- Maintain control: the objective to keep control over the policymaking process may not be achieved when a policy plan leaves much room for adjustment. If adjustments of a policy remain possible over a long period (which is the case with adaptive policies), parties other than the policymaking institute will try to have a say in the way that that policy has to be adjusted. They will have more opportunities to issue their interests, which threatens the controlling power of the policymaking institute.

- Prompt decision-making: despite the fact that the application of certain expertises is advantageous for policies, policymakers may not desire them if it could delay the decision-making process. The objective to achieve consensus seems to be in conflict with the objective for prompt decision-making. Several respondents mentioned that using scenario analyses to ‘achieve consensus’ is underused by explaining that it would improve policymaking but it can also delay the decision-making process.

**Conclusions and Recommendations**

**Main Conclusions**

The first conclusion from this research is that underuse is indeed present among expertises that enable adaptive policymaking. There are also other expertises that are considerably underused, which has to do with the fact that they complicate the interpretation and use of scenarios. This concerns the expertises to create a continuous time perspective and a continuous outlook in scenarios.

There are various causes of underuse, but the most frequently raised causes are related to political barriers that hinder policy advisors to apply needed expertises. The political barriers introduce great challenges to improve the utilization of the next generation scenario expertise. Since those barriers seem typical to policymaking for transport infrastructures, they are likely to remain present.

**Recommendations**

First of all several recommendations for specific expertises are given. This is followed by general recommendations concerning all expertises and adaptive policymaking respectively. The specific recommendations are:

- To overcome ignorance of the option to switch, include practical examples of that have proven to be technically feasible.

- In the examples, include the potential benefits of incorporating the option to switch (e.g. between different transport modalities on one infrastructure). This can trigger the acknowledgement that adopting that expertise can improve the robustness of policies.
- Continue to offer the expertise for analysing the option to phase since it is well possible that it will be applied more frequently in the future. Be aware of the political barriers that are present. Especially the desire to develop simple, straightforward and deterministic policies discourages the application of the option to phase.
- It can be useful to figure out what exactly network analyses are used for by the Ministry of Transport, in which stage of the policymaking process it is applied and whether scenario analysis can play a role in that stage too.

Concerning any scenario expertise that is offered to policy advisors:
- To respect the desire to keep transaction costs low, use quantitative analysis to demonstrate whether it is beneficial to apply them when offering any of the expertises.
- Also support examples of option analyses with similar quantitative information.

With special regard to adaptive policymaking:
- Provide clear-cut case examples from practice of fictitious, demonstrating the potential benefits from adaptive policymaking.
- Be moderate in offering multiple option analyses at the same time. Multiple use of option expertises makes the total analysis too complex.
- Keep adaptive policies as simple as possible. They must be easily understandable.
- Apply a multiple discrete time perspective for adaptive policies with few time points only to avoid complex scenarios with a continuous time perspective.
- When using a discrete outlook of the scenarios, keep stressing on the pitfalls of fixing one’s view on point estimates.

With special regard to the options to phase, grow and switch it is recommended to:
- Include few decision options at a time instead of vast decision trees with multiple paths.
- Support each decision option with quantitative information to avoid ambiguity in the policy.

**General Conclusions from the Research**
In addition to the main conclusions, some general conclusions can be drawn from this research. Some conclusions lead to recommendations for further research, which is indicated with an arrow (➢).
- The way transport policy advisors develop scenarios is strongly affected by the interests of their higher level policymakers. If this was not the case, underuse of expertises would have been present to a lesser extent.
- Policymakers are increasingly aware of the challenges of dealing with uncertainty. Many of them struggle to discover what the best ways are to adequately deal with it. They gradually acknowledge that a learning attitude is essential to avoid pitfalls.
- Adaptive policymaking seems more common in the private sector than in the public sector. This can be related to the fact that economic incentives stimulate decision-makers of private companies to continuously look for ‘best practices’ when facing uncertainty. This leads to a recommendation for further research:
  - Investigate whether adaptive policymaking is also underused in the private sector and whether political barriers are less intensively present. In there are no barriers restraining the application of adaptive policies, it can be useful to offer the expertise in that sector. This recommendation obviously only applies when RAND desires to offer their services to private companies.

- Local governments desire more flexibility in policies than the national government. Due to their direct relationship with investors (e.g. in real estate), they have more interests in keeping their policies flexible. By fitting in the plans of such investors in their own policy plans, they benefit from economic and social contributions from those investors. This requires their policies to be flexible and may imply that they have interests in expertises for adaptive policymaking. This can be investigated:
  - Investigate whether local governments indeed have stronger needs for expertises to make adaptive policies than the national government. If the national policies do not hinder the local governments from making adaptive policies, it is recommended to offer them the next generation scenario expertise.

- The last recommendation for further investigation is related to the domain to which this research has been done. This research was focussed on transport infrastructure policymaking, but maybe there are other public domains where similar challenges are faced due to intensive uncertainties.
  - Investigate within the public energy and spatial planning domains whether there is a need for the next generation scenario expertise and whether underuse is present. This research may also be useful to verify whether the political barriers are inherent to policymaking in any sector.
Uncertainties increasingly challenge the success of policymaking, it shapes the complex landscape of policymakers. While faced with numerous unknowns, they are responsible for developing policies that serve the public interest. On top of this it is often remarked that the pace of change is even accelerating (Ringland 1999 and Pearson 2004).

It becomes especially problematic when policies are developed for long terms, when their success is sensitive to exogenous factors and when they involve irreversible capital intensive decisions. Gilbert (2004) says that “decisions are especially challenging when they involve the commitment of large quantities of assets to a particular course of action that is not easy to reverse ex post. Getting them wrong can be very expensive”. Such conditions are inherent to many large scale transport infrastructure projects. The success of large scale transport infrastructures is sensitive to many risks.

RAND Europe\(^2\) (hereafter called ‘RAND’) has thorough expertise in scenario analysis to serve clients who face suchlike challenges. They issued to do a research to the challenges and opportunities of their particular scenario expertise. An agreement between RAND and the faculty of Technology, Policy and Management (Delft University of Technology) has been made to accommodate this research project as a Master Thesis assignment.\(^3\) Within this faculty, the section of Transport Policy and Logistics Organisation (TLO)\(^4\) takes responsibility of assessing the Master Thesis.

The first paragraph of this chapter is dedicated to the background of the research problem (1.1), which is followed by the formulation of the problem (1.2). Next, the research goal is defined (1.3) after which the scope of the research is determined (1.4). The research questions are formulated in the next paragraph (1.5). Before the research can be initiated it is important to define the main assumptions that are made (1.6). A report outline is presented in the last paragraph of this chapter (1.7).

\(^2\) RAND Europe is the European affiliate of the RAND Corporation in the U.S. It is a not-for-profit research institute that serves the public interest and offers expertise in policy science.

\(^3\) The faculty of Technology, Policy and Management intends to make a significant contribution to sustainable solutions for complex social problems through internationally oriented education and research (Source: www.tbm.tudelft.nl).

\(^4\) The Transport Policy and Logistics Organisation section focuses, both in education and research, on traffic-, transport-, and infrastructure problems from a techno-policy perspective (Source: www.tbm.tudelft.nl).
1.1 Background of the Problem

Uncertainty Prevails
Ratcliffe (2000) says that “the future will always be unpredictable, but it has been shown that by adopting the right approach and by using appropriate techniques it can be imagined, planned for and managed”. In other words, uncertainty does intensify the complexity of decision-making and it must be dealt with in a structured way. By means of a structured approach, uncertainty can be classified, actors can communicate about it more easily and evidence-based decisions can be made.

In response to this need, many different approaches to deal with uncertainty have been developed. A common objective among policymakers when dealing with uncertainty is to develop ‘robust policies’, which stands for policies that will perform well in any plausible future.

To develop such robust policies it is inevitable to think in terms of ‘scenarios’, i.e. plausible, consistent and distinctive future states of the world. This concept has its origins in the 1950s, when the RAND Corporation developed scenario analysis for military purposes. Within a few decades General Electric and Shell also adopted it for their strategy developments, after which it became a very common approach for any kind of problem owner. Because of its wide adoption, numerous ways have evolved by which it is being applied. Users refer to ‘scenario development’ to describe a variety of different methods and practices (Millett 2003).

Shifting Towards the Paradigm of Adaptive Policymaking
Although scenario analysis has been developed more than half a century ago, it is still proven to be very functional. On the other hand, claims are made that robust policies do not suffice anymore: “in view of the unpredictable and rapidly changing world it is too great a challenge to identify robust policies” (Walker 2000). The definition of robust policies in this context stands for fixed static policies that will perform well against all plausible futures. Walker (2000) also mentions that “the plausible scenarios of the future are most likely to be so diverse, that one fixed static policy will not suffice”. Therefore it becomes more and more important to develop adaptive policies. We need a structured process to monitor the environment, gather information, incrementally implement the policy and continuously adjust it to the circumstantial developments. By doing that, changes in the policy are acknowledged as a matter of principle (Walker et al., 2003). The growing complexity of our society calls for this new paradigm of adaptive policymaking.

Expertise to deal with Uncertainty is Advancing
The basic idea behind adaptive policies is that flexibility has a value. Maintaining the right to choose between policy alternatives at any time is more likely to yield favourable outcomes than a fixed static policy (a policy that does not allow for any changes). Various methods have been developed that enable adaptive policymaking and are used in both the public and private sector. Those methods are developed with the aim to make ‘no-regret moves’ even though necessary information about the future is incomplete and large irreversible investments are involved.
RAND has extensive know-how in scenario analyses including adaptive policymaking. Their expertise is referred to as the ‘next generation scenario expertise’.\(^5\)

**Although advanced, Expertise to deal with Uncertainty seems underused**

Although advanced expertise to deal with uncertainty is available to policymakers, they do not apply it to the full extent. Stephen Millett (2003) says that corporate and institutional managers still do not get the full return on investment when applying scenario techniques. When expertise can add value to policymaking but still is not applied, there is a case of underuse. Especially the advanced expertises for adaptive policymaking seem not to be frequently used, since present policies hardly leave much room for adjustments. In case of significant circumstantial changes that would invalidate the success of an implemented policy, adjustments are made on an ad-hoc basis. In other words, those adjustments are not based on systematic policymaking. Based on this reasoning, we can assume that especially adaptive policymaking is underused.

This means that policymaking under uncertainty can potentially be improved. Meanwhile it also implies that there are causes that restrain policymakers to utilize that expertise. Those causes must be identified before the utilization of expertise to systematically deal with uncertainty can be improved.

### 1.2 Problem Formulation

The background described above leads to a formulation of problem:

While transport policymakers are increasingly challenged by uncertainties, they do not make adequate use of available expertise to deal with it systematically. The reasons for this so-called ‘underuse’ are yet unknown.

It is expected that expertise for adaptive policymaking is especially underused among transport policy advisors when they do studies for infrastructures.

### 1.3 Research Goal

RAND offers their expertise to serve the public interest. As such, it is important that their services meet the demands of policy clients. Since their expertise seems to be underused, they issued to investigate whether and how the utilization of their scenario expertise can be improved.

The main goal of this research is “…to explore whether there is a need for the next generation scenario expertise among transport policy advisors and to find out what is required to improve its utilization, assuming that underuse is present”.

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\(^5\) The definition of ‘next generation scenario expertise’ is elaborated extensively in Chapter 3 “Next Generation Scenario Expertise: an answer to various Types of Uncertainty”
The main goal entails the realization of the following six sub-goals:

- To determine what the next generation scenario expertise comprises;
- To explore the extent to which the next generation scenario expertise is needed by transport policy advisors;
- To explore the extent to which the next generation scenario expertise is applied by them;
- To find out whether the scenario expertise is underused;
- To identify the causes of that underuse;
- To formulate recommendations by which those causes can be alleviated.

1.4 Research Scope

There are several factors that determine the scope of this research. Dealing with uncertainty can be an issue for any policymaker, but this research focuses on the transport sector specifically (1.4.1). To get a balanced view of how uncertainty is dealt with in the transport sector, it is important to take various transport modalities into account (1.4.2). Within the transport sector, the research is focussed on infrastructure-related policy problems since that often involve high levels of uncertainty (1.4.3). Public organizations play a key role when it comes to carrying such risks, which means that the scope can be narrowed down to the public domain (1.4.4). Since it regards high levels of uncertainty, the policy problems that are central to this research concern the national level (1.4.5) and have a long-term time horizon (1.4.6). The last aspect is the type of uncertainty. Uncertainty has a broad meaning but this research is applicable to certain conditions in which uncertainty prevails (1.4.6).

1.4.1 Transport Sector

This research could be applied to any sector where uncertainty plays a significant role in decision-making. Since RAND has extensive experience with research in the transport sector, they prioritised to apply this research to transport policymaking.

1.4.2 Variety of Modalities

To obtain a response that ‘cross-cuts’ the transport infrastructure sector it is important to look at projects in various domains: both passenger- and freight transport projects have to be considered, as well as different transport modalities. The different transport modalities that are possible to consider are road-, rail-, and air- transport as well as transport over water. Choosing for a variety of modalities also has the disadvantage that the study results can not be claimed to concern a specific modality (e.g. road transport). To discover whether there is a need for the expertise among road transport policy advisors it is required to do an investigation completely focussed on that sector.

1.4.3 Infrastructure-related Policy Problems

Infrastructure projects often involve large ‘sunk costs’, i.e. investments that are irreversible. In such cases it is particularly important to pay attention to the involved uncertainties. The transport policy problems that are of interest for this research are related to infrastructures.
The research is not an assessment of specific infrastructure projects, but rather an exploration of the policymaking practices around infrastructure projects.

1.4.4 Public Domain
The government plays a key role in taking up risks when large scale projects are undertaken for the public interest. Different public organisations are charged with scenario- and risk analyses for transport infrastructure projects. Hence, the research focuses on the public domain.

1.4.5 National Level Policymaking
Assuming that the larger the scale of an infrastructure project, the greater the involved uncertainties are, the policy problems that will be taken under study are of national concern.

1.4.6 Long-term Time Horizon
There is a distinction between different time horizons on which policies can be based. People often speak of short-term, medium-term and long-term (Centraal Planbureau n.d.). The Netherlands Bureau for Economic Policy Analysis (hereafter called ‘CPB’) defines ‘short-term’ as a period of one to two years. They produce short-term prognoses on a quarterly basis. The definition ‘medium-term’ is used for prognoses with an outlook of four to five years, which is related to the governmental cycle. The ‘long-term’ prognoses concern an outlook of 20 to 40 years, or even longer. The CPB conducts scenario studies for medium- and long-term time horizons. Their scenarios are widely used by governmental institutes in the Netherlands and abroad.

Policies with long-term horizons suit the scope of this research. Especially in those conditions it is likely that decisions have to be made based on inconclusive evidence.

1.4.7 Type of Uncertainty
The theoretical basis on which the research embarks is that the success of policymaking is profoundly affected by exogenous factors from economical, technological, political, social and environmental nature (Walker et al. 2003). Since the behaviour of such factors can never be predicted with full confidence, uncertainty is defined as “any departure from the unachievable ideal of complete determinism” (Walker et al. 2003). This illustrates how broad the meaning of the word ‘uncertainty’ is. There are two pre-conditions that help to further determine the type of uncertainty that is relevant to this research. The first is that policymaking is faced with uncertainty in such a way that decisions have to be made based on “inconclusive evidence” (Funtowicz and Ravetz 1990). The second is that policymakers sometimes have to make decisions that are irreversible, i.e. investments or other efforts can not be ‘refunded’ if the policy turns out differently than prospected. Both pre-conditions are common when long-term policies are made for transport infrastructures. The transport infrastructure cases that will be looked at in this research need to meet these pre-conditions.

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6 Centraal Planbureau (CPB)
1.5 **Research Questions**

Based on the theoretical background, problem formulation, research goal and scope, the central research question is formulated (1.5.1). There are five partial research questions that contribute to answering the central question (1.5.2).

1.5.1 **Central Question**

The central question of this research is:

“How strong are the needs of transport policy advisors for the next generation scenario expertise when doing studies for infrastructures and how can possible underuse of that expertise be alleviated?”

It is not the objective to look at different scientific methods than can be applied when carrying out scenario analyses. The research is rather focused on particular expertises that can be applied when using scenario analysis for transport policy studies. The term ‘expertise’ refers to skills and/or knowledge in a particular area.7

1.5.2 **Partial Research Questions**

The first requirement to answer the central research question is to find out which types of expertise belong to the ‘next generation scenario expertise’. The first partial research question is:

1. "What types of expertise belong to the next generation scenario expertise?"

From this point onwards, the terms ‘types of expertise’ and ‘expertises’ are used to refer to those that are identified for the first partial research question.

The second step is to investigate the needs of transport policy advisors for the next generation scenario expertise:

2. "Which expertises are strongly needed by transport policy advisors?"

This results in an answer to the first part of the central research question. The second part of the central question concerns the issue of ‘underuse’: in case a certain type of expertise is needed by many policy advisors but they do not apply it in their scenario analyses, we can say that that expertise is ‘underused’. To discover whether certain expertises are significantly underused we need to know to which extent the expertises are applied by

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policy advisors (sub-question ‘3a’) and which expertises are not applied while they are needed (sub-question ‘3b’):

3

“Which expertises are significantly underused by transport policy advisors?”
   a. Which expertises are applied in practice by transport policy advisors?
   b. Which expertises are simultaneously needed and not applied by transport policy advisors?

The next step is to identify the main causes of the underuse:

4

“What are the main causes of underuse?”
   a. “What are the reasons for not applying expertises while there is a need for them?”
   b. “What patterns can be found in those reasons?”

Identifying the main causes of underuse enables to determine what can be done to improve the utilization of the next generation scenario expertise. This concerns those particular expertises that are significantly underused. The last partial research question depicts the actions that are to be taken to alleviate the potential underuse:

5

“What can be done to improve the utilization of the significantly underused expertises?”

1.6  Assumptions

This research is based on several assumptions. The assumptions are listed below:

1. Policymakers are confronted with intensive uncertainty.
2. This uncertainty increases over time.
3. Uncertainty boosts the complexity of policymaking.
4. Appropriate utilization of expertise to deal with uncertainty leads to more effective policies.
5. The larger the investment is for which a decision has to be made, the more important it is to systematically deal with uncertainty.
6. The longer the time horizon of a policy, the greater the uncertainty under which the involved decisions are made.
7. Adaptive policies are more efficient when the uncertainties are intensive.
1.7 **Report Outline**

The report is sub-divided in seven chapters. The first chapter has been dedicated to the introduction to the problem and the motivation of the research. The contents of the remaining chapters are briefly described below:

- **Chapter 2 “Research Approach”** describes how the research is organized. In the chapter, the partial research questions are linked to research activities and the partial products of those activities.

- **Chapter 3 “Next Generation Scenario Expertise: an Answer to various Types of Uncertainty”** is first of all dedicated to typologies of uncertainty and how it should be dealt with. The second part of the chapter is dedicated to defining the next generation scenario expertise (the first partial research question).

- **Chapter 4 “The Needs for the Next Generation Scenario Expertise”** presents the results from investigating the extent to which the next generation scenario expertise is needed by transport policy advisors (the second partial research question).

- **Chapter 5 “Detecting the Underused Expertises”** contains some results from analysing the extent to which expertises are applied by policy advisors and presents the extent to which expertises are underused (the third partial research question).

- **Chapter 6 “Main Causes of Underuse”** contains the formulation of the causes of underuse (the fourth partial research question).

- **Chapter 7 “Conclusions & Recommendations”** contains two milestones of this research. At first the conclusions and lessons that can be drawn from this research are described. Second, it contains the recommendations through which the utilization of the next generation scenario expertise can potentially be improved (the fifth partial research question).
This chapter describes how the research is organized. The main research activities and their outputs are linked to each other in such a way that the research objective can be achieved.

At first, a thorough literature research is done on policymaking under uncertainty, scenario analysis, transport infrastructure studies and any associated topic (2.1). Next, several expert sessions with (former) RAND analysts are held about RAND’s particular expertise in scenario analysis (2.2). The following step comprises two interview rounds that are held with a selected group of transport policy advisors. The main theme of both interview rounds is ‘applying scenario analysis to transport infrastructure related policy studies’. The first interview round is explorative and consists completely of open questions, to provide the respondents freedom in the way they give answers. The results are used to formulate the questions of the second round of interviews. Those interviews are pre-structured, containing both closed questions and open questions. The closed questions are intended to obtain quantifiable data and the open questions to obtain descriptive arguments that support their answers (2.3).

The next research activity is to analyse the gathered data of the second round interviews. The answers to the closed questions are used for three analyses. The first concerns the policy advisors’ needs when they conduct scenario analyses. The second concerns their ‘practices’, i.e. the expertises they apply in practice. Both are discussed in paragraph 2.4. After that, the same information that is retrieved from the closed questions is used to do a comparative analysis: examining the extent to which the transport policy advisors’ practices correspond to their needs. The aim is to find out which expertises offered by RAND are being underused, i.e. they are not applied while the policy advisors do perceive a need for it (2.5). The following research activity is to link the underused expertise types to the arguments that are given by the respondents during the interviews. Those arguments are given as answers to the open questions of the second round interviews. A review of the arguments is done to define the main causes of underuse and to link that to the expertises that are concerned (2.6). After all these activities, the main conclusions can be drawn and with the help of a final expert session the recommendations can be formulated focussing on how the causes of underuse can be alleviated (2.6).

The research activities, the relating products and how all are inter-related, is illustrated in the figure on the next page (Fig 1-1 “Research Design”).
Figure 1-1 Research Design

Symbols:

( ) = research activity, including reference to paragraph where the activity is elaborated
[ ] = product of research activity

Exploitative Literature Research (G.1)

Collection of types of expertise

RAND Expert Sessions (G.2)

The next generation scenario expertise

Exploitative interviews first round (G.3-1)

Impressions of how transport policy advisors conduct scenario analyses

Prestructured interviews second round (G.3.2)

Closed questions

Open questions

Gathered data about "needs" (G.4.1)

Data analysis concerning "needs" (G.4.1)

Extent to which transport policy advisors need the next generation scenario expertise

Comparative analysis of "needs" and "practices" (G.5.1)

Extent to which the expertises are underserved

Review of strongly underserved expertises and relating causes (G.5)

Gathered data about "practices" (G.4.2)

Data analysis concerning "practices" (G.4.2)

Extent to which transport policy advisors apply the next generation scenario expertise

Session with RAND experts (G.7)

Recommendations

Causes of underserved expertises

Barriers causing underserved expertises (G.6)
2.1 Explorative Literature Research

Since scenario analysis has its origins in the 1950s, one can imagine that many variants have been developed in due time. Initially it was used for military purposes but since the 1970s, companies in different industries started to use it too. The way organizations carry out scenario analyses varies enormously.

An explorative literature research helps to get a comprehensive insight in the many ways by which scenario analyses can be conducted. Many books and articles are dedicated to this topic. The writers are often experts who have extensive experience in this field. They have either done research to scenario analysis, or they have carried out scenario analyses themselves as a service for organizations. Such services can be done for different types of organizations: public/private, large/small, profit/non-profit, etc. It is important that the literature research encompasses a wide variety of expertise in scenario analysis.

Output of Explorative Literature Research

The explorative literature research results in a collection of types of expertise that can be applied when conducting a scenario analysis. This collected information is a starting point to work towards the definition of the ‘next generation scenario expertise’.

2.2 Expert Sessions

The explorative literature research concerns scenario expertise in general. Since it is the aim to determine RAND’s particular scenario expertise, a pair of sessions is held with two RAND experts. They have extensive experience in conducting scenario analyses and are experts in the field of adaptive policymaking. The literature-based information about scenario expertise is the ‘raw material’ that is used during the sessions. It is presented to the two experts, after which they reflect on it and add complementary insights. Their complementary insights are important since some expertise may not be discovered through the literature research, whereas RAND does possess it.

The ultimate goal of the sessions is to combine the literature input with the experts’ input, which together evolves into the definition of the ‘next generation scenario expertise’. The two experts are listed in Appendix A, sub-heading “RAND Experts in Scenario Analysis and Adaptive Policies”.

Output of Expert Sessions

The output is a collection of expertises that can be applied when doing scenario studies and that belong to the services RAND can offer.

2.3 Interviews

Two interview rounds are held with transport policy advisors who have been involved in scenario analyses for infrastructure related studies. The first round of interviews is explorative and consists of open questions (2.3.1). The second round of interviews is aimed to gather data, which for the greater part is to be used for quantitative analyses (2.3.2).

Before the interviews are held, it is determined who has to be interviewed and what the topics of the interviews are. How the target group of respondents is determined is
described in paragraph 2.3.3. These respondents are required to be involved in transport infrastructure-related studies, for which scenario analyses are done to cope with the uncertainties. How those studies are selected is described in sub-paragraph 2.3.4, which also includes a description of each study.

The list of respondents that are interviewed can be found in Appendix A “Respondents”.

2.3.1 **Explorative Interviews (first round)**
The first round of interviews is explorative and consists of open questions. The interviewed transport policy advisors are asked about policymaking under uncertainty and more specifically, about how they conduct scenario analyses for infrastructure studies. Since the questions are open, the response contains a broad spectrum of the policy advisor’s experiences and views. The responses obtained from the explorative interviews are used to formulate the questions of the second round interviews. It is important that a lot of attention is paid to formulating those questions, in order to acquire useful information for all remaining research activities.

**Output of Explorative Interviews**
The experiences shared by the respondents contribute to a broad impression of how scenario analyses are conducted in practice. It also provides an impression of why they do it that way: what do they find important when conducting scenario analyses for transport infrastructure studies?

2.3.2 **Pre-structured Interviews (second round)**
The second round interviews are pre-structured, with the intention to gather data that can be used for quantitative analyses. The questions concern what expertises are needed by transport policy advisors when conducting scenario analyses. Similarly, the transport policy advisors are asked about what expertises they apply in their scenario analyses. The discussed expertises are those that are in the framework resulting from the literature research and the RAND expert sessions.

The main difference with the first round is that the second round questions are completely focussed on the next generation scenario expertise. Another difference is that the interviews are more structured.

**Output of Second Round Interviews**
In the second round interviews, closed questions are asked to retrieve quantifiable data about which expertises are needed by transport policy advisors. This results in a collection of data about their needs. The same kind of questions are asked about which expertises are applied, which results in a collection of data about their so-called practices. In addition to the closed questions, open questions are asked to obtain arguments that support their answers. The arguments concern two aspects: why they perceive a need for certain expertises; and if applicable, why certain expertises are underused according to them.

2.3.3 **Target Group of Respondents**
The process of policymaking for transport infrastructures is very extensive and the activity of forecasting plays an important role. To determine the suitable target group of respondents for the interviews, it is important to first investigate what the different phases of policymaking are and how forecasting is integrated in it.
Forecasting can be seen as an activity that helps to deal with uncertainty. There are various types of policy actors who deal with uncertainty, not only those who are involved in forecasting. Therefore an investigation has to be done about the different types of policy actors who each deal with uncertainty in a different way. After that it can be determined what type of policy actors are the suitable target group of respondents for this research.

**Phases of Policymaking**

Dunn (1994) describes the process of policymaking in general as a series of intellectual activities in a political context. Policy relevant information is created, assessed and communicated by policy analysts in one or more phases of this process. He distinguishes the phases of ‘agenda setting’, ‘policy formulation’, ‘policy adoption’, ‘policy implementation’ and ‘policy assessment’. Each phase is related to specific policy-analytic procedures that generate the relevant knowledge. One of these procedures is ‘forecasting’, which is linked to the phase of ‘policy formulation’. The procedure of forecasting can provide policy-relevant knowledge about the future as a consequence of adopting alternative policies. Dunn mentions that “forecasting can examine plausible, potential and normatively valued futures, estimate the consequences of existing and proposed policies, specify probable future constraints on the achievement of objectives, and estimate the political feasibility (support and opposition) of different options”.

**Phases of Dealing with Uncertainty**

‘Dealing with uncertainty’ and ‘forecasting’ are broad definitions. Making a distinction between phases of dealing with uncertainty helps to clarify this issue, in order that the research focus can be sharpened on that front. Defining those phases is a regular topic of discussion among policymakers.

At a congress on ‘Policymaking under Uncertainty’, held on 15 and 16 May 2006, policy scientists and policymakers were gathered to discuss such issues. They agreed that ‘policy uncertainty’ is being treated in three particular phases and that in each phase there are specific policy actors who play a major role. The three phases are:

- Scientific Forecasting
- Policy Development
- Policy Proposing

**Scientific Forecasting**

Scientific forecasting is the phase in which independent research is done which can be used for any kind of policy issues. The research is not dedicated to specific problems, but is of more generic nature. Clients using the research results are the government, parliament and other public organisations such as political parties and labour unions. The involved actors who carry this task can be called policy scientists. They are often experts of specific disciplines such as economics, sociology or environmental affairs. Examples of institutes that carry this task in the Netherlands are the so-called planning bureaus. These are the

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8 The congress was organized by the RIVM, CPB and RAND Europe. It was held in The Hague, with the purpose to share thoughts and experiences between policy scientists, policy advisors and policymakers.
CPB, the Netherlands Environmental Assessment Agency\(^9\), the Netherlands Institute for Spatial Research\(^{10}\) and the Social and Cultural Planning Office of the Netherlands\(^{11}\). These institutions are required to be independent since they carry the responsibility to develop objective forecasts. Flyvbjerg, Bruzelius and Rothengatter (2003) say that if stakeholders get involved in the forecasting process, they are likely to influence the outcomes in their favour.

**Policy Development**
In the phase of policy development, the knowledge that is generated by scientific forecasting is linked to policy problems. Through problem analysis and deliberate studies **policy advisors** are responsible for creating more specific insights in policy problems. Ultimately, they are engaged in developing policy alternatives. This also involves the acquaintance of multi-actor settings, since participation of stakeholders plays an important role. Departments of ministries and their advising organisations are mainly engaged with these responsibilities.

**Policy Proposing**
Policy products that result from the previous phase such as budgetary plans, policies and large scale projects are proposed to the Chamber of Representatives. The actors who are engaged in proposing the developed policies to obtain approval from representatives of the public can be called **policymakers**, since they are involved with high level policymaking.

**Integrating ‘Dealing with Uncertainty’ in Dunn’s Phases of Policymaking**
Scientific forecasting and policy development fit in Dunn’s phase of ‘policy formulation’. Dunn explains the definition of ‘policy formulation’ by linking policy alternatives to their forecasted future consequences. Policy proposing is more related to Dunn’s defined phase of ‘policy adoption’. How the three phases of forecasting can be integrated in Dunn’s topics is illustrated in Figure 1-2 “Dealing with Uncertainty as an Integrated Activity of Policymaking”. The elaboration of Dunn’s topics is based on literature, but the further elaboration of ‘dealing with uncertainty’ is - through lack of available literature - only based on discussions at the mentioned congress. In spite of this, unravelling the phases of dealing with uncertainty and the related actors is a necessary step to fine tune the research focus.

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\(^9\) Milieu- en Natuur Planbureau (MNP)
\(^{10}\) Ruimtelijk Planbureau (RPB)
\(^{11}\) Sociaal en Cultureel Planbureau (SCP)
**Figure 1-2 Dealing with Uncertainty as an integrated Activity of Policymaking**

<table>
<thead>
<tr>
<th>Policy-analytic procedures</th>
<th>Phases of policymaking</th>
<th>Distinctive phases of dealing with uncertainty and the related actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Structuring</td>
<td>Agenda Setting</td>
<td>Scientific Forecasting (Policy Scientists)</td>
</tr>
<tr>
<td>Forecasting</td>
<td>Policy Formulation</td>
<td>Policy Development (Policy Advisors)</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Policy Adoption</td>
<td>Policy Proposing (Policymakers)</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Policy Implementation</td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>Policy Assessment</td>
<td></td>
</tr>
</tbody>
</table>

(Dunn 1994)

Based on discussions held at the Congress on 'Policymaking under Uncertainty' The Hague, 15 and 16 May 2006.

**Determination of Target Group**

The elaboration above enables to determine the target group of respondents for this research. Since the policy advisors are closely connected to both the scientific side and the policymaking side, they mostly likely have a comprehensive insight in the overall activity of dealing with uncertainty in a political context. Policy advisors use the independently developed forecasts to support their studies and eventually present the results to the policymakers. They are engaged with linking scientific forecasting to actual policy problems on one hand, and meanwhile have to consider the interests of high-level policymakers on the other. Therefore **policy advisors**, as defined for this purpose, are the suitable target group to be interviewed for this research. In the remaining part of this report the term ‘policy advisor’ is used to refer to the interviewed respondents. The term ‘policymaker’ is used to refer to higher level public decision-makers.

Since the type of policy problems that are of interest concern long-term time horizons it is important to look for respondents who have been involved in policymaking for large scale projects.

The main national-level organization where transport policy advisors can be found for the interviews is the Dutch Ministry of Transport. In order to obtain a target group with
diverse domains, the respondents can be found in the Directorate-General for Passenger Transport\textsuperscript{12}, the Directorate-General for Civil Aviation and Freight Transport\textsuperscript{13} and the Directorate-General of Public Works and Water Management\textsuperscript{14}. The latter has an interesting specialised service because it is responsible for transport related research: the Transport Research Centre\textsuperscript{15}. The list of respondents that are interviewed can be found in Appendix A.3 and A.4 “Participants of First and Second Round Interviews”.

\subsection*{2.3.4 The Interview Topics: Transport Infrastructure related Studies}

The central topic during each interview is the specific infrastructure related study with which the concerning respondent is involved. The selected respondents are employed at different institutional departments with different portfolios of responsibility (freight vs. passenger transport and different modalities). This criterion of diversity also has to be taken into account when selecting the topics that are central to the interviews.

Some of the selected topics concern physical infrastructures for which scenario studies are done to assess their public importance and benefits. These are the more ‘front stage’ policymaking topics that are interesting for this research. Other interesting topics are transport policy studies that run on the background and indirectly affect the physical infrastructure policies. An example is the Mobility Paper (2004)\textsuperscript{16}, which depicts the long-term vision of the Ministry of Transport. Scenario analyses are extensively used to determine the long-term transport vision in the course of which many uncertainties are considered. It indirectly affects physical infrastructure policies since those have to ‘fit in’ the vision of the Mobility Paper.

It must be mentioned that the selection of cases may cause a bias in the results. The reason is that several projects concern physical infrastructure projects while others concern more ‘research type’ of studies that are not directly related to specific infrastructures. Although in both cases it concerns scenario studies for long-term transport policymaking, it is possible that the different types of studies call for different expertises. This can affect the results in a way that judgments about needs for certain expertises for example only concern studies for physical infrastructures.

The physical infrastructure projects and the other transport policy studies are separately discussed below.

\textbf{Physical Infrastructure Projects}

The initial list of potential physical projects contained the Zuiderzee Line\textsuperscript{17}, the High Speed Line (HSL-Zuid), programme for infrastructure and transport (hereafter called MIT-projects)\textsuperscript{18}, Mainport Schiphol and the Maasvlakte. This list is created by considering

\begin{thebibliography}{9}
\bibitem{dgp} Directoraat-generaal Personenvervoer (DGP)
\bibitem{dgvl} Directoraat-generaal Transport en Luchtvaart (DGTL)
\bibitem{rws} Directoraat-generaal Rijkswaterstaat (RWS)
\bibitem{avv} Adviesdienst Verkeer en Vervoer (AVV)
\bibitem{mob} Nota Mobiliteit, Plan Kern Beslissing deel IV (PKB IV)
\bibitem{zzl} Project Zuiderzeelijn (ZZL)
\bibitem{mit} Meerjaren Programma Infrastructuur en Transport (MIT)
\end{thebibliography}
the different transport modalities: the first three concern rail-transport, the third also involves road transport, the fourth concerns air transport and the fifth is a project for transport over water.

The Maasvlakte could eventually not be taken in the research because of time constraints. This implies that no physical water infrastructures are taken in the research. For the HSL-Zuid there were no respondents available who could partake in the interview rounds. The diversity of projects is not severely affected by this since the Zuiderzee Line and MIT-projects cover rail-infrastructures (for both passenger and freight transport). The transport policy studies (that are described in the next section) are not for specific modalities only, but concern policymaking for transport in general.

The resulting list of physical infrastructure topics for the interviews is:

- Zuiderzee Line
- Mainport Schiphol
- MIT-projects

Zuiderzee Line
The Zuiderzee Line project organisation consists of a joint responsibility of the Ministry of Transport, the Ministry of Public Housing, Spatial Planning and the Environment\(^1\), and the Ministry of Economic Affairs\(^2\). The aim is to provide a fast public transport link from Schiphol and Amsterdam to Almere and Groningen, to improve the accessibility of the North of Holland with regard to the Randstad. The higher objective is to stimulate the local economy of the North of Holland. Meanwhile it is also important to review whether a high-quality public transport system will enable Almere to achieve an equal status compared to other cities in the Randstad. Another aspect of the study concerns the stimulus of further development of the Schiphol-Amsterdam-Almere axis and the connection between Flevoland and the northern part of the Netherlands. The fast link eventually helps to improve the regional economic position of this northern part of the Netherlands.

It is clear that this study is embedded in a multi-actor environment in which several regional and local governments take part. A crucial topic that is studied is the future development of the western and northern regions, with special attention to the threats and opportunities on national-economic level (Projectorganisatie Zuiderzeelijn, n.d.).

Mainport Schiphol
Schiphol airport has two interwoven functions in relation to the national economy. At first it is an airport with a hub-function, which means that it is a gateway where many national, European and inter-continental connections congregate. Secondly, it is a metropolitan area with high-level living and business establishment conditions. It is an environment where many companies operate in international production and consumption networks and where many civilians live and work (Ministerie van Verkeer en Waterstaat, ‘Air Transport Policy’, n.d.).

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\(^1\) Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieu (VROM)

\(^2\) Ministerie van Economische Zaken (EZ)
Spatial planning, transport demand, expansion, employment, noise regulations and the environment are ongoing policy issues related to the airport. The air transport sector is sensitive to oil price changes, pressure from environmental activist groups, terrorism threats and other factors, which complicates long-term planning. Many efforts are put in scenario analyses to get a grip on such uncertainties.

**MIT-projects**
The MIT is an integral programme of infrastructure projects that are related to transport policy for main roads, waterways, railways and water management. On a yearly basis this programme is updated and reported to the Chamber of Representatives as part of the infrastructure budget planning. It provides an overview of all infrastructure projects that are either planned or are in progress with which the Ministry of Transport is involved. The MIT-decision-making process consists of three phases (exploration, design study and realisation) and five decision moments (Ministerie van Verkeer en Waterstaat, ‘MIT-SNIP-projectenboek, stand van zaken 2006).

The aim of the programme for infrastructure and transport is among others to control risks by facilitating a structured decision-making process.

**Transport Policy Studies**
Several contacts of RAND who are involved with transport policy studies were available to take part in the interviews of this research. They are not involved in studies for physical transport infrastructures, but rather in studies that support transport infrastructure policymaking. Those studies can be subparts of ongoing transport policy programmes. The studies about which the interviews are held are:

- Mobility Segment of Welfare and Environment Study
- Dutch National Model System
- Mobility Paper
- Policy Letter for Freight Transport
- Spatial Investments Programme

**Mobility Segment of Welfare and Environment Study**
The Welfare and Environment study\(^1\) is a long-term exploration of the spatial utilization and habitat environment. It is a joint study of the three planning bureaus (MNP, CPB and RPB). The initiative is taken to actualise, broaden and deepen an earlier study from the CPB. Main inputs are other scenario studies: the ‘Four futures of Europe’ en ‘Vier vergezichten op Nederland’. Both contain four scenarios reflecting the international and national economic developments until 2040 respectively.

The research concentrates on several themes of which one is traffic and transport. The National Transport Research Centre plays an important role in this partial study. The analyses have a strong quantitative nature for which models have been used from different institutes. Besides the quantitative information they also provide qualitative descriptions of the future (Ruimtelijk Planbureau, ‘Welvaart en Leefomgeving’).

\(^1\) Welvaart en Leefomgeving (WLO)
Dutch National Model System

The Dutch National Model System\textsuperscript{22} is a unique forecasting instrument to investigate the effects of transport policies. The department of Public Works and Water Management has been using this model since 1986 and it is owned by the National Transport Research Centre. The prognoses it makes concern traffic flows for both road and rail. The model is used to forecast national and regional transport volumes and traffic flows on specific network links for one or more scenarios. It is also used to assess likely impacts of transport policies such as road pricing (de Jong et al., n.d. and Ministerie van Verkeer en Waterstaat – Adviesdienst Verkeer en Vervoer, ‘Het Landelijk Model Systeem’).

Mobility Paper

The Mobility Paper sets out the headlines of the national traffic and transport policies for the next decennia. Its main theme is the necessity of mobility for social and economic development. The Mobility Paper follows up on the Spatial Policy Document (Nota Ruimte), a policy commitment to which municipalities, local- and regional governments have contributed in conformance with the Joint Arrangements Act\textsuperscript{23} (Ministerie van Verkeer en Waterstaat 2004). A key input to the Mobility Paper is the ‘Environmental Scenarios Long Term Exploration 1995 – 2020’\textsuperscript{24}, which contains three scenarios for economic growth (Centraal Planbureau, 2004).

Policy Letter for Freight Transport

The Policy Letter for Freight Transport\textsuperscript{25} has to be presented to the House of Representatives of the Dutch Parliament before summer 2006 and contains specifications of the freight transport policy as set out in the Mobility Paper. The core message of the letter is twofold:

- A long-term policy vision about the freight transport regarding safety, environment, infrastructure and European level policies.
- An action plan to ensure that spatial capacity will be available in the future (the next 20 – 30 years) for those segments of freight transport and logistics that are important for the Dutch economy.

Spatial Investments Programme

The Spatial Investments Programme\textsuperscript{26} is a continuously actualised investment programme for the middle term (around 2010). It concerns the labour, habitat, greenery, facilities and infrastructure for Amsterdam. It provides a political framework for prioritizing and deciding on investment budgets of local projects (Gemeente Amsterdam, 2004). The generic scenarios they are used for the most recent update of their spatial investment programme are the ‘Four Futures of Europe’. It required them to make a translation from

\textsuperscript{22} Landelijk Model Systeem (LMS)
\textsuperscript{23} Wet Gemeenschappelijke Regelingen (WGR-plus)
\textsuperscript{24} Omgevingsscenario’s Lange Termijn Verkenning 1995 – 2020 (LT-97)
\textsuperscript{25} Beleidsbrief Goederenvervoer
\textsuperscript{26} Programma Ruimtelijke Investeringen (PRI)
the European and national level of those scenarios to their regional focus (Projectgroep Ruimtelijke Investeringen Gemeente Amsterdam, 2005).

Although the Spatial Investments Programme does not concern national governed projects, the large project scales do make it an interesting subject for this research.

2.4 **Data Analysis of Needs and Practices**

The next step of the research is to analyse the information from the second round interviews. One product that is analysed is the gathered data about the policy advisors’ needs for the next generation scenario expertise. The aim is to find out which expertises are strongly needed for transport infrastructure policymaking (2.4.1). The gathered data about the policy advisors’ practices is mainly useful for the comparative analysis that follows afterwards. It is anyhow also used to get an impression of the extent to which each expertise is applied in practice. To achieve that a similar analysis is done as is for the needs (2.4.2).

**2.4.1 Data Analysis of Needs**

The interviewed transport policy advisors are asked whether they *do* or *do not* need each of the expertise types in the next generation framework. The gathered data is analysed to get an overview of how many respondents perceive a need for each defined expertise. Information about strongly needed expertises is an important partial product of this research.

**Output of Data Analysis of Needs**

The graphic overviews that result from this analysis represent the so-called ‘needs’ for the next generation scenario expertise, according to the interviewed transport policy advisors. It is also presented in scores on a scale from 0 - 10. This information is not used for the following research activities, but it is an important partial product of the research.

**2.4.2 Data Analysis of Practices**

During the second round interviews, the respondents are asked whether they *do* or *do not* apply each of the defined types of expertise in the next generation framework. The gathered data is analysed to get an overview of the number of respondents who apply each expertise.

**Output of Data Analysis of Practices**

The output of this research activity is a graphic overview of the so-called ‘practices’ of transport policy advisors, based on the next generation scenario expertise. The extent to which each expertise is being applied by the respondents is presented in scores on a scale from 0 - 10. This information is not used for the following research activities.

2.5 **Comparative Analysis of Needs and Practices**

The next step is to compare both the answers (or ‘judgments’) that are given by the respondents about the needs and the practices. This is done in order to determine whether expertises are underused. How this is exactly done is elaborated in more detail in chapter 5 “Detecting the Underused Expertises”. That can be found when it is not applied by policy advisors *and* meanwhile perceives a need for that expertise.
Output of Comparative Analysis
The main output of this research activity is quantitative information about the extent to which expertises are underused. Those expertises that are strongly underused are of greatest interest to this research and the relating causes are aimed to be identified.

2.6 Review of Strongly Underused Expertises and relating Causes
The next step is to review the causes of underuse that are mentioned by the respondents and to link that to those expertises that appear to be strongly underused. All causes are examined to compose one list containing the main causes of underuse.

Output of Review of Strongly Underused Expertise and Relating Causes
The output of this research activity is a list of main causes of underuse, linked to the significantly underused expertises. This is done to determine what has to be done to improve the utilization of the next generation scenario expertise.

2.7 Final Session with RAND Experts
The strongly underused expertises and the list of causes are presented to the two RAND experts who also have been engaged in the earlier sessions of this research. In this final session it is discussed what those findings mean to RAND and what the consequences are for their next generation scenario expertise. The aim is to draw the conclusions and to formulate the recommendations to RAND.

Output of Final Session with RAND Experts
The final session eventually results in the formulation of the recommendations to RAND: how can they anticipate on the discovered causes of underuse of the next generation scenario expertise?
Scenario analyses are widely used to deal with uncertainty in a systematic way. It is commonly used when the involved uncertainties are significantly high. Various institutes have put efforts in defining the different types of uncertainty with which policymakers are confronted. This helps to determine whether scenario analysis is an appropriate way to approach their problems, and more specifically how the scenario analysis should be carried out. The explorative literature research has been the main source of information of the first paragraph, in which various typologies of uncertainty are discussed. The types of uncertainty in which scenario expertise is important are given special attention (3.1). The second paragraph of this chapter is dedicated to presenting the next generation scenario expertise, which resulted from the sessions with that were held with two RAND experts (3.2).

The aim of this chapter is to demonstrate the main findings that helped to answer the first partial research question:

“What types of expertise belong to the next generation scenario expertise?”

3.1 Typologies of Uncertainty and Different Ways to Deal with it

‘Uncertainty’ is a broadly used definition. There are many theories about how to classify different types of uncertainty. It is important that policy advisors can identify with what type of uncertainty they are dealing before they can properly deal with. The explorative literature research helped to discover different typologies of uncertainty (3.1.1). Especially when the uncertainty is very intensive, simple forecasting methods do not suffice. Several advanced concepts have been developed to face this intensified uncertainty (3.1.2).

3.1.1 Typologies of Uncertainty

A guide for uncertainty assessment and communication has been developed for the MNP, which is part of the Dutch National Institute of Public Health and the Environment27 (RIVM). The goal of that guide is to provide a structured approach to identify uncertainty and to address the role of uncertainty in the context of policy advice (Sluijs et al. 2004).

27 Rijksinstituut voor Volksgezondheid en Milieu (RIVM)
Although it is not particularly meant for transport related policy studies but more for environmental purposes, it is an extensive guide which does provide useful insights about when to use scenario analysis with regard to different types of uncertainty.

The McKinsey expertise on defining uncertainty is also quite progressive. They define four levels of uncertainty which they use as a basis to recommend certain courses of action when companies have to make long-term strategic decisions. Their levels of uncertainty are closely related to the use of scenarios for policymaking. As such, the two following approaches for classifying uncertainty will be discussed:

- The RIVM/MNP Guidance for Uncertainty Assessment and Communication
- The Four McKinsey Levels of Uncertainty

The RIVM/MNP Guidance for Uncertainty Assessment and Communication
In a forerun to the development of the RIVM/MNP Guidance for Uncertainty Assessment and Communication, Walker et al. (2003) propose three dimensions of uncertainty: ‘location’, ‘level’ and ‘nature’. The first concerns the location of uncertainty within model attributes (when models are used to deal with uncertainty). The second concerns the level of ignorance, which depicts whether one can determine statistical properties to alleviate the uncertainties or not. The third, ‘nature’, concerns whether the uncertainty is about knowledge or whether it is about inherent variability of the system under study.

The RIVM/MNP Guidance for Uncertainty Assessment and Communication makes use of these three dimensions of uncertainty and adds two more dimensions. One is the ‘qualification of knowledge base’, which focuses on the extent to which information is scientifically valid. The other is the ‘value-ladenness of choices’, which focuses on possible subjectiveness when doing the assessment (Sluijs et al., 2003).

It is essential to first determine ‘where the uncertainty is located’ before the uncertainty assessment on the other dimensions can be accomplished. Having determined the location, the question whether scenario analysis is an appropriate method to deal with uncertainty depends on two of the remaining four dimensions: the ‘level of uncertainty’ and the ‘value-ladenness of choices’. Because of their importance for assessing whether scenario analysis is an appropriate method of dealing with uncertainty, these three dimensions are further elaborated below:

- Location
- Level of Uncertainty
- Value-ladenness of choices

Location
When attempting to determine what the policy relevant uncertainties are that one is confronted with, the first step is to find out where those uncertainties are located. The location of the uncertainty has to be determined before the classification of that uncertainty along the four remaining dimensions can be done.
In the RIVM/MNP Guidance, five locations are distinguished. These are called ‘context’, ‘data’, ‘model’, ‘expert judgment’ and ‘outputs’. Detailed descriptions of these different locations can be found in the guidance. The guidance recommends specific methods to deal with uncertainty dependent on the location of that uncertainty and how it is classified along the four other dimensions. It recommends scenario analysis especially when the uncertainty is located in the ‘context’ and in the ‘model inputs’. The latter is a sub-part of the location ‘model’. Both are depicted below.

**Context**
The location ‘context’ refers to how the policy problem is framed: what belongs within the system boundary, how complete is the definition of the problem? If agreement about the problem framing is lacking, the uncertainty is said to be located in the context.

**Model inputs**
The location ‘model’ refers to the model that is used for analyzing the problem. This suggests that models are applied, although that is not a relevant issue in this case. More important to know is what they mean with ‘model inputs’. When there is uncertainty about the forces that drive policy-relevant changes to society, that uncertainty is placed in ‘model inputs’ according to the RIVM/MNP Guidance. They recommend to use scenario analysis when there is uncertainty about the forces that drive structural changes. Examples of such forces are technological developments, oil price, demographic trends, etc. These forces can have great impacts on the outcomes of a policy, which makes it relevant to take them into account in the policy study.

The RIVM/MNP Guidance contains a matrix with the different locations where uncertainty can be present on the vertical axis. The four other dimensions are represented on the horizontal axis, each dimension having a separate column. The matrix is illustrated in Appendix B “RIVM/MNP Uncertainty Matrix”, including an indication of those cases when the use of scenario analysis is recommended. That is the case when the uncertainty is located in the ‘context’ or ‘model inputs’ and when it concerns a high level of uncertainty or a high value-ladenness of choices. In the RIVM/MNP guidance it is also stated that it may well be appropriate to use scenario analysis in various other cases. Their recommendations should be interpreted as ‘exclusive’.

**Level of Uncertainty**
The idea behind the classification of levels of uncertainty is to define a progressive transition that goes from complete determinism to indeterminacy (or ‘total ignorance’). Between the extremes of ‘determinism’ and ‘indeterminacy’ three stages are distinguished, namely ‘statistical uncertainty’, ‘scenario uncertainty’ and ‘recognised ignorance’.

**Statistical Uncertainty**
Statistical uncertainty is the case when probabilities can be determined for ranges of values of any relevant factor.
Scenario Uncertainty

Scenario uncertainty goes beyond statistical uncertainty, since in such a situation one can only think of plausible scenarios of the future but no probabilities can be ascribed to those scenarios.

Recognized Ignorance

Recognised ignorance is the case when both statistical properties are unknown and relationships between factors that affect the outcome of a policy can not be figured out. When one is not capable of investigating the relationships between such important factors, the fundamental mechanisms of the problem system can hardly be understood. It will require to make assumptions about those mechanisms after which scenarios can be developed (adapted from Sluijs et al. 2003 and Walker et al. 2003).

Summarized, when the level of uncertainty can be classified as ‘scenario uncertainty’ or ‘recognized ignorance’, the RIVM/MNP Guidance recommends to apply among other things scenario analysis.

Value-ladenness of Choices

The value-ladenness of choices focuses on possible subjectiveness when doing the uncertainty assessment. Determination of the value-ladenness of choices leads to a measure of the extent to which study results are influenced due to bias. If in the uncertainty assessment it appears that the value-ladenness is high, it is well possible that the policy recommendations are affected by the norms of the stakeholders who are related to the policy problem. In such a case, the RIVM/MNP Guidance recommends to apply scenario analysis. They also recommend to apply various actor analysis methods to map the different perspectives of the involved stakeholders and their influence on the uncertainty assessment.

The Four McKinsey Levels of Uncertainty

Courtney, Kirkland and Viguérie are (former) consultants at McKinsey and wrote various articles about uncertainty, of which one was published in the Harvard Business Review of November-December 1997. They define four levels of uncertainty to form a basis of determining the right course of action (Courtney, Kirkland and Viguérie, 1997), see figure 3-1 “Four Levels of Uncertainty”. The four levels of uncertainty are:

- Clear Enough Future
- Alternative Futures
- Range of Futures
- True Ambiguity
Figure 3-1 Four Levels of Uncertainty by Courtney, Kirkland and Viguerie

Source: “Strategy under uncertainty” [Courtney, Kirkland and Viguerie, 1997]

Clear Enough Future
The first level of uncertainty is described by a single discrete future that is yet unknown. It concerns pure knowledge deficiency which can be bridged. The future is an unambiguous continuation of the past. Through trend analyses and Discounted Cash Flow (DCF) models, the costs and revenues of a project can reliably be forecasted. Such an unambiguous prediction of the future is probably only realistic when taking a small time horizon. Thomas (2001) also explains that the usefulness of DCF analysis for strategic decision-making is limited to the ‘planning horizon’, in which one can reliably predict the project cash flows. Sluijs et al. (2004) mention that in reality scenarios are often surprise-free and do not go beyond trend extrapolation, whereas it is the purpose to discover the different ways in which the future can unfold. This means that although policymakers are confronted with high levels of uncertainty, they use scenario analysis in a way which suits McKinsey’s first level of uncertainty: the clear enough future.

Alternative Futures
The second level of uncertainty is described by a number of discrete futures. There are several plausible scenarios and it is hard to predict which one will occur. The key essence is that while it is hard to predict which scenario will occur, each of the scenarios requires a distinct policy to achieve desirable results. For example when it is unclear whether the European government will either become more centralized or decentralized and both futures have different impacts on the decisions of a policymaker, this level of uncertainty prevails.

Range of Futures
In the third level of uncertainty the possible futures can only be described by a range of outcomes. This level of uncertainty is more of concern when certain external factors have great impacts on the outcome of policies, but it is not sure how that factor will evolve over time. At most, an upper and lower level of such a factor can be estimated, but no useful
estimations of probabilities can be made within this range. An example of such a factor is the demand for road transport capacity in 2030. A transport infrastructure can be designed to accommodate the lower or higher estimated value of that demand, but it is uncertain which is best to take into account. Scenarios with a continuous outlook help to illustrate the variability of uncertain factors.

**True Ambiguity**

The fourth level of uncertainty is described as an extreme range of plausible futures. It is not only the unpredictability of important factors that marks this level of uncertainty, but even the lack of knowledge about which factors are relevant. “It might not even be possible to identify, much less predict, all the relevant variables that will define the future” (Courtney, Kirkland and Viguerie 1997). This seems to correspond to the definition of “total ignorance” Walker et al. (2003). Courtney, Kirkland and Viguerie recommend in this condition to ‘wait and see’ rather than using scenarios to develop policies.

### 3.1.2 Several Advanced Concepts to Deal with High Levels of Uncertainty

Many organizations in the private sector apply techniques to adapt their policies to circumstantial changes. Although this does not concern the public sector, it can be compared to adaptive policymaking by governmental institutes. Decision-makers in the private sector are confronted with similar challenges as those in the public sector: to make decisions for long-term policies while the environment can change in multiple directions. It is inevitable for any type of decision-maker to deal with high levels of uncertainty. A common strategy that is used by private companies to deal with high levels of uncertainty is to ‘reserve the right to play’. Many examples such strategies can be found in the oil industry and the pharmaceutical industry.

Another advanced concept to deal with high levels of uncertainty is developed by several experts from RAND. They designed a procedure for developing adaptive policies, intended for public applications. Their aim is to alleviate the problem that policy changes are repeatedly made on an ad-hoc basis. Such policy changes should rather be part of a process that is recognized by policymakers (Walker, Rahman and Cave 2001).

Both concepts mentioned above are elaborated in more detail:

- Reserving the Right to Play: a Way to Adapt to Circumstantial Changes
- A Designed Procedure for Developing Adaptive Policies

**Reserving the Right to Play: a Way to Adapt to Circumstantial Changes**

The basic thought behind ‘reserving the right to play’ is that within a policy, one can keep the possibility to take certain actions at any time in the future (Kippenberger, 1998). Those actions will only be taken when it appears to be beneficial. In other words, the basic policy is not unchangeable, but it leaves room for adjustments at later times when more information about the future becomes available to the decision-maker.

Real options analysis is an example of a method that enables to incorporate flexibility in a policy. It takes into account the sequential possible courses of action of a decision-maker. Mun (2002) says that the real options method introduces a learning model: when
uncertainty becomes resolved through the passage of time, managers can make the appropriate mid-course corrections.

The method is based on the principles of financial options, which provide the right to buy or sell stocks for a price and within a certain period determined \textit{a priori} (Rila 2001). The idea of real options is that one can buy rights on any type of investment (not only stocks), while not being obliged to do that investment. The types of investments that are of interest for this specific research are those involved with transport infrastructure projects. The next question is: ‘what does it mean to reserve the right to play in terms of infrastructure projects?’

The design of the original bridge over the Tagus River at Lisbon provides a good example of ‘reserving the right to play’ in an infrastructure project. The bridge was built in 1966 and it was designed to be stronger than originally needed, so that it could carry a second level in case that was ever desired. By doing that, the Portuguese government reserved the right to increase the transport capacity of the bridge at any later time. During the 1990s, the traffic volume had increased significantly and they decided to build the second level for a suburban railroad line (de Neufville 2001).

As can be seen, the Portuguese government realised that it was wise to invest in an ‘over-dimensioned’ bridge. If they had not invested in the stronger structure initially, they might have had to build an additional bridge in the 1990s. In case the traffic volume had not increased the supplementary investment would have been a loss, although that loss would be much smaller than building an additional bridge. This demonstrates that the flexibility of their policy had a greater value than the price of the supplementary investment in the strong bridge.

**A Designed Procedure for Developing Adaptive Policies**

Another way of systematically applying adaptive policies is depicted by Walker, Rahman and Cave (2001). The basic idea behind it is similar to that of real options analysis or any other method that incorporates flexibility in a policy: the aim is to keep the policy flexible in order that it can be adapted in accordance with changes in the policy environment.

In Appendix C “A Process for adaptive policymaking”, the process of adaptive policymaking as proposed by Walker, Rahman and Cave is presented. In the first phase of this process, the basic policy is designed as well as the vulnerabilities, i.e. the potential adverse consequences of the basic policy. When it is certain what those vulnerabilities are and how strong their impacts are, taking mitigating actions can reduce their consequences. When the vulnerabilities are uncertain, one can spread the involved risks by taking hedging actions. Both the mitigating and hedging actions can be planned for prior to implementing the policy. Once it is implemented, it is necessary to monitor the external uncertain factors that have significant impacts on the outcome of the policy, which is called ‘signposting’. In order to know when exactly the policy has to be adjusted, it is important to determine the critical values of the uncertain external factors, also called ‘trigger values’. That means that if such a factor reaches a trigger value, the involved decision-makers know that corrective action has to be taken to avoid negative outcomes of their policy.

In case the trigger values are reached, there are three types of action that can be taken dependent on how drastic the policy environment has changed. In the lightest case,
defensive action can be taken. This means that the basic policy objective is not revised but small measures are taken to reduce the negative impact of the changes. In case the changes have stronger negative impacts, corrective action has to be taken which involves greater interventions than the previous, but still within the frame of the initial policy objective. It is also possible that neither defensive nor corrective actions will suffice. This can be the case when significant trend breaks occur such as an economic collapse. In such a case the policy has to be reassessed, which means that the policy objectives have to be redefined, as well as the performance indicators, the new vulnerabilities, signposts, etc.

As such, this process of adaptive policymaking “explicitly makes use of new information to resolve the original uncertainties over time” (Walker, Rahman and Cave 2001).

3.2 Framework of the Next Generation Scenario Expertise

The explorative literature research and the sessions with the RAND experts have lead to determining the framework of the next generation scenario expertise, which is illustrated in Figure 3-2 “Framework of the Next Generation Scenario Expertise”.

The framework has a hierarchic structure with three sub-levels. The lowest sub-level contains all the different types of expertise that were identified during the literature research and seemed relevant by the RAND experts with whom the two sessions were held. The types of expertise (or simply called ‘expertises’) are clustered under several attributes that altogether comprise the middle sub-level of the framework. The attribute of a clustered group of expertises basically describes the sort of expertises it contains. For example: the attribute ‘format’ contains the expertises to develop ‘quantitative-’ and ‘qualitative scenarios’. Within such an attribute, the expertises are not necessarily mutual exclusive: applying one type of expertise does not mean that the other type of expertise can not be applied in the same scenario study. The key issue is that when developing scenarios, one can choose between those expertises. The attributes are also clustered, since some of them belong to the same category. That sub-level of the framework is denoted by the ‘attribute groups’. For example: the attributes ‘participants’ (who gets involved in the scenario study) and ‘interaction’ (how they are involved in the study) are clustered in the attribute group ‘participation’.

The next generation scenario expertise is sub-divided in five attribute groups. The first is called ‘principal characteristics’, which concerns the basic principles of a scenario study (3.2.1). The second attribute group is ‘approach’. The approach is dependent on the objective for using scenario analysis (3.2.2). The third attribute group concerns the resulting scenarios (3.2.3), the fourth the participation (3.2.4) and the fifth contains the different expertises that deal with adaptive policymaking (3.2.5).

The framework is aimed to represent the expertises for scenario analysis that are present at RAND. Since the experience with scenario analysis by RAND analysts is very extensive, it is hardly possible to achieve that goal. The framework at least contains the scenario expertise as defined by the two RAND analysts who were involved in the expert sessions.
### 3.2.1 Principal Characteristics

Any scenario has several identifiable principal characteristics. First of all, the scenarios that are developed can be generic or specific. This is defined as the 'type of scenarios'. The distinction is also defined as the 'nature' of the scenarios. The time perspective is another principal characteristic, which can either be continuous or discrete. The fourth principal characteristic of the scenarios is their orientation: they can be environment oriented or rather policy oriented.
This means that the four resulting attributes that belong to the principal characteristics of the scenarios are:

- Type of Scenario
- Nature
- Time Perspective
- Orientation

These attributes and the relating types of expertise are each described below.

**Type of Scenario**

Scenario analysts can either develop **generic** or **specific** scenarios.

The classification as ‘generic scenarios’ is only achieved when the resulting scenarios have no fixed relationship with a particular problem. When scenarios have a specific relationship with a policy problem, they need to contain more detailed information about the policy environment. In such a case, generic scenarios are not sufficient since they do not provide those details that are necessary to analyze the problem of concern.

The Dutch planning bureaus (described in paragraph 2.3.3 “Target Group of Respondents”) typically develop generic scenarios. Their scenarios concern plausible future states of the world while they do not address actual policy problems. For transport related policy problems, generic scenarios are often used as a basis on top of which studies are done about specific transport related factors.

**Nature**

The nature of the scenarios that are developed can be **exploratory** or **normative** (Godet and Roubelat 1996).

Exploratory scenarios describe how the future might evolve and can be used to discover how the future might evolve. With those scenarios, robust policies can be developed: policies that perform well in the range of possible futures. They are also called ‘projective scenarios’.

According Sluijs et al. (2004), normative scenarios are developed by starting with a prescribed vision of the future and then working backwards in time to illustrate how that future has emerged. After reasoning back to the present, one can determine the steps that have to be taken to achieve a desired future or to avoid the ‘doom scenario’ (Riet 2003, and Godet & Roubelat 1996). They are also called ‘anticipatory-’ or ‘prospective scenarios’.

Developing normative scenarios is in its essence a more deterministic approach than is the case with exploratory scenarios.

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28 NATO uses scenario planning for defence purposes and has posted some general – unauthorized - notes about different scenario methods on the internet. For more information see ‘The Use of Scenarios in Long Term Defence Planning’ (2002); Plausible Futures Newsletter; retrieved June 6, 2006, from http://plausible.custompublish.com
**Time Perspective**
Scenario developers can either choose for a **continuous** or **discrete** time perspective.

In case of a discrete time perspective, the plausible future states of the world are analysed at specific moments. The can for example develop scenarios about the Dutch economy in 2020. In case of continuous scenarios, the plausible future states envelop a continuous period between starting date and end date. The scenario description would then entail the developments of the Dutch economy between now and 2020.

**Orientation**
Scenarios can be **policy environment** oriented or **policy** oriented (Dammers 2000 cited in Mietzner & Reger 2004).

Environmental scenarios signify a scan of how uncertain exogenous factors may develop in the future, regardless of any action that is taken by the policymaker. Other terms used to describe this type of orientation are ‘reference scenarios’ or non-intervention scenarios’. Policy scenarios signify a scan of the future outcomes and impacts of one or more policy alternatives, i.e. the actions that can be taken by the policymaker. These are also called ‘intervention scenarios’.

**3.2.2 Approach**
The next attribute is the approach that is used when doing the scenario analysis. The approach can either be ‘content focussed’ and ‘process focussed’. A combination of both is possible, but usually there is an emphasis on one of the two. Typical to a content focussed analysis is that it is usually done in relation with specific policy problems. In such a case we desire to know more about the future and we want to know what actions we have to take to achieve our policy goals (Heijden 2004). Process focussed analyses have a stronger learning character and stimulate an ongoing ‘strategic conversation’ as mentioned by Heijden (2004). In a process focussed approach there is a stronger emphasis on the way the scenario analysis is carried out, rather than on the actual scenarios that result from the study. It is often remarked that not only the scenarios that are developed help to deal with uncertainty, but also the fact that the participants learn about the future. Millett (2003) even says that "a discontinuous future cannot be reliably forecasted, but it can be imagined and lived in as a means of learning from it".

The focus of a scenario study is not *either* content- or process-focussed, but the emphasis is often on one of the two. The two resulting attributes that belong to the approach are:

- Content Focussed
- Process Focussed

**Content Focussed**
Based on the literature research and the sessions with the RAND experts, it was concluded that content focussed analyses can be done for three different purposes: to **develop policy options**, to **evaluate policies** (ex ante and ex post) or to **manage risk**.

When developing policy options for long-term plans, it is important to have a clear impression of how the future may look like. The final scenarios that result from the analysis contain important information that is to be used for developing the policy options.
Policy evaluation is either done prior to making policy choices or after a policy has been implemented. Especially in the first case, when intended for a long period, it is inevitable to make assumptions about the future (Rhyne 1995). In this context, scenario studies can be applied for the purpose of evaluating policies. The content of those scenarios play a crucial role in evaluating the success of the policy.

The definition of ‘risk’ stands for the variance of net benefits around an expected value (Commissie ‘Risicowaardering’ n.d.). The term ‘managing risk’ is often used in an operational context. It is about identifying the probability that an event will occur, the impact of that event and relating both aspects to operational decision-making. In that context it is often the objective to find the optimum in a utility function, which in other words can be described as maximizing the expected value by choosing the right course of action. This topic belongs to the science of operations research. Scenario analysis for the purpose of managing risk can for example be very useful when conducting a large scale project of which the success is dependent on unpredictable events. By applying scenario analysis one can identify the possible events that have great impacts on the project and as such “address the full range of exposures to risks” (Miller and Waller 2003).

Process Focussed

A process focussed approach can also be done for three different purposes: to achieve consensus among the involved stakeholders, to train the participants or to broaden their mindset. In each of the three cases, the learning aspect plays an important role.

Consensus can be achieved through scenario analysis by group discussions in which plausible futures are negotiated, followed by reconciliation (Selin, 2006). It is then not the ultimate goal to determine exactly how the future will be, but rather to achieve an agreement on what is plausible and what course of action can be taken accordingly. Also when it is the purpose to train or to broaden the mindset of the participants, scenario analysis is a tool that serves the communication among them. Various large organisations have employed scenario analysis with such an approach and hence improved their strategic conversation (Heijden 2004).

3.2.3 Resulting Scenarios

The attribute group ‘results’ is about how the resulting scenarios are given shape. One aspect that is of concern is the ‘outlook’. This is related to the levels of uncertainty as defined by Courtney, Kirkland and Vigerie (1997), elaborated in paragraph 3.1.1 “Typologies of Uncertainty”. They make a distinction between discrete- and continuous futures, among which also can be chosen for the scenarios that one develops: to either have a discrete- or a continuous outlook. Another aspect is the format: one can chose between a qualitative and a quantitative format of the scenario descriptions. The two attributes that belong to the scenario results are therefore:

- Outlook
- Format
Outlook
Results that follow from the scenario analysis can be presented as discrete or continuous results.

Most often scenario analysis results are a discrete set of exclusive futures, each having its own character. However, there are examples of scenario analyses that consider uncertainty on a continuous scale (Norman and Smith 2006). This means that for each uncertain factor that is part of the scenarios, its range is estimated instead of a point estimation.

Format
The attribute ‘format’ reflects the distinction between qualitative and quantitative scenarios.

Qualitative scenarios describe future states in the form of narrative texts with a plausible story-line (Huss and Honton 1987). Quantitative scenarios are commonly generated by applying modelling techniques (Sluijs et al. 2004). It is assumed for this part that a quantitative format of scenario results requires quantitative analysis. This means that even though this section is about the format of the scenario results, in effect it says something about the way the scenario analysis is carried out.

3.2.4 Participation
The attribute group ‘participation’ comprises the actors who get involved in the scenario analysis and how they are involved. Which types of participants get involved in the scenario study is determinative for the expertise that is needed to conduct that study. Similarly, the way those participants are involved is also determinative for the required expertise in the scenario study. Consequently, the two attributes that belong to ‘participation’ are:

- Participants
- Interaction

Participants
Among the participants of a scenario study we can distinguish analysts, experts, the problem owner and the stakeholders.

‘Analysts’ can either be internal or external, such as third party consultants. They are characterized by having broad experience and knowledge, compared to experts. ‘Experts’ rather have very specific experience and knowledge within a certain discipline, such as ‘economists’, ‘environmental experts’, ‘transport experts’, etc. The ‘problem owner’ (also called the ‘policy client’) issues the problem but does not necessarily have to be involved in the scenario analysis. A statistical research about the adoption of scenario techniques in organizations and the involvement of the corporate managers pointed out that their involvement is not always evident (Klein and Linneman 1981). ‘Stakeholders’ are those actors who are affected by the policy problem and/or the involved policy measures and who have no strong decision-making power, although they can exercise force on the decision-maker.
Interaction
How the participants are involved in the scenario analysis is another aspect of participation. A distinction can be made between single-way, two-way and multiple-way interaction.

Examples of single-way interaction are closed interviews and surveys. Open interviews are an example of two-way interactions. Multiple-way interaction can be achieved by holding workshops or group-sessions. There are also sophisticated methods to involve various actors interactively such as the Delphi-method and gaming.

3.2.5 Adaptive Policymaking
The attribute group ‘adaptive policymaking’ contains a collection of expertises that are related to it. As can be seen in paragraph 3.1.2 “Several Advanced Concepts to Deal with High Levels of Uncertainty”, there are different ways of incorporating flexibility in policies. The challenge is to include as many types of expertise as possible that are acknowledged by the RAND experts who have been involved in the expert sessions.

One of those two experts has developed the concept of ‘option thinking’ through which uncertainty can be dealt with adequately. The idea is that through analyzing options one can shape uncertainty or hedge oneself against it. It also results in “more robust and adaptive policies” (Rhee 2005). Van Rhee (2005) raises four different ways of applying options thinking: ‘shaping’, ‘hedging’, ‘dynamic decision-making’ and ‘robust policymaking’. They altogether envelop the aspects of adaptive policymaking that are elaborated in paragraph 3.1.2 “Several Advanced Concepts to Deal with High Levels of Uncertainty”. Each of these ways of applying options thinking is elaborated below.

One aspect that was raised in paragraph 3.1.2 which is crucial for adaptive policymaking in general is ‘signposting’. In order to assist the decision-making process within adaptive policies it is essential to monitor the relevant uncertain factors in the policy environment. Together with the four mentioned variants of options thinking, this results in five attributes that are clustered under ‘adaptive policymaking’:

- Signposting
- Shaping
- Hedging
- Dynamic Decision-making
- Robust Policymaking

Signposting
Elementary to scenario analyses is the determination of those factors that are both uncertain and have great impacts on the system domain of the problem owner. Signposting involves determining the trigger values of those factors, which is necessary for adaptive policymaking. When the trigger value of an uncertain and relevant factor is reached, the decision-makers are warned to adjust or even reassess the policy.

In addition to the determined trigger values, the decision-makers can also define back-up plans. This enables to avoid ad-hoc policymaking. During the interviews it appeared that
it was redundant to include ‘back-up plans’ in the next generation scenario framework. This is because the option variants ‘Hedging’, ‘Dynamic Decision-making’ and ‘Robust Policymaking’ can be considered as elaborated procedures to incorporate back-up plans. For that reason, the expertise relating to ‘back-up plans’ has been taken out of the framework.

**Shaping**

The *option to influence* uncertainty is the first variant of ‘shaping’. When there is uncertainty about the outcome of a decision-making process, it can be useful to lobby or to engage in partnerships. By doing that, possible resistance from actors can be avoided which enables to keep the length of the decision-making process within limits.

Another way of shaping uncertainty concerns the *option to investigate*. When uncertainty is the result of a knowledge deficiency, it can be reduced by means of investigation. Typical examples are market research, seismic surveys for gas explorations or extensive investigation of mobility demand. Such extra research does require efforts, but it the efforts can pay off since the uncertainty is reduced. Analyzing the option to investigate demonstrates whether it is worth to carry out extra research with regard to the involved reduced uncertainty.

The third way of shaping uncertainty is by considering the *option to divide up risk*. Dividing up risk can be achieved by spreading it over various parties. It is a continuous aim of the government to let (public and private) parties carry risks in feasible proportions. Analyzing the option to divide up risk demonstrates which risks can be carried by which party.

**Hedging**

To ‘hedge oneself’ literally means ‘to protect oneself’. There are three option variants that reflect how policies can be protected against uncertainty.

The first is the *option to insure*, which can be done to hedge against currency fluctuations or rising costs of materials. The Commission for Risk Assessment\(^{29}\) has done a study specifically for public investment projects. In their report\(^{30}\) they mention that risks are either ‘diversifiable’ or ‘non-diversifiable’ (Commissie Risicowaardering n.d.). When the diversifiable risks concern a specific factor such as the oil price, they are said to be ‘insurable’. That means that the risks are not spread over many factors, but are rather concentrated. Risks that are spread over many factors need not to be insured for.

The second way to hedge oneself against uncertainties is by incorporating the *option to exit*. Incorporating the option to exit by means of termination clauses in contracts enables to hedge against potential negative yields of a project.

The third way of hedging is achieved by analyzing the *option to diversify*. This concerns the same type of risks as mentioned in the description of the ‘option to insure’: diversifiable risks. The Commission for Risk Assessment mentions in the same report that diversifiable risks are present when costs and benefits of a project have no causal relation

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29 “Commissie Risicowaardering”, initiated by the Ministry of Finances

30 “Risk Assessment for Public Investment Projects”, no date.
with costs and benefits from other sources (Commissie Risicowaardering n.d.). That means that if project A fails, there is no increased probability that project B will also fail. This introduces an opportunity to spread the risks. For example, to alleviate the problem of traffic jams the Ministry of Transport has different policy alternatives such as implementing road tolls, a carpooling system and a road expansion. The fact that a failure of the road toll policy does not imply that the carpooling system will also not reduce the traffic jams, means that the yields of these alternatives are independent. Consequently, the Ministry can diversify their risks by implementing a combination of those alternatives. The expected value is likely to be higher than in the case of implementing a single policy alternative only.\footnote{Van Rhee (2005) mentions that risks can not only be diversified over uncorrelated -or independent- policy alternatives, but also over anti-correlated policy alternatives. That would mean that alternative A and alternative B are not independent, but that a negative yield of alternative A implies a positive yield of alternative B. In such a case the combination of the policy alternatives is likely to have a higher expected value than implementing one of the two alternatives only. The expected value depends on the probabilities that events will occur and their impacts on the yields.}

**Dynamic Decision-making**

The basic idea behind dynamic decision-making is that decisions do not have to be made all at once, but can be spread over a period of time. Especially when investments are irreversible, as is the case with infrastructures, it is essential to pay attention to the phasing and timing of a project (Commissie Risicowaardering n.d.).

The **option to delay** is the one way of integrating dynamic decision-making. In case the level of uncertainty is high and it is not urgent to make a decision, it is conducive to delay that decision until the uncertainty becomes resolved. This is not always possible since sometimes the urgency of policy problems is high and the availability of information becomes a matter of minor importance. However, by consciously considering the option to delay, there is more transparency about the (dis-)advantages of delaying the decision.

The **option to phase** a project is another way of integrating a dynamic decision-making process. By doing this, it becomes possible to adjust the construction of an infrastructure when for example the demand for mobility changes. This means that the construction of the infrastructure can be subject to adjustments until the project is accomplished.

To take into account the possible acceleration and deceleration of transport capacity demand, it would be desirable to also consider the **option to accelerate and decelerate** the project. The advantage of decelerating a project can be that resources become available to accelerate other projects that are more urgent.

**Robust Policymaking**

As mentioned earlier, a ‘robust policy’ is often defined as a single static policy that performs positively under a range of plausible scenarios. This definition does not take into account adaptive policies. Therefore we need to redefine the term ‘robust policy’ as one that performs well in different scenarios, be it due to (predefined) adaptations of that policy.

The **option to switch** from one mode of transport to another is an example of such a robust policy. A basic requirement for such an option to switch is that it is technically...
feasible. Besides, it will require supplementary investments to design and construct an infrastructure that can accommodate different transportation modes (e.g. both fast and slow trains). The advantage is that the policy is robust for scenarios in which fast and slow trains are favourable, which makes it worth to consider that option.

Another form of robust policymaking is by integrating the option to grow in the infrastructure. Integrating the option to grow makes that one has the right (but not the obligation) to expand the infrastructure. This leads to a policy that is robust in both a growth- and a zero growth scenario. Airlines commonly use this technique to avoid excessive acquisitions of aircraft in zero-growth or negative scenarios. In case of transport infrastructure projects, the option to grow can for example entail a spatial reservation around the infrastructure. This provides the policymakers the right but not the obligation to expand the transport infrastructure.

The third way of robust policymaking is to incorporate the option to adjust the operational scale. This can for example be achieved when a factory retains less efficient machines, to be used in peak periods only. In terms of transport infrastructures, the operational scale concerns the transport activities that run on the infrastructure. The infrastructure has to be designed in such a way that the operational scale can actually be adjusted.
CHAPTER 4 The Needs for the Next Generation Scenario Expertise

At this point it is determined what types of expertise belong to the next generation framework (i.e. the framework representing the next generation scenario expertise). The next step is to measure the extent to which transport policy advisors need those expertises.

First of all, explorative interviews are held with a set of 14 transport policy advisors. These interviews are held to get an insight in how they deal with uncertainty, how they apply scenario analyses and how they think about adaptive policymaking. The gained insight is useful to formulate the questions of the second round interviews, which are pre-structured. The information that is needed to measure the needs for the next generation scenario expertise is collected by means of those pre-structured interviews. Closed questions are asked to enable to quantify the collected information. In addition, open questions are asked to collect the policy advisor’s arguments: why is there a strong need for certain expertises?

The pre-structured interviews are held with 12 respondents, who also participated in the explorative interviews. Most of them are policy advisors at the Dutch Ministry of Transport.

The questions of the interviews concern the types of expertise that can be found in the next generation scenario framework. Those questions are formulated in such a way to retrieve answers with regard to the specific projects the policy advisors are involved in. As such, the answers are more to the point than when each respondent would give answers about the needs for expertises in general.

This chapter is devoted to the second partial research question of the research:

“Which expertises are strongly needed by transport policy advisors?”

The first paragraph of this chapter describes how the responses from the interviews are analyzed (4.1). The second paragraph describes the main findings (4.2). The results of the analysis can be found in Appendix E “Results of Measuring the Needs for the Next Generation Scenario Expertise”. Finally, some intermediate conclusions are made about the results that are found in this phase of the research (4.3).
4.1 Data Collection and Analysis of the Policy Advisor’s Needs

The procedure that is applied to analyze the extent to which there is a need for each type of expertise is very basic (4.1.1). When analyzing the information that is collected by interviews, special attention has to be given to potential misinterpretations by the respondents (4.1.2).

4.1.1 Procedure of Data Collection and Analysis of the ‘Needs’

The needs are analyzed for each type of expertise within the framework that is presented in the previous chapter. The respondents are given the possibility to either confirm that there is a need for each expertise, or to reject that there is a need (see Figure 4-1 “Optional Judgments about the Needs for the Next Generation Scenario Expertise”).

![Figure 4-1 Optional Judgments about the Needs for the Next Generation Scenario Expertise](image)

For each type of expertise a count is done of the number of respondents who confirmed that there is a need. The total number of times that an expertise is said to be needed is divided by the total number of respondents who actually provided a judgment. This is not 12 in all cases, since the respondents can not always answer (e.g. due to lack of information). As such, the value we obtain is a ratio that indicates to what extent the expertise is needed among the respondents who provided a judgment.\(^{32}\)

This value is transformed to a scale of 0 (zero) to 10 (ten). A score of 0 indicates that no respondents confirmed that there is a need for the expertise, while 10 indicates that all the respondents did confirm. An advantage of this scaling is that in case not all respondents can answer about the needs for an expertise, the resulting score can still easily be compared with that of other expertises.

The values are not presented in percentile scores since that may raise the impression that a statistical analysis has been carried out, which is obviously not the case. The pre-structured interviews are held with 12 respondents only, which is not sufficient for a statistical analysis. Due to the small number of respondents this research should not be called an ‘assessment’, but rather an ‘explorative research’. The quantitative results are indicative rather than absolute.

\(^{32}\) During the interviews there were 14 expertises about which 11 respondents provided a judgment. In three cases 10 respondents provided a judgment. The remaining expertises were judged by all respondents.
Graphic Presentation of the Scores
The scores are presented in graphs with horizontal bars. Each bar represents a specific type of expertise from the next generation framework. The bars have a purple colour on the left side and a green colour on the right side. The left (purple) side corresponds to the number of respondents who rejected that there is a need. The right (green) side corresponds to the number of respondents who confirmed that there is a need. If half of the respondents confirm that the expertise is needed, the bar will be half green and half purple.

Paragraph 4.2 “Results from Analysis of Needs” is dedicated to discussing the scores and the arguments given by the respondents. It contains five sub-paragraphs, each of them relating to a specific attribute group of the scenario framework. In those sub-paragraphs, the scores of the expertises are at first presented after which the relating arguments are described separately.

4.1.2 Misinterpretations that can occur during the Interviews
Two aspects that may cause misinterpretations during the interviews are elaborated:

- The Definition of ‘Needs’
- Response Ambiguity

Definition of ‘Needs’
The phrase ‘need for a scenario expertise X’ can be interpreted in two ways: ‘it is necessary to apply expertise X in scenario studies’ or ‘it is favourable to apply expertise X in scenario studies’. A policy advisor who says that it is necessary to carry out scenario analyses in a certain way, expresses something different than his/her personal needs.

The key issue here is that we try to discover whether policy advisors would apply certain expertises if there were no barriers, regardless whether they think it is necessary to apply it. For that reason this important notification is raised to all the respondents, but it has to be kept in mind that the data may be distorted due to a misinterpreted definition of the term ‘needs’.

Error Sensitive Judgments
In some cases it can be hard for respondents to explicitly judge whether there is a need for certain types of expertise. If one has no experience with a particular expertise, he/she may estimate that there is a need for it while not being completely certain. This is not surprising, since in such a case the respondent is asked to make a judgment based on his/her intuition, rather than on his/her experience.

To take account of such error sensitivity in the judgments of the respondents, they have been taken in the calculations as half weighed counts. For example, there are ten respondents who judge whether there is a need for expertise ‘X’ or not. Among them, there are nine respondents who are completely certain that there is a need. The tenth respondent (who has no experience with the expertise), thinks that there is a need for it but does not confirm it explicitly. The resulting score for expertise X is 9,5 ‘needed’ and 0,5 ‘not needed’. Note that since in this example there were ten respondents who made a judgment, the score needs no transformation to the scale from 0 – 10. In case there are more than ten
judgments, a single error sensitive judgment has a smaller impact on the total score (e.g. 9.7 ’needed’ and 0.3 ’not needed’).

In case there are many respondents who do not give completely explicit judgments, the resulting scores are more error sensitive. The cases in which there are two or more error sensitive judgments are indicated in the graphs by means of horizontal error bars with edge markers on both sides: [---------]. This illustrates the interval of the potential error. The greater the potential error, the larger the interval. Note that this interval is transformed to the scale from 0 – 10, just like the scores are.

**Example:**

There are 12 respondents who do a judgment about the needs for expertise ‘X’. Six of them are certain that there is a need for that expertise and three assume that there is a need but are not completely certain. The consequence is that one quarter of the judgments is error sensitive. On a scale from 0 – 10 it means that the certain score equals 5.0 points and the error sensitive judgments equal 2.5 points. By counting the three error sensitive judgments with half weights, the resulting score becomes 6.25 \( \frac{5.0 + \frac{2.5}{2}}{2} = 6.25 \). If none of the error sensitive judgments would be counted, the score should equal 5.0. If they would all be regarded as certain judgments, the score would equal 7.5. This is illustrated with the error bar that ranges from 5.0 to 7.5.

### 4.2 Results from Analysis of Needs

The results will be described on the basis of a first quick scan over the quantitative results, followed by a more detailed elaboration of the remarkable findings. The expertises that belong to one attribute group are altogether discussed in one sub-paragraph: ‘Principal Characteristics’ (4.2.1), ‘Approach’ (4.2.2), ‘Resulting Scenarios’ (4.2.3), ‘Participation’ (4.2.4) and ‘Adaptive Policymaking’ (4.2.5).

#### 4.2.1 Principal Characteristics

The scores of the expertises that belong to the principal characteristics of scenario studies can be seen in figure 4-2 “The Needs for Expertises belonging to Principal Characteristics”:
The upper two bars indicate that among the interviewed policy advisors the need for specific scenarios is stronger than the need for generic ones.

The fact that no strong need is expressed for developing generic scenarios probably is related to the role of the policy advisors who have been interviewed. They are mainly involved in developing scenarios within specified problem frameworks from their institutional departments. For that purpose, their scenario analyses aim to generate information about problem-specific uncertain factors, such as the regional commuter density in the year 2020. A few respondents however expressed a need for a more generic approach, since such an approach provides more room to think broadly.

The CPB (Netherlands Bureau for Economic Policy Analysis), which is an independent institute, is more involved in developing generic scenarios. Those scenarios can be used to develop specific scenarios, for example for transport infrastructure studies. The institutes

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53 An example of generic scenarios that are developed by the CPB is the ‘Four Futures of the Netherlands’, which is based on the ‘Four Futures of Europe’. Another (older) study is the ‘Environmental Scenarios – Long Term Explorations 1995 – 2020’. These generic scenarios are for example used by the Dutch Ministry of Transport for determining their long-term policy plans in the Mobility Paper. Before they could make those plans, they had to transform the generic CPB scenarios into more specific scenarios containing mobility forecasts.
that are charged with the responsibility to develop policy plans (such as a ministerial department) are more likely to need such specific problems. Most respondents explained that they do use generic scenarios that are provided by the CPB, but that they develop specific scenarios.

**Nature**
Most policy advisors explained that there is a too strong tendency to keep to the principles of trend forecasting, i.e. think of the future as a continuation of the past. The reason is probably that trend extrapolations can easily be made and communicated. By bringing slight changes to those trends it is fairly easy to construct several scenarios. They argued that they prefer to think more broadly about the future and that that is important to develop effective policies. Normative scenarios are built on the basis of different visions of the future (Godet and Roubelat 1996), which requires to think broadly.

This may explain why there is a reasonable need for normative scenarios. The results also indicate that exploratory scenarios are favoured among the respondents. Exploratory scenarios are useful to develop policies or to evaluate them. They can also be used to assess whether policies are robust (Riet 2003). Since the respondents are selected on the basis that they have been involved in transport policy studies, it is understandable that they express a need for exploratory scenarios. Those scenarios help them to assess the transport policies they study/develop.

**Time Perspective**
Half of the respondents expressed a need for a continuous time perspective. There were more respondents who said that there is a need for a discrete time perspective. Some of them notified that a discrete time perspective can comprise a single point of time but also multiple points of time. They added that it is not necessary to have continuous scenario descriptions, but that several time points can suffice. The distinction between a single time point and multiple time points is not addressed in the framework. An expression of needs for a time perspective with multiple discrete points is counted as a score for the ‘discrete time perspective’ in the framework.

**Orientation**
Especially policy scenarios seem to be favourable among the respondents. Most policy advisors that are interviewed are often involved in evaluating policies. In such evaluations the specific policies are tested in different configurations, which explains why they need policy scenarios rather than scenarios that only describe external environment.
4.2.2 Approach

The scores of the needs for expertises belonging to the approach are presented below:

**Figure 4-3 The Needs for Expertises belonging to ‘Approach’**

**Content Focussed**

Content focussed scenarios seem strongly needed for the purpose of ‘developing policy options’ and for ‘evaluating policies’. The need for scenarios to ‘manage risk’ is lower according to the scores. Those three purposes for which content focussed scenarios can be used are discussed separately.

**Develop Policy Options**

As a response to debates about the public responsibility for infrastructure projects, the Ministries of Transport and Economic Affairs\(^{34}\) initiated the ‘research programme on the economic effects of infrastructure’\(^{35}\) in the late 1990s. It has lead to directives for the procedure of doing cost-benefit analyses for project evaluations. Those evaluations are strongly content focussed and one key input to the cost-benefit analyses is the set of policy options that are developed by (transport) policy advisors. That means that the policy options need to be content focussed to be compatible for the cost-benefit analyses. This explains why the respondents expressed a need to develop content focussed policy options.

**Evaluate Policies**

As mentioned above, cost-benefit analyses are widely used in the Dutch policy domain to evaluate policies both ex ante and ex post. This is often a strongly content focussed process.

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\(^{34}\) Ministerie van Economische Zaken (EZ)

\(^{35}\) Onderzoeksprogramma Economische Effecten van Infrastructuur (OEEI)
The scenarios that are used for those evaluations therefore also need to be content focussed, which explains why more than half of the respondents expressed a need for it.

**Manage Risk**
Managing risk is important when conducting a project. Developing scenarios helps to identify what events that have great impacts on the success of the project may occur. This is an important activity when designing and managing a project. Policy studies that are done for infrastructure projects are usually of another nature: they concern the feasibility or the actual effectiveness of the policy. Managing risk is not a crucial issue in this stage. This explains why the needs for scenarios with the purpose to manage risk are not strong among the interviewed policy advisors. They are more involved in feasibility studies or evaluations, rather than designing or managing projects.

**Process focussed**
The figures indicate that applying scenarios to achieve consensus or to broaden the mindset are favoured by the transport policy advisors. The need to use it for training the participants seems negligible.

**Achieve Consensus**
Consensus between actors is often remarked to become an important issue of policymaking since it increases the support for policies. More than half of the respondents confirmed that there is a (growing) need for methods that serve to achieve consensus, be it scenario analysis or any other method.

**Training the Participants**
Applying scenario analyses to train the participants is clearly not favoured among the respondents. This is probably due to the fact that tasks and responsibilities of the interviewed policy advisors do not include training.

**Broaden the Mindset**
It has been mentioned by several respondents that it is useful to broaden the mindset of policy advisors themselves in order to stimulate more creativity. They added that to achieve this it is necessary to involve a wide variety of participants. On the other hand there are policy advisors who are engaged in strongly focussed studies for well specified problems with a narrow scope. This does not necessarily call for broad problem solving approaches. The scores of the needs are equally spread.
4.2.3 Resulting Scenarios

All figures concerning the ‘resulting scenarios’ indicate strong needs:

Figure 4-4 The Needs for Expertises belonging to ‘Resulting Scenarios’

Outlook

According to most respondents there is a need for both a discrete and a continuous outlook of the scenarios.

Many respondents explained that discrete scenarios are sufficient to support dealing with uncertainty in transport policy problems. The advantage of discrete scenarios is that they are easily understood. It is more practicable to describe single future states of the world than ranges of futures. They also said that doing a sensitivity analysis for each uncertain factor makes those scenarios continuous in their outlook, since it makes them envelop a range of outcomes rather than point estimates.

Discrete scenarios are also said to have disadvantages. When describing well specified future states of the world, there is a common tendency to focus on those descriptions and to base policies on point estimates. To avoid that pitfall the interviewed policy advisors recommend to develop scenarios with a continuous outlook, even if requires more efforts. It forces the user to think about the future in terms of ranges, rather than in point estimates.\(^\text{56}\)

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\(^{56}\) Scenario studies often result in three or four scenarios. The ‘Environmental Scenarios – Long Term Explorations 1995 – 2020’ from the CPB contain three scenarios. This triggers the tendency among high level policymakers to base policies on the ‘middle scenario’ (Sluijs et. al. 2004), i.e. the scenario in which most factors have trend developments that are between those of the two other scenarios. One common argument to do that is that the middle scenario is a continuation of the past and that it is likely that those trends will carry on. Another argument is that there will be no strong negative consequences if the upper or lower scenario unfolds instead of the middle one. The Welfare and Environment study (WLO-studie) contains four scenarios. Most policy advisors say that this will hopefully resolve the tendency to focus on one scenario only, since there is simply no ‘middle scenario’. This issue illustrates that there is not just a tendency to fix one’s mind on discrete futures, but the tendency is even to focus on a single discrete future only.
Format
When policy studies are done for the purpose of budget planning it is important to have a quantitative basis since all budget items have to be well-grounded. The scenarios that are used for the policy study of such a budget plan need to contain sufficient quantitative data about the future. Besides, when policy plans have to be presented to decision-makers and stakeholders, it is important that it is a clearly defined and unambiguous plan. Quantitative information helps to avoid misinterpretations and ambiguity. Therefore policy goals, policies and measures often are supported with quantitative information. Hence, the need for quantitative scenarios is relatively strong.

A remarked disadvantage of quantitative scenarios is that it is limited those aspects that actually can be quantified (see also Sluijs et. al. 2004). Another disadvantage is that the development of quantitative scenarios often involves the use of modelling techniques which frequently results in surprise free scenarios. The desire to deal with fundamentally different futures can then not be fulfilled.

A combination of both qualitative and quantitative scenarios is broadly recommended as the best way to deal with uncertainties. Qualitative descriptions give an impression of the wide variety of possible futures and quantitative data is simply needed to enable content focussed policy studies (e.g. project- and budget planning).

4.2.4 Participation
Concerning the participation it must be notified that the interview questions about the interaction were not related to the answers about the participants. That means that the results about the interaction does not say anything about whom of the participants it concerns. The score are:

Figure 4-5 The Needs for Expertises belonging to ‘Participation’
Participants
It is often remarked that to gain support for a policy it is important to involve all different actors from an early stage. Most respondents said that involving them eventually results in better problem formulations and an increased likelihood that proposed policies will be approved. The need for involving all types of participants in scenario analyses is therefore high.

Interaction
There is absolute no need for one-way interactions with participants in scenario studies according to the interviewed policy advisors. Half of the respondents desire two-way interactions when carrying out scenario analyses and all of them favour a multi-way interaction. Multi-way interactions are established in the form of workshops or group discussions, which are methods that allow for a better dialogue than closed interviews (one-way interaction) or private interviews (two-way interaction).
4.2.5 **Adaptive Policymaking**

The score of the needs for ‘signposting’ and the four variants of option thinking are elaborated separately.

**Figure 4-6 The Needs for Expertises belonging to ‘Adaptive Policymaking’**
**Signposting (e.g. with Trigger Values)**

Monitoring uncertain factors is in general seen as something important to maintain effective policies. On the other hand it is also remarked that sudden (unexpected) changes of factors that affect policy outcomes automatically draw the attention of policymakers, so signposts are not needed. When important factors do change dramatically (e.g. due to a sudden economic recession) and the success of a policy is threatened, the issue of adapting the policy automatically comes on the agenda. In accordance with this point of view, it is not surprising that some respondents expressed no need for a systematized procedure to monitor the environment.

This is obviously a reactive attitude, whereas the idea of signposting with trigger values stimulates a proactive attitude towards adapting policies. The difference is that systematic signposting enables to avoid policymaking on an ad-hoc basis. Around half of the respondents said that there is a need for it.

**Shaping**

**Option to Influence**

According to the scores, there is no dominant need for considering the option to influence uncertainty. To influence uncertainty is regarded important and effective, but not all respondents find it necessary to extensively consider whether it should be done or not.

**Option to Investigate**

According to the respondents, investigation is continuously done with the purpose to reduce uncertainties. On the other hand, determining whether investigation reduces uncertainty to that extent that it is worth the involved efforts is needed according to a bit more than half of the respondents. It is not surprising that in case of large scale projects, considering the option to investigate will most probably end up in deciding to actually carry out the investigation. Most times the reduced uncertainty will counterbalance the required efforts of the investigation.

**Option to Divide-up Risk**

The majority of the respondents mentioned that there is a need for dividing-up risk in public infrastructure projects. They referred to Public Private Partnerships (PPPs), which is elaborated in a directive for cost-benefit analyses\(^ {37} \) when evaluating infrastructure projects. In that directive it is mentioned that PPPs become more and more common (Centraal Planbureau and Nederlands Economisch Instituut n.d.). The aim of PPPs is to gain more transparency in the costs, benefits and risks of a project. Only when that is clear, it can be determined which parties will carry certain risks.

According to the directive, analyzing the options to divide-up risks is to be carried out after completion of the cost-benefit analysis. There are useful tools that enable to determine whether PPPs should be done or not. These tools are called the 'Public Private Comparator' and the 'Public Sector Comparator'.\(^ {38} \) In such an analysis it is assessed

\(^{37}\) This directive is created as part of the ‘research programme on the economic effects of infrastructures’, in Dutch the ‘Onderzoekprogramma Economische Effecten van Infrastructuur’ (OEEI).

\(^{38}\) The Public Private Comparator and the Public Sector Comparator are tools that demonstrate whether the Net Present Value of a PPP construction is higher than when a project is carried out by the public sector only.
whether a hybrid of public and private organisations leads to a better cost-benefit ratio or whether the project should be conducted by public organisations only. Private organisations demand high returns on their investments when risks are high, which means that the risks involved in the project strongly determine whether a PPP construction is attractive or not.

**Hedging**

**Option to Insure**

One raised argument against the use of insurances by the government is that the risks they can carry need no insurance and the insurance of risks they can not carry are too costly. Insurer will require extremely high prices for the risks the government can not carry (also called non-diversifiable- or macro-economic risks). It is also mentioned in the report about risk assessments for public infrastructure investments (Commissie Risicowaardering n.d.) that insurances against shocks in costs and benefits of projects often lack because they would be too costly. The government does attempt to insure projects by incorporating a risk surcharge in the cost-benefit calculations. This surcharge is supposed to reflect the magnitude of the macro-economic risks, although it is hardly possible to estimate the magnitude of such risks. This is something different than the definition of the ‘option to insure’, which really concerns the involvement of an insurer. As can be seen in the graphs, more than 2/3s of the respondents said that there is no need to insure infrastructure projects.

**Option to Exit**

There are many discussions about keeping the option to exit among when it comes to transport infrastructures. The ‘Betuwelijn’ is an example of a project of which the costs highly overrun the forecasted revenues. The project is anyhow carrying on, which means that ‘to exit’ is not considered a serious option. Most of the respondents explained that in their eyes there are high psychological barriers of cancelling such a mega-project. It feels like a big loss when aborting a project at a late stage, even if the actual loss is greater when that project is carried on. Some of them said that there is nevertheless a need to incorporate the option to exit in projects. On the other hand the majority said that there is no need since those projects will most probably be efficient anyway, albeit in 50 years.

**Option to Diversify**

The interviewed policy advisors who have been involved in policy studies for specific projects (e.g. the Zuiderzee Line or MIT-projects) mentioned that there is no need for diversifying risks. The smaller MIT-projects are done for local bottlenecks in the traffic flow and in such studies there are limited opportunities to diversify the risks over several policy alternatives.

The respondents who have been involved in policy studies for higher level policy plans (e.g. the Mobility Paper or the Policy Letter for Freight Transport) did express a need for diversifying risks by implementing various policy alternatives at the same time. Those plans are made to achieve high level policy goals for which there are often multiple alternatives. An example of a high level goal is the “improvement of the traffic flow across the Netherlands”. There are several policy alternatives such as the implementation of road tolls, increasing carpool facilities and introducing a levy on mileage on peak hours. The effectiveness of those alternatives is probably more uncertain compared to alternatives for
local bottlenecks (e.g. road expansion or placing traffic lights). Therefore it is more interesting to consider the option to diversify in studies for high level policy plans.

Some of the interviewed policy advisors were involved in infrastructure projects and others were involved in studies for higher level policy plans, which explains why the scores are somewhat equally spread on both sides of the graph.

**Dynamic Decision-making**

*Option to Delay*

Less than half of the respondents indicated that it is interesting to consider the option to delay within infrastructures projects. Most of them said that ‘delaying’ is a common topic of discussion for public projects but to formally integrate that in the decision-making process seems not so necessary. It is also mentioned that sometimes studies are done to determine which projects must be prioritized over others (often in case of MIT-projects). That includes the consideration of delaying certain (less urgent) projects. The purpose in that case is slightly different than the objective to wait until uncertainty becomes resolved.

*Option to Phase*

The option to phase is one of the most favoured expertises that belong to adaptive policymaking. The reasoning is opposite to that with the option to diversify: when speaking of policy studies for physical infrastructures, the option to phase is an interesting aspect. It is interesting when developing policy alternatives for infrastructures or when evaluating them. Those who were involved in studies that are used to develop higher level policy plans did not express a strong need for it.

*Option to Accelerate/Decelerate*

Studies to determine the prioritization of MIT-projects are done regularly, which is also mentioned when raising the issue of the option to delay. In those cases it is important to be able to determine which projects should be accelerated vs. decelerated. On the other hand it is mentioned that the decision-making processes for public infrastructures is already so complex that integrating the issue of accelerating/decelerating is not favourable. The majority expressed no need for this option.

**Robust Policymaking**

*Option to Switch*

A recurring remark that was made about the option to switch is that it is only interesting for specific cases in which it is technically feasible. If it is technically possible, it is likely to involve high investments. It is also complicated to determine whether it is worth those investments with regard to the improved robustness against uncertainty.

There is a practical example of a transport infrastructure in which the option to switch is incorporated: the Zuidtangent\(^\text{39}\). The initial plan was to construct a bus-lane between the cities but it was not certain whether that would remain the best suitable transport modality in the far future. It was acknowledged that a light rail may be more interesting in the

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\(^{39}\) The Zuidtangent is a bus connection between Haarlem and Hoofddorp, with Schiphol Airport in between. It provides a fast connection between the international airport and two cities where a significant portion of its labour force is accommodated.
future, when the light rail technology is further developed. Therefore it was decided to accommodate a bus connection but to construct the infrastructure in such a way that it remains possible to switch to a light rail system in the future. It did involve a cost surplus to construct it that way, but the decision-makers apparently agreed that the option to switch to light rail counterbalanced the uncertainty.

The majority of the policy advisors indicated that regardless of the technical feasibility or other complications, there is a need for integrating the option to switch in transport infrastructures.

**Option to Grow**
Integrating the option to grow in an infrastructure means that the opportunity to expand that infrastructure in the future is retained. In general, keeping the option to grow in infrastructures is seen as a good way to make the plan robust against uncertainties. It only becomes complicated when a spatial reservation (which is a way of keeping the option to grow) restricts other parties to utilize that space (e.g. real estate investors who want to build a business park). The question is: what is more appropriate; to reserve an area for potential expansion in the future or to utilize it for any other kind of activity?

A practical example of this issue can be found in the Mobility Paper. In that paper it is stated that “to avoid possible hindrance of future expansions and/or bundling of the main infrastructure, the space around it must remain available. It is however not reasonable and not necessary to reserve space around the complete main infrastructure. Especially in urban areas it is the challenge to find a balance between reserving space for infrastructure and the claims for that space for other (urban) activities” (Ministerie van Verkeer en Waterstaat 2004). There are no explicit statements about how that balance is to be found. It is only said that if other urban activities are taking place after an infrastructure expansion has been announced, the additional costs to expand that infrastructure will have to be covered by the concerning municipality. This means that in fact no attention is paid to the value of accommodating (urban) activities versus the value of the option to grow.

In the example above it appears that attention is paid to the option to grow, but in a very implicit manner. No explicit attention is paid to finding the balance between the option to expand versus accommodating other activities. Most respondents confirmed that there is a need for more explicit growth option analyses.

**Option to Adjust Operational Scale**
The option to adjust the operational scale is more applicable to the users of the infrastructure, after its construction is accomplished. Those users are mainly private companies (e.g. the Dutch railway operator ‘NS’). Whether they have a need to adjust their operational scale is not directly an issue for the policy advisors who have been interviewed.

Several policy advisors did give examples of ‘adjusting the operational scale’ that are less directly related to the infrastructures themselves, but more to their construction. An example is adjusting the Labour force of infrastructure constructors when it appears necessary. This can be useful when the option to accelerate/decelerate or the option to delay is exercised, but it requires more flexible labour contracts.
The needs for this option with regard to transport infrastructures are equally spread over both sides of the graph.

4.3 Conclusions from the Analysis of Needs

The aim of this chapter is to find out which expertises within the next generation scenario framework are strongly needed according to the interviewed transport policy advisors. Based on the findings that are elaborated in this chapter a few intermediate conclusions can be made:

Concerning the principal characteristics of the scenarios that are developed the following can be concluded:

- Contrary to specific scenarios, there is no need to develop generic scenarios for the purpose of transport infrastructure studies.

- Exploratory scenarios are needed to enable the assessment of policies but since those are often not extremely different in reality, normative scenarios are also needed: they are more likely to make policymakers think broadly.

- A continuous time perspective is not strongly needed since it complicates the analyses. Multiple discrete time points are sufficient, e.g. for the purpose adaptive policymaking.

- Some of the respondents do need scenarios about the policy environment but most of them desire scenarios that relate to specific policies.

Both content focussed- and a process focussed approaches seem needed according to the respondents, with some exceptions:

- Content scenarios are needed to develop policy options and evaluate policies (managing risk does not belong to the tasks and responsibilities of the interviewed policy advisors)

- Process focussed scenarios are needed for the purpose of achieving consensus and broadening the mindset (the purpose to train the participants of the scenario study is not needed).

The scenarios that result from the analyses need to:

- …have a discrete outlook to be easily interpretable, although a continuous outlook illustrates that the future is variable and avoids making plans on point estimates;

- …contain quantitative data to support the making of detailed policy plans supplemented with qualitative descriptions that illustrate the wide variety of possible futures to avoid ‘fixation’.

Concerning the participation:

- All types of participants need to get involved in the scenario studies for transport infrastructure policymaking (analysts, experts, stakeholders and problem owner).

- They should get involved in the analysis by means of two-way interaction (e.g. open interviews) or preferably by means of multi-way interaction (e.g. workshops
and group sessions). There is no need for one-way interactions in scenario analyses (e.g. surveys).

About adaptive policymaking the following can be concluded:

- The needs for any of the expertises that can be used to enable adaptive policymaking are neither extremely high nor low.
- Dividing-up risk is tried to be achieved by means of Public Private Partnerships.
- In the Mobility Paper the option to grow is being considered although but it is not explicitly analysed. There is a need for a more explicit approach of analysing the options to grow.
- There are a few conditions that determine whether there is a need for certain expertises:
  - The option to diversify becomes interesting when policy plans are made that contain sets of policy alternatives to achieve high level policy goals, rather than studies focussed on small scale transport bottlenecks.
  - The option to phase is interesting to those who are involved in policy development for- and evaluations of physical infrastructures, rather than for those who do studies that are not directly related to infrastructures.
  - Policy advisors first need to be convinced that it is technically feasible to incorporate the option to switch in transport infrastructure projects before they will be interested in applying it.

This measurement of needs only provides a rough indication and concerns transport policy advisors who are involved in policy studies for infrastructures. Although there is a need for particular expertises, those expertises are not necessarily used in practice by the policy advisors. That would mean that there are cases of underuse. When cases of underuse are discovered, the relating causes can be investigated. These issues are elaborated in the following two chapters.
CHAPTER 5  Detecting the Underused Expertises

This chapter is dedicated to the goal of discovering which expertises are significantly underused. This is done by figuring out which expertises are not applied by policy advisors although they perceive a need for them, which corresponds to the third partial research question:

“Which expertises are significantly underused by transport policy advisors?”

a. Which expertises are applied in practice by transport policy advisors?

b. Which expertises are simultaneously needed and not applied by transport policy advisors?

The term ‘expertises’ refers to those types of expertise that are included in the next generation scenario framework.

The requirements to detect possible underuse are:

- To have data about the extent to which the expertises are needed by transport policy advisors
- To have data about the extent to which the expertises are applied by the same policy advisors

The first requirement is fulfilled and is elaborated in the previous chapter (see Chapter 4 “The Needs for the Next Generation Scenario Expertise”). The second requirement is fulfilled with a similar analysis and is elaborated in the first paragraph of this chapter (5.1). The data that is analysed for that purpose is collected by means of the pre-structured interviews. This research activity - which is called ‘the analysis of practices’ - relates to sub-question ‘a’: “Which expertises are applied in practice by transport policy advisors?”. To find the answer to the second partial question, a comparative analysis is done of the ‘practices and needs’ (5.2). The key issue is to discover whether there are cases in which policy advisors do not apply expertises whereas it would fulfil their needs. This results in a collection of data about the extent to which each expertise is underused. The last step is to elaborate on the expertises that are predominantly underused (5.3).
5.1 Investigation of ‘Practices’: the Extent to which the Expertises are applied by Policy Advisors

In the first sub-paragraph an explanation is given of how the data is collected (5.1.1). The main purpose of that data is to do a comparative analysis to detect possible underuse, which is elaborated in paragraph 5.2 “Building Blocks for Detecting Possible Underuse”.

By doing a simple analysis of this data, we obtain an overview of the number of respondents who actually apply each expertise. This information is not relevant for the following research steps but it does provide some interesting information. How that simple analysis is done is explained in sub-paragraph 5.1.2. The results of that analysis are briefly discussed in the last sub-paragraph (5.1.3).

5.1.1 Procedure of Data Collection

During the pre-structured interviews the expertises within the next generation scenario framework are explained to the respondents. They are asked whether they applied each of those expertises in their transport infrastructure policy studies or not. In other words, the way the data is collected is similar to that of the needs, since the respondents are given two exclusive options to answer the questions (See Figure 5-1 “Optional Judgments about Practices concerning the Next Generation Scenario Expertise”).

Figure 5-1 Optional Judgments about Practices concerning the Next Generation Scenario Expertise

<table>
<thead>
<tr>
<th>Practices</th>
<th>Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not applied</td>
</tr>
</tbody>
</table>

The data collection results in an overview per respondent, containing information about which expertises each of them actually applies in practice. This is important for the comparative analysis because that is focussed on detecting cases of underuse per respondent.

5.1.2 Analysis of the ‘Practices’

To obtain an overview of the extent to which each expertise is applied, the number of affirmative answers is counted. As with the questions about the needs, some respondents are not capable of answering e.g. because they just do not know all the details of how the scenario study is carried out. Therefore the total number of affirmative answers is divided by the number of respondents who did answer the question, which results in ratio. This value is transformed to a scale of 0 (zero) to 10 (ten), ‘0’ indicating that it is not applied by any of the respondents and ‘10’ indicating that all respondents apply it.

Since the pre-structured interviews are held with 12 respondents only, the resulting data about the extent to which the expertises are applied in practice is merely indicative.
5.1.3 **Results from Analysis of ‘Practices’**

The results from the analysis of practices are only a side-product of the research. They are not necessary for the comparative analysis or any other research step. It is anyhow interesting to get an impression of which expertises commonly applied by transport policy advisors for their infrastructure scenario studies. It is also interesting to see whether several expertises are not applied at all. The graphs presenting these results can be found in Appendix D “The Extent to which the Expertises are Applied”. A brief summary of those results is given below:

About principal characteristics of the developed scenarios the following can be derived from the graphs:

- Generic scenarios (i.e. not related to any policy problem) are hardly developed by the policy advisors. They are more engaged in scenario studies for specific projects.
- In most cases the scenarios are exploratory, in few cases they were used for backcasting (normative).
- The scenarios most often have a discrete time perspective: a single point of time in which the futures are described. In one case the time perspective contained multiple time points.

This is related to the fact that most of the interviewed transport policy advisors use *generic* scenarios that are provided by the independent planning bureaus (e.g. the CPB) and use them as a basis to develop *specific* scenarios. Because the scenarios they use as a basis are often about a single point of time in the future, their own developed scenarios are likewise discrete.

- They mainly develop policy scenarios but also concentrate on the policy environment.

The approach is most often content focussed:

- A content focussed approach is applied to develop policy options and to evaluate policies. Managing risk is hardly the objective.
- Using scenarios to support decision-making processes, training participants or broadening their mindset is less common.

About the resulting scenarios the following can be derived from the analysis:

- All respondents said that they develop scenarios with a discrete outlook (describing point estimates of the future). Sometimes it is combined with a continuous outlook (discrete futures including intervals of several important factors).
- Both qualitative descriptions and quantitative information is provided in the scenarios they develop.
Concerning the participation:

- Analysts, experts, stakeholders and problem owner all get involved in the scenario studies. According to the respondents the first two are intensively involved from start to end, whereas the stakeholders and problem owner are more involved in the in the initial phase.
- One-way interactions with the participants are hardly applied, two-way interactions sometimes and multi-way almost in all cases.

About the expertises that belong to adaptive policymaking a general conclusion can be made that the majority has not applied them in their policy studies for transport infrastructures.

In addition it is mentioned that active monitoring of the environment (i.e. ‘signposting’) is hardly applied. Some said that the only way of monitoring the environment is done by interpreting the scenarios that are developed by the planning bureaus (e.g. CPB). They develop generic, exploratory scenarios about the policy environment, providing insight in how uncertain factors might develop. This is only useful for long-term policymaking, but not when it is the aim to actively adapt policies in accordance with the continuously changing environment.

One recurring remark was about the option to grow. It is often said that the option to grow is being considered within transport infrastructures, but very implicitly. No frameworks are used to explicitly determine whether it is necessary to integrate an option to expand the infrastructure. The extent to which the infrastructure needs possible expansion is even given less attention.

5.2 Building Blocks for Detecting Possible Underuse

The data that is used to detect possible underuse among the expertises is the information about the needs for- and the use of each expertise (5.2.1). Both are collected during the pre-structured interviews. The analysis of this data is done on the basis of a framework that is made up for this particular research. It is referred to as the ‘framework for comparative analysis’ (5.2.2). After using the framework, several analytical steps are taken to obtain information about the extent to which each expertise is underused (5.2.3). Using the framework for comparative analysis does not only reveal whether an expertise is underused, but also whether it is for example ‘overused’. The relating implications are elaborated in sub-paragraph 5.2.4. The results of the comparative analysis are presented and discussed in the last sub-paragraph (5.2.5).

5.2.1 The Collected Data for Detecting Underuse

In the second round interviews, each respondent is asked whether he/she does or does not apply each expertise from the next generation scenario framework. This is referred to as a ‘judgment about the practices’. Similarly, the respondent is asked whether he/she does or does not need each expertise. This is referred to as a ‘judgment about the needs’. The result is that each respondent gives a duplicate judgment about each expertise which is necessary for the next step: comparing it by means of the ‘framework for comparative analysis’.
In case a respondent indicates that an expertise belonging to adaptive policymaking is underused, he/she is asked whether it concerns qualitative or quantitative application of that expertise. The idea is that the twelve types of option analysis can be done qualitatively and/or quantitatively. In addition to that, signposting can be done intuitively or on a more systematic basis with real numerical values. By asking this question we attempt to figure out whether underuse among the adaptive policymaking expertises concerns a specific way of applying it. This information is recorded and is used in the comparative analysis.

5.2.2 Framework for Comparative Analysis

The framework with which the comparative analysis is done is based on principles that are similar to the RAND/UCLA Appropriateness Method (RAM), which is briefly explained in the first section. The second section of this sub-paragraph is dedicated to explaining the framework itself.

The RAND/UCLA Appropriateness Method

The RAM is a method that is developed and used by the RAND Health domain to examine whether medical treatments are appropriately applied or not (Kahan et al. 2001). There are two reasons why the basic principles of the RAM are useful for the comparative analysis in this particular research. The first reason is that in both cases experts are engaged in doing a duplicate judgment: one about the use of a certain expertise and one about the need for that expertise. The second reason is that the method leads to an overall judgment whether that expertise is appropriately used or not.

With the RAM, experts (i.e. doctors) are engaged in doing a duplicate judgment about particular medical treatments. The judgments are about in what cases those treatments are applied and in what cases they should be applied. If a treatment is being applied whereas the doctors judge that it should not be, it means that that treatment is ‘overused’. If a treatment is not applied whereas the doctors judge that it should be, it means that that treatment is ‘underused’. In both cases they speak of inappropriateness. Appropriateness is likewise possible. This occurs when the treatment is applied when it should be, and is not applied when it should not (according to the doctor’s judgments who take part in the research).

The Framework for Comparative Analysis in this Research

The framework for comparative analysis in this research can be seen below (Table 5-1 “Framework for Comparative Analysis”). There are four quadrants, each referring to one ‘category of appropriateness’. Comparing the policy advisor’s judgment about practices to his/her judgment about needs results in a ‘category of appropriateness’ for each particular type of expertise.
Table 5-1 Framework for Comparative Analysis

| Categories of Appropriateness | Needs          |
|------------------------------|----------------
|                              | Needed | Not Needed |
| Practices                    | Applied |           |
|                              |         | Appropriate use | Overuse |
|                              | Not Applied |           |
|                              |         | Underuse | Appropriate non-use |

Those categories are:

- **Appropriate use (upper left quadrant)**
  
  When the respondent applies a type of expertise and also perceives a need for that expertise, the expertise is allocated to the category ‘appropriate use’.

- **Overuse (upper right quadrant)**
  
  If the respondent applies the expertise but judges that there is no need for it, it is allocated to the category ‘overuse’.

- **Appropriate non-use (lower right quadrant)**
  
  A combination of no application and no need results in the category of ‘appropriate non-use’.

- **Underuse (lower left quadrant)**
  
  The category of ‘underuse’, which is the main focus in this research, is the case when the respondent does not apply the expertise but claims that there is a need for it.

In case of underuse, special attention has to be given to the arguments of the respondent. The given arguments are important information for this research, since it is the ultimate aim to discover the causes of underuse.

5.2.3 Comparative Analysis

The goal of the comparative analysis is to discover to what extent each expertise is underused. To achieve this goal, three sequential steps are taken.

*Step 1: Determining the category of appropriateness*

In this step, the framework for comparative analysis is used. Per expertise, each respondent’s judgments about ‘practices’ and ‘needs’ are compared. The expertise gets one point in the category of appropriateness according to the framework for comparative analysis. The remaining categories receive zero points.
Example:
Respondent ‘R₁’ judges that expertise ‘X₁’ was not applied in their scenario study for a transport infrastructure project. She also claims that if it was up to her, she would have applied that expertise because she thinks it is needed. The points for X₁ according to respondent R₁ become:

<table>
<thead>
<tr>
<th></th>
<th>Needed:</th>
<th>Not Needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied:</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Applied:</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

When a respondent does not provide any judgement, all categories receive zero points.

In sub-paragraph 4.1.2 “Misinterpretations that can occur during the Interviews”, it is explained that in some cases not all respondents could judge with full confidence that there is a need for particular expertises. This occurred in some of the cases when the respondents did not have any experience with that expertise. Since those judgments are counted as half ‘needed’ and half ‘not needed’, it means that in the comparative analysis half a point is allocated to the category ‘appropriate non-use’ and the remaining half to ‘underuse’.

Example:
Respondent ‘R₇’ also said that expertise X₁ was not applied in his scenario study. He said that probably there is a need for it, not being completely sure. The point would be distributed as follows:

<table>
<thead>
<tr>
<th></th>
<th>Needed:</th>
<th>Not Needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied:</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Applied:</td>
<td>0,5</td>
<td>0,5</td>
</tr>
</tbody>
</table>

Applied:

Not Applied: 0,5

Needed:

Not Needed: 0,5
Step 2: Calculating the total scores of all respondents

After having determined how the points are allocated per respondent, the total scores for each category can be calculated. The result is a set of four total scores per expertise.

Example:

All 12 respondents did judge about expertise X1. From exercising step 1 for all the responses, the following table can be filled in:

<table>
<thead>
<tr>
<th>Expertise 'X1'</th>
<th>R_1</th>
<th>R_2</th>
<th>R_3</th>
<th>R_4</th>
<th>R_5</th>
<th>R_6</th>
<th>R_7</th>
<th>R_8</th>
<th>R_9</th>
<th>R_10</th>
<th>R_11</th>
<th>R_12</th>
<th>Total scores:</th>
</tr>
</thead>
<tbody>
<tr>
<td>\sum_{i=1}^{12} R_i^{AU,X1} = 1 + 0 + 0 + 1 + 1 + 0 + 0 + 1 + 0 + 1 + 0 + 0</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>\sum_{i=1}^{12} R_i^{OU,X1} = 0 + 0 + 0 + 0 + 0 + 1 + 0 + 0 + 0 + 0 + 0 + 0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>\sum_{i=1}^{12} R_i^{AN,X1} = 0 + 1 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 1</td>
<td>3,5</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>\sum_{i=1}^{12} R_i^{UU,X1} = 0 + 0 + 1 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 1 + 0</td>
<td>2,5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of responses (n): 12

R_i = Respondent 'i'
AU = Appropriate use
OU = Overuse
AN = Appropriate non-use
UU = Underuse

This means that:
\[ \sum_{i=1}^{12} R_i^{AU,X1} = \text{“the sum of the points that are given to the category ‘Appropriate use’ for Expertise X1, by respondents R}_1 \text{ to R}_{12}” \]

This step is repeated for each expertise (X1 through X38, since there are 38 types of expertise in the Next Generation Scenario Framework).
**Step 3: Transforming the total scores to a scale from 0 – 10**

Since in some cases not all respondents could provide a judgment (e.g. because they just did not know), the total scores have to be made comparable with each other by transforming them to a standard scale from 0 -10. This is done in the third step by dividing the total scores by the number of received responses and multiplying that by 10.

**Example:**

The four total scores from the previous example are would become:

\[
S_{AU \_ X1}^{AU \_ X1} = \frac{\sum_{i=1}^{12} R_{AU \_ X1}^{AU \_ X1}}{n} \times 10 = \frac{5.0}{12} \times 10 = 4.2
\]

\[
S_{OU \_ X1}^{OU \_ X1} = \frac{\sum_{i=1}^{12} R_{OU \_ X1}^{OU \_ X1}}{n} \times 10 = \frac{1.0}{12} \times 10 = 0.8
\]

\[
S_{AN \_ X1}^{AN \_ X1} = \frac{\sum_{i=1}^{12} R_{AN \_ X1}^{AN \_ X1}}{n} \times 10 = \frac{3.5}{12} \times 10 = 2.9
\]

\[
S_{UU \_ X1}^{UU \_ X1} = \frac{\sum_{i=1}^{12} R_{UU \_ X1}^{UU \_ X1}}{n} \times 10 = \frac{2.5}{12} \times 10 = 2.1
\]

\[S = \text{total score on the scale from 0 - 10}\]

\[n = \text{total number of responses received}\]

This means that:

\[S_{AU \_ X1}^{AU \_ X1} = \text{"the total score for Expertise X1 in the category 'Appropriate use' on the scale from 0 - 10"}\]

Also this step is repeated for each expertise, after which all results are presented in one table.

**Step 4: Converting the total scores into graphs**

The last step is to create graphs to illustrate the extent to which each expertise scores in each category. The graphs have a square format with four quadrants. Each quadrant is dedicated to a category of appropriateness. In each quadrant a square coloured figure is drawn of which the area corresponds to the score in that category. A score of 10 results in a figure that fills the quadrant completely. A score of 5.0 would result in an area coloured up
to the axis marker. The colours used for each category are similar to the colours used in the previous examples (white = appropriate use, light grey = overuse, dark grey = appropriate non-use and blue = underuse).

Since the category of underuse is most relevant in this research, the corresponding numerical score is indicated in the lower left quadrant of the graph.

**Example:**

The four total scores from the previous example would be presented in the following way:

As mentioned in paragraph 5.2.1 “The Collected Data for Detecting Underuse” the respondents are asked whether underuse of any expertise belonging to adaptive policymaking concerns its quantitative or qualitative application. This information is taken into account when doing the analysis and is presented in the table containing all scores (not in the graphs).

5.2.4 **Possible Recommendations for Expertises that are not Underused**

The goal of this research is to discover which expertises strongly needed underused, with special regard to those that are underused. The causes and implications of underuse are extensively elaborated in the following chapters. The comparative analysis also reveals whether expertises score high in any of the three other categories, but the relating implications are only reflected upon briefly in this sub-paragraph.
- Appropriate Use:

  Expertises that are applied and needed according to most of the transport policy advisors should continue to be offered and promoted. They seem to be appropriate expertises for scenario studies in transport infrastructure projects. There are no barriers that refrain policy advisors from applying those expertises.

- Overuse:

  It may not seem reasonable that expertises are applied by transport policy advisors while they do not need them. This is however not impossible. A reason can be that policy advisors have to conform to regulations for conducting policy studies of infrastructures (e.g. policy evaluations). If those regulations enforce to use certain expertises that are not needed according to the policy advisors, there is a case of overuse. The recommendation for expertises that are predominantly overused is to continue to offer them but to remain aware of developments in the regulations. It is possible that after a period the regulations change and that certain expertises are no longer required to be applied in policy studies for infrastructures.

- Appropriate non-use:

  Concerning the expertises that are neither applied nor needed by policy advisors it is recommendable to cease offering them. It may be good to first investigate why there are no incentives for applying those expertises.

5.2.5 Analysis Results

The graphs with all the results from the comparative analysis can be found in appendix E “Results from the Comparative Analysis”. The table with all the scores can be found on the next page. Because the values are rounded off, the sum of the partial scores do not always equal 10.

A column is added for the expertises belonging to adaptive policymaking containing the proportion by which qualitative vs. quantitative application of those expertises is underused. If the score in the category ‘underuse’ equals 4.0 and one quarter of the respondents mention that the underuse concerns qualitative application of that expertise, this is indicated as “4.0 (1.0 – 3.0)”. It should at all times be reminded that these are rough indications since it is based on very few judgments only.

The underuse scores that are higher than 2.5 are indicated with an orange shading. The threshold value of 2.5 is used since it can be seen as a relative majority of the judgments. It indicates that out of all judgments (that are spread over four categories), more than a quarter resulted in ‘underuse’.
Table 5-2 Scores from Comparative Analysis

<table>
<thead>
<tr>
<th></th>
<th>Appropriate use</th>
<th>Overuse</th>
<th>Appropriate non-use</th>
<th>Underuse (Qualitative – Quantitative)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of scenario</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generic</td>
<td>1.7</td>
<td>0.0</td>
<td>8.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Specific</td>
<td>8.3</td>
<td>0.0</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Nature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exploratory</td>
<td>8.3</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Normative</td>
<td>4.2</td>
<td>0.0</td>
<td>3.8</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Time perspective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrete time perspective</td>
<td>8.3</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Continuous time perspective</td>
<td>1.7</td>
<td>0.0</td>
<td>5.0</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Orientation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policy environment scenarios</td>
<td>5.8</td>
<td>0.0</td>
<td>4.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Policy scenarios</td>
<td>8.3</td>
<td>0.0</td>
<td>0.8</td>
<td>0.8</td>
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<tr>
<td><strong>Content focussed approach</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop policy options</td>
<td>6.4</td>
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<td>3.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Evaluate policies</td>
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<td>0.0</td>
<td>4.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Manage risk</td>
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<td>0.0</td>
<td>7.3</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Process focussed approach</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achieve consensus</td>
<td>3.3</td>
<td>0.0</td>
<td>3.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Train participants</td>
<td>0.8</td>
<td>0.0</td>
<td>9.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Broaden the mindset</td>
<td>4.2</td>
<td>0.0</td>
<td>4.6</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Scenario outlook</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrete outlook</td>
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<td>0.9</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Continuous outlook</td>
<td>4.5</td>
<td>0.0</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>Format of resulting scenarios</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Qualitative scenarios</td>
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<td>1.7</td>
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<td>Quantitative scenarios</td>
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<td>0.4</td>
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<tr>
<td><strong>Participants</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analysts</td>
<td>9.2</td>
<td>0.0</td>
<td>0.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Experts</td>
<td>9.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.4</td>
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<tr>
<td>Problem owner</td>
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<td>0.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Stakeholders</td>
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<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Interaction with participants</strong></td>
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<tr>
<td>One-way</td>
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<td>0.9</td>
<td>9.1</td>
<td>0.0</td>
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<tr>
<td>Two-way</td>
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<td>0.0</td>
<td>4.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Multi-way</td>
<td>9.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Signposting</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trigger values</td>
<td>0.8</td>
<td>0.4</td>
<td>5.0</td>
<td>3.8 (1.5 – 2.3)</td>
</tr>
<tr>
<td><strong>Shaping</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influence</td>
<td>2.5</td>
<td>0.0</td>
<td>5.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Investigate</td>
<td>4.1</td>
<td>0.0</td>
<td>4.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Divide-up risk</td>
<td>4.6</td>
<td>0.0</td>
<td>3.5</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Hedging</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Insure</td>
<td>2.0</td>
<td>0.0</td>
<td>7.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Exit</td>
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<td>0.0</td>
<td>6.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Diversify</td>
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<td>5.2</td>
<td>0.7</td>
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<td><strong>Dynamic decision-making</strong></td>
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<td>Delay</td>
<td>3.6</td>
<td>0.0</td>
<td>5.5</td>
<td>0.9</td>
</tr>
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<td>Phase</td>
<td>2.5</td>
<td>0.4</td>
<td>3.1</td>
<td>4.0 (1.9 – 2.1)</td>
</tr>
<tr>
<td>Accelerate/decelerate</td>
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<td>0.0</td>
<td>5.7</td>
<td>2.0</td>
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<tr>
<td><strong>Robust policymaking</strong></td>
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<td>Switch</td>
<td>3.2</td>
<td>0.0</td>
<td>3.6</td>
<td>3.2 (1.4 – 1.8)</td>
</tr>
<tr>
<td>Grow</td>
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<td>1.3</td>
<td>1.9</td>
<td>3.1 (0.0 – 3.1)</td>
</tr>
<tr>
<td>Adjust operational scale</td>
<td>3.8</td>
<td>0.0</td>
<td>5.0</td>
<td>1.3 (0.8 – 0.4)</td>
</tr>
</tbody>
</table>

Scale: 0 – 10
5.2.6 **Reflection on the Results from the Comparative Analysis**

By reflecting on the results from the comparative analysis we make several conclusions concerning the expertises that are not underused. This is based on the possible recommendations that are described in sub-paragraph 5.2.4 “Possible Recommendations for Expertises that are not Underused”. In addition to that, we will have a look at the expertises that scored above 2.5 in the category ‘underuse’ since those are of greatest interest for this research.

About the expertises that belong to the principal characteristics of the scenarios we can conclude:

- The interviewed policy advisors develop specific scenarios, which is in accordance with what they need. This is contrary to generic scenarios: they neither develop them nor need them, so it is not useful to offer them this expertise.
- Exploratory scenarios are appropriately used. Normative scenarios should also continue to be offered, although there are also several cases in which it is neither applied nor needed.
- A discrete time perspective is common and appropriate in scenarios. A continuous time perspective is hardly applied, although several said that they do prefer it. The reasons for this underuse must be discovered.
- The orientation is in accordance with the desires from the respondents. Analysing the policy environment is not always done, but policy scenarios are very common and should continue to be offered.

The scores concerning the scenario approach are somewhat varied:

- There is no real case of ‘inappropriateness’ when the approach is content focussed, i.e. it is either applied as wished or it is not. This means that it depends on the policy study whether it should be offered or not. Using scenario analysis to ‘manage risk’ is hardly applied and there is no interest in it.
- The use of scenarios for training purposes is not and should not be offered. Offering scenario expertise to broaden the mindset can be useful, although not in all cases. There is an interest in using it for the purpose of achieving consensus, although there are some reasons why they do not always apply it.

About the scenarios that result from the studies:

- Both a discrete- and a continuous outlook are needed according to the policy advisors but the latter is still not always applied. The reasons of underuse must be discovered before offering it.
- Both qualitative descriptions and quantitative data must be included in the scenario results. It is recommended to apply both.
Concerning the participation:

- All types of participants are and should be involved. The problem owner should be involved a bit more according to the interviewed policy advisors, which corresponds to the findings of Klein and Linneman (1981) as mentioned in Chapter 3 “Next Generation Scenario Expertise: an Answer to various Types of Uncertainty”.

- It is not recommended to continue offering one-way interactions with participants, contrary to group sessions and workshops which are very common and accepted. Open interviews with single participants can be offered but it depends on the case whether it is desired.

The scores for the expertises belonging to adaptive policymaking vary, but there are more cases of underuse:

- Several respondents said that signposting should become a more systematic part of policymaking since it is necessary to react timely on changes in the environment. This can involve to qualitatively monitor the environment or to determine quantitative trigger values.

- The options to influence, investigate and divide-up risk are in some cases recommended to be offered whereas in other cases there is no sufficient need. What those cases are is not clear.

- The three options of hedging are predominantly not applied and there is no need for it either. Only in some cases the option to diversify is appropriately used, which concerns scenario studies for higher level policy plans (see paragraph 4.2.5, section “Hedging - Option to Diversify”). In such type of policy studies it is recommended to offer the expertise.

- The options to delay and to accelerate/decelerate projects are not applied regularly and in those cases there is not much need either. The option to phase is underused according to the majority of the respondents. Special attention must be paid to the reasons behind it.

- The options to switch and to grow seem to be equally spread over all categories (except for ‘overuse’). Both are judged as underused according to one third of the respondents, which makes them relevant to investigate the relating causes.

All cases of underuse with the option to grow concern quantitative analysis. A qualitative approach of determining the option to grow is applied in some cases, but it is not appropriate according to the respondents. In paragraph 4.2.5, section “Robust Policymaking – Option to Grow”, an example is given of how the option to grow is applied in a qualitative way. In that example it follows that several questions are decided implicitly: whether room for expansion should be integrated at all and how large the possible expansion must be. Such decisions can be based on more quantitative analysis, which should also be done according to the results. The ‘overuse’ that is present for the option to grow relates to the qualitative approach of doing that analysis.
The expertise that is needed to analyse the option to adjust the operational scale can in some cases be offered, whereas in other cases there will be no need.

5.3 **Main Conclusions from the Comparative Analysis**

There are two main conclusions that can be drawn from the comparative analysis.

The first concerns the expectation that expertise for adaptive policymaking is needed but still not sufficiently applied by transport policy advisors when doing scenario analyses for infrastructure studies. This is confirmed by the results from the analysis, since four out of seven expertises with the highest scores for underuse belong to adaptive policymaking. In addition, the scores for underuse among the ‘adaptive policymaking’ expertises are in general higher than the remaining expertises.

The second conclusion is that the seven expertises are predominantly underused:

- Analysing the option to phase
- Apply signposting (with trigger values)
- Incorporating a continuous time perspective in the scenarios
- Analysing the option to switch
- Analysing the option to grow
- Applying scenario analysis with the purpose to achieve consensus
- Creating scenarios with a continuous outlook
CHAPTER 6  Main Causes of Underuse

During the pre-structured interviews the respondents are asked to share their arguments related to the judgments they make about the ‘practices’ and ‘needs’. Especially when it seems that an expertise is underused, special attention is given to the related causes according to the respondents. This is done to find the answer to the following partial research question which contains two sub-questions:

“What are the main causes of underuse?”
  a. “What are the reasons for not applying expertises while there is a need for them?”
  b. “What patterns can be found in those reasons?”

Regarding the first sub-question, the reasons for underuse that are given by the respondents are gathered. The received arguments are reviewed to find possible patterns (see sub-question ‘b’). This is done to identify what the main causes of underuse are (6.1). Next, some conclusions are made about these main causes (6.2).

6.1 Results from Reviewing the Reasons for Underuse

The interviewed policy advisors have raised various issues as reasons for not applying expertises while they do need them. Most of them provided comparable arguments that can be clustered. This resulted in four main causes of underuse that are described separately and are referred to with suitable terms. The first is ‘ignorance’, which concerns the lack of knowledge among policy advisors that certain expertises are available to them (6.2.1). The second is ‘novelty’, which stands for expertises that are known by the policy advisors but that they still do not apply them consequently (6.2.2). The third is ‘redundancy’, meaning that certain expertises are needed but remain unused since other expertises are more common to the policy advisors (6.2.3). The last concerns ‘political barriers’. This is a generic term which is related to the fact that political interests affect the way uncertainty is dealt with (6.2.4).
6.1.1 **Ignorance**
There are two ways in which ignorance can be a cause of underuse:

- The expertise is yet unknown by policy advisors or;
- Policy advisors are not aware of the potential benefits when applying the expertise.

It is obvious that policy advisors have to be familiar with expertises before they can adopt them. With regard to the lacking awareness of the potential benefits, some respondents explained that expertises are only likely to be adopted after they have been proven to be useful in other projects. Especially if there is no sense of urgency (e.g. due to failed projects), it is not likely that unused expertises will be adopted in the policymaking process.

‘Ignorance’ as a cause of underuse was frequently raised when adaptive policymaking was discussed, with special regard to the option to switch. It is often doubted whether the option to switch is technically feasible, even though there are infrastructures in which that option is integrated (see paragraph 4.2.5, section “Option to Switch”).

6.1.2 **Novelty**
When policy advisors are aware that certain expertises are useful but are not widely applied yet, the cause of underuse is called ‘novelty’. Application of the expertise is still emerging, meaning that the underuse will most probably reduce over time.

The OEEI\(^{40}\) was initiated in 1998 to improve the assessment of economic effects of large transport infrastructure projects. One of the resulting reports is a directive for cost-benefit analyses (Centraal Planbureau en Nederlands Economisch Instituut n. d.). In this report it is mentioned that when facing uncertainties adaptive policies can be advantageous compared to fixed policies. Examples of phasing and delaying are given to illustrate how dynamic decision-making can improve the yields of infrastructure projects. They demonstrate that it is possible to determine when sub-parts of the infrastructure must be constructed to continuously meet the demands for transport capacity, without committing oneself to a full size infrastructure at once. This resembles the option to phase. With a similar example they illustrate the potential benefits of analysing the option to delay. A key issue is that low efficiency is inherent to most infrastructure projects as a result of overcapacity in the first period after completing the construction.\(^{41}\)

Although the OEEI provides useful insights about the merits of the option to phase and delay, those expertises are not applied in all transport infrastructure studies. The policy advisors explained that they are familiar with phasing and delaying due to the OEEI. The reasons why those expertises are still not frequently applied is that the expertises are still new for large scale projects and - similar to the case with ‘ignorance’ - their effectiveness

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\(^{40}\) Onderzoeksprogramma Economische Effecten van Infrastructuur, ‘research programme on the economic effects of infrastructures’.

\(^{41}\) This efficiency is considered low when the project rate of return does not exceed 4% (Centraal Planbureau en Nederlands Economisch Instituut n. d).
needs to become apparent gradually before they will be adopted widely. Since these expertises are not yet widely applied this cause is called ‘Novelty’.

6.1.3 Redundancy

When an expertise can be applied to achieve certain objectives and in practice those objectives are achieved by another expertise, ‘redundancy’ is the cause of underuse.

The Dutch Ministry of Transport introduced ‘network analysis’ in the Mobility Paper, which engages multiple actors in analysing transport problems. The aim is to achieve consensus in the formulation of the problem and the way it must be approached. Ultimately, the decisions concerning the implementation of new policies gain support from the involved actors (Ministerie van Verkeer en Waterstaat; Rijkswaterstaat; Dienst Weg- en Waterbouwkunde 2005).

As can be seen, achieving consensus is regarded as something important within decision-making processes for infrastructure policies, which is confirmed by the interviewed policy advisors. They however referred to their ‘network analyses’ as a common way to achieve it rather than involving the actors in scenario studies. This explains why that expertise is underused according to the comparative analysis.

6.1.4 Political Barriers

Various reasons for underuse were raised by the policy advisors which can be clustered under the generic term ‘political barriers’. This is probably the most common known cause of underuse, since all respondents mentioned it at least once. It is important to consider the particular complexities that are inherent to the politics of policy analysis. Rein and Schön (cited in Fischer and Forester 1993) refer to the problematics of framing, which integrates facts, values, theories and interests. They use the term ‘frame’ as a “perspective from which an amorphous, ill-defined, problematic situation can be made sense of and acted on”. In other words; facts, values, theories and interests all play a role when approaching complex problems, which is typical to policymaking. The causes of underuse that are mentioned by the policy advisors relate to various interests of policymakers.

Although policy advisors may desire to apply certain expertises, they are sometimes limited to do so due to political interests of higher level policymakers.

Because several of such ‘political barriers’ are identified, they are each described separately. The political barriers arise when one or more of the following objectives are pursued by policymakers:

- Straightforward Policies
- Simple Policies
- Low Transaction Costs when Applying Expertises
- Deterministic Policies
- Maintain Control
- Prompt Decision-making
Straightforward Policies
When a policy contains many unclear elements it is not likely that it will gain acceptance from the Chamber of Representatives. A policy has to be as straightforward as possible. Kippenberger (1998) says that the pressure to express clear and unambiguous strategies probably is greatest when the future is least clear. He uses this as an argument why miscalculations in history are partly brought about by the uncertain environment.

Expertises that disrupt the straightforwardness of a policy are therefore not likely to be applied even though policy advisors think there is a need for them. Adaptive policies are presumably less straightforward than fixed policies. Proposing a project without knowing how the infrastructure will look like in the future is not a straightforward policy.

Although policymakers know that the long-term future can in now wise be forecasted, they do favour quantitative information in scenarios. This probably has to do with the fact that they desire to make straightforward policies, since the availability of quantitative information makes it easier to exactly determine the configuration of the infrastructure.

Simple Policies
When a policy appears to be complex and contains numerous options, it demands many efforts to understand it before it can be approved. Policymakers therefore continuously strive to make their policies as simple as possible. It can not be denied that this can be at cost of the effectiveness of the policy, particularly when due to intensive uncertainty there are many issues that can better be decided upon in a later stage. Although the uncertain environment requires policymakers to be very considerate, it remains important to them to keep policies simple.

Taking into account all considerations to either influence, to investigate, to diversify, etc. diminishes the simplicity of a policy plan. It is also difficult to make simple policies when basing them scenario results with a continuous outlook. Even making a policy on the basis of more than one scenario is sometimes said to result in too complex policies, since each single scenario requires a separate evaluation of the policy outcomes.

In the Mobility Paper, three scenarios\(^{42}\) that have been developed by the CPB are enquired to determine the long-term transport policy plan in the Netherlands. The growth prognoses for freight transport until 2020 are 15%, 50% and 80% in each scenario. The Ministry of Transport uses 50% as a reference for the growth of freight transport. Fixed infrastructure policies that are robust in all three scenarios are probably not possible and adaptive policies are complex. This may explain why they rather focus on one scenario only. It also explains the underuse of applying a continuous time perspective to scenarios and developing scenarios with a continuous outlook. Both provide a more complete picture of how trends can develop but also make it more difficult to interpret and use the scenarios for policy studies.

Low Transaction Costs
Striving for low transaction costs restrains policy advisors to apply expertises even though they need them. The incentive to apply those expertises decreases if it requires certain extra efforts. Introducing expertises with which the policy advisors are not yet familiar implies

\(^{42}\) Omgevingsscenario's Lange Termijn Verkenning 1995 – 2020 (LT-97)
that they have to get acquainted with it at first. The objective to keep transaction costs low are then the cause of underuse.

The respondents did not mention specific expertises with regard to this issue, but raised it as a more general fact. In the report “Risk Assessment for Public Infrastructure Projects” (Commissie Risicowaardering n.d.) the issue of low transaction costs is raised in a slightly different way. It is mentioned that public institutions are dealing with budget constraints which hinders them from diversifying risks. This is not similar to the required efforts when introducing new expertises, but is related to the incurred costs for analyzing whether risks must be diversified.

**Deterministic Policies**

The desire to fix the plans for an infrastructure project is not uncommon among policymakers according to the respondents. When a project is adjusted or even cancelled after it is initiated, the impression may rise that the policymakers have failed in carrying their responsibilities. This goes to such an extent that the incentive to proceed with an inefficient project is stronger than adjusting it to improve its efficiency. Policymakers are therefore not likely to give much room for structural adjustments of the basic policy. Flyvbjerg (2005) says that policymakers have the ‘monument complex’, with which he explains that they strive to get approvals for projects even if the social benefits do not evidently counterbalance the incurred costs. It is more important to them that they launch projects that also get accomplished.

It becomes a very sensitive issue when projects have to be aborted after they have been initiated, with special regard to large scale projects. The paradox is that particularly in those cases costs and revenues can be miscalculated, because of the risks that are involved. The risks are among other things high due to the high initial costs and long periods before the first benefits are made.

**Maintain Control**

The Amsterdam municipal agency Infrastructures Traffic & Transport (who takes care of the regional Spatial Investment Programme) emphasizes that the national government must provide more room for flexible policies. They also mention that they need instruments with which they can respond to the accelerating economic-, housing- and mobility developments (Gemeente Amsterdam, Programma Ruimtelijke Investeringen 2005). The reasoning behind that is that the coming decennia will be characterized by economic progress as well as recessions. The local policymakers apparently desire more adaptive policies than national policymakers do.

A reason why they do not get all opportunities to make adaptive policies, although they desire it, has to do with the political interest of maintaining control. To provide flexible policy plans requires the national policymakers to release some control over that plan. A flexible (or adaptive) policy can be adjusted in the future which may imply that local governments get a say in the way it must be adjusted. Some respondents said in relation to dynamic decision-making and robust policymaking that when policymakers can maintain control, they will do so. This explains why adaptive policymaking is underused.

\[43\] dienst Infrastructuur Verkeer en Vervoer (dIVV)
**Prompt Decision-making**
Involving many parties in the decision-making process and giving them a significant say in the way a project must be carried out requires more time to achieve consensus. It can even give room for resistance to certain actor groups which can delay the decision-making process. When policymakers avoid delays in decision-making, the objective to achieve consensus is obstructive.

### 6.2 Conclusions from Reviewing the Causes of Underuse

There seem to be various causes of underuse, but the political issues make it complex to improve the utilization of certain expertises. This counts especially for the expertises belonging to adaptive policymaking.

Ignorance about expertises and their benefits implies that those expertises must continue to be offered and promoted. They are likely to be adopted as long as policy advisors express a need for them and get acquainted with them. Expertises that are acknowledged to be important but are still new in the policy domain may increasingly be applied in the future. Redundancy of expertises means that there are other ways of achieving the goals that can be achieved by the concerning expertise. It can be useful to investigate what the differences are between the offered expertise and by the one that is commonly applied by the policy advisors.

Political sensitive issues can not just be alleviated since they are typical to policymaking. Other ways have to be found to still improve the utilization of expertises that are obstructed by the political interests that affect policymaking.
This last chapter is dedicated to review the main results from the research to the next generation scenario expertise. In the first paragraph the conclusions that are related to each partial research question are briefly described (7.1). The recommendations that follow are related to the last partial research question (7.2):

“What can be done to improve the utilization of the significantly underused expertises?”

The objective to improve the utilization of the Next Generation Scenario Expertise is very ambitious, but this explorative research can be seen as a building block to achieve that objective. After discussing the recommendations, some general conclusions are made based on lessons that are learnt while doing this research (7.3).

7.1 Conclusions with Regard to each Partial Research Question

The research product related to the first partial question is the framework that represents the Next Generation Scenario Expertise (7.1.1). This framework is essential since it is used for all following research activities. The next important research product resulted from investigating the needs for the next generation scenario expertise (7.1.2). This is related to the second partial research question. After that, efforts are made to answer the third partial question: whether underuse of expertises is present (7.1.3). The reasons for not applying expertises while there is a need for them are reviewed, which has lead to a comprehensive list of main causes of underuse (7.1.4). This is done with respect to the fourth partial research question. The findings for the last partial question are elaborated separately in paragraph 7.3 “Recommendations”.

7.1.1 The Next Generation Scenario Expertise

To find out what types of expertise are available to policy advisors an explorative literature research is done. This provided in how uncertainty can be dealt with in policymaking by means of scenario analyses.

An explorative literature research focussed on the topics ‘uncertainty’, ‘transport policymaking’, ‘scenario analyses’ and ‘adaptive policymaking’ resulted in a broad insight in expertises that are available to deal with uncertainty. After presenting that to two (former) RAND analysts during expert sessions, it is determined what expertises belong to
the next generation scenario expertise, i.e. what scenario expertises are available to transport policy advisors and can be offered to them by RAND.

One conclusion in this respect is that the expertises can be clustered in several groups. Some are related to the type of scenarios that are developed, others to the purpose for which the analysis is done and how the scenario results are presented. There are also expertises that are related to the way participation is engaged in the scenario analysis and others represent the different ways adaptive policymaking can be achieved.

The framework contains 38 different expertises and is attempted to be as comprehensive as possible. There certainly are other scenario expertises available at RAND. It should therefore be reminded that the ones in the framework mainly reflect the expertises that are found in the literature research and are acknowledged by the RAND analysts who participated in the expert sessions.

7.1.2 Conclusions concerning the Needs for the Next Generation Scenario Expertise

The next step was to find out which of those expertises are strongly needed, since it is useful to offer those to transport policy advisors when they do scenario studies for infrastructure projects. This is achieved by interviewing a set of transport policy advisors who have either been involved in infrastructure projects or in policy studies for such projects.

There is a relative strong need for scenarios that are related to specific policy problems and there is no strong need for developing generic scenarios. Among the respondents, most perceive a need for policy scenarios rather than orienting themselves on the policy environment. The time perspective is preferred to be discrete, (with either single or multiple points of time). When doing those scenario studies they prefer to explore the results rather than to set norms and determine how to achieve them (back-casting).

A content focussed approach is needed when developing or evaluating policies. The objectives to achieve consensus or to broaden the mindset are favoured among the respondents, which require a more process focussed approach.

There is a need for a discrete outlook of the scenario results, as well as a continuous outlook. In general scenarios can be described as discrete future states of the world and that can be supplemented by ranges in which uncertain factors can vary. A continuous outlook illustrates that the future is variable and avoids making plans on point estimates. Concerning the format of the results, quantitative data is needed but must be supplemented by qualitative information about the scenarios, to avoid ‘fixation’ on numbers.

According to the respondents; analysts, experts, stakeholders and the problem owner must get involved in scenario studies. There is only no need for involving any of them by means of closed interviews or surveys. Workshops and group sessions are strongly favoured.

The needs for any of the expertises that can be used to enable adaptive policymaking are neither extremely high nor low. Sometimes it depends on the policy cases whether there is a need for certain ways of making adaptive policies. When it is possible to implement sets of policy alternatives, the option to diversify is of interest to policy advisors. This can be possible when general long-term policies are developed (e.g. Mobility Paper). This is contrary to policies for physical infrastructures. In such cases there are often limited
(mutual exclusive) alternatives such as the choice between a road- and a rail connection. It is not often feasible to implement both, since that would be cost intensive and take up much space. In such cases, the option to phase is more interesting.

7.1.3 Conclusions concerning Underuse within the Next Generation Scenario Expertise

After measuring the extent to which each expertise is needed, several analytical steps are taken to detect possible underuse of the expertises. This is achieved by analysing whether policy advisors consequently apply expertises when they need them. In case they do not, there is a case of underuse. The expertises that are underused according to more than a quarter of the respondents are listed below:

- Analysing the option to phase projects; considered underused by two fifth of the respondents.
- Apply signposting (e.g. with trigger values) to systematically monitor the policy environment; also considered underused according to more than one third of the respondents.
- Incorporating a continuous time perspective in the scenarios; underused according to one third of the respondents.
- Analysing the option to switch (e.g. between transport modalities); also underused according to one third of the respondents
- Analysing the option to grow which enables to expand an infrastructure after the project is accomplished; considered underused by one third of the respondents
- Aiming to achieve consensus when doing studies for policy problems; also considered underused by one third of the respondents although it is not necessarily desired to do that within scenario studies
- Creating scenarios with a continuous outlook; considered underused by a quarter of the respondents

The results also revealed that qualitatively assessing the option to grow is more often applied than it should be according to the policy advisors. On the other hand, when it concerns a quantitative approach of analysing the option to expand an infrastructure, there is a case of underuse. This means that the option to grow is favoured to be analysed in a quantitative way.

The presumption that adaptive policymaking in general is underused can be confirmed according to the discovered results. A scan over the scores illustrates that most expertises belonging to adaptive policymaking are somewhat underused whereas that is not the case with the remaining expertises in the next generation scenario framework.

7.1.4 Main Causes of Underuse

The main causes of underuse are of different natures:

In some cases it is purely a matter of ignorance: policy advisors are not yet aware of all the available expertises and the benefits of applying them. This is particularly the case with the expertise to analyse the option to switch.
In other cases policy advisors are aware of the availability of expertises, but do not apply
them since it is not common yet. It generally takes some time before new expertises are
adopted in the policymaking process (for transport infrastructures). This is the case with
the expertise that enables to analyse the option to phase an infrastructure project.

Another cause of underuse is that policy advisors are familiar with the expertise and do
acknowledge that it is needed, but apply other expertises to achieve the same goal. In the
Dutch Ministry of Transport it is common to use network analyses to achieve consensus
with stakeholders who are affected by proposed policies. This means that there is a need for
achieving consensus within the policymaking process but that scenario analyses are not
used for this purpose. Hence the underuse of the scenario expertise that relates to achieving
consensus.

The fourth main cause of underuse relates to different political barriers for applying certain
expertises. Those barriers are mainly caused by the political interests of higher level
policymakers, which affects the way policy advisors do their policy studies. This is a more
difficult issue since those barriers seem to be typical to policymaking for transport
infrastructures. They are therefore likely to remain present in this domain. The barriers are
briefly described:

- The desire of policymakers to make straightforward, simple and deterministic
  policies implies that policies that are too ambiguous and complex will not be
  accepted, even if they are developed by using sophisticated expertises (e.g. those
  for adaptive policymaking).

- When it requires extra efforts to apply any expertise there is a chance that it will
  still not be applied, even though policy advisors need it. The desire for keeping
  transaction costs low restrains policy advisors to adopt expertises that have not
  been applied before.

- Another political barrier is the desire of policymakers to maintain control.
  Providing flexible policies introduces opportunities for actors (other than the
  policymakers who initiate the policy) to affect the way the policy is given shape.

- When in all stages of the policymaking process decisions have to be based on
  consensus, the policymaking process there is a risk that decisions will be delayed.
  Such delays are not favoured among policymakers since they seem to have
  incentives for getting approvals for their proposed policies.

### 7.2 Recommendations

The main goal of this research is “…to explore whether there is a need for the next
generation scenario expertise among transport policy advisors and to find out what is
required to improve its utilization, assuming that underuse is present” (see paragraph 1.3
“Research Goal”). Having discovered the particular expertises that are underused and the
relating causes, we can formulate the recommendations to RAND. Recommendations for
further research are indicated with an arrow ( ➤ ).
**Ignorance**

Not many policy advisors are aware of the feasibility to incorporate the option to switch in infrastructures, let alone the advantages it brings along. When offering the expertise to analyse the option to switch, the following is recommended:

- Include practical examples of switching options that have proven to be technically feasible.
- In the examples, include the potential benefits of incorporating the option to switch (e.g. between different transport modalities on one infrastructure). This can trigger the acknowledgement that adopting that expertise can improve the robustness of policies.

**Novelty**

Analysing the options to delay and to phase are acknowledged expertises to deal with uncertainty according to the research programme on the economic effects of infrastructures (OEEI). The underuse of the option to phase can mainly be explained by the fact that its application for infrastructure projects is slowly and gradually being adopted. This leads to the following recommendations:

- Continue to offer the expertise since it is well possible that it will be applied more frequently in the future. It is important to also consider the political barriers that play a role, since those concern adaptive policymaking in general. Especially the political interests of making simple, straightforward and deterministic policies are important may hamper the use of the option to phase.

**Redundancy**

Achieving consensus is an important objective within transport policymaking but it is embedded in network analysis rather than scenario studies. This leads to a recommendation for further research:

- It can be useful to figure out what exactly network analyses are used for by the Ministry of Transport, in which stage of the policymaking process it is applied and whether scenario analysis can play a role in that stage too.

**Political Barriers**

The political barriers introduce greater challenges to improve the utilization of the concerning expertises. Since those barriers seem typical to policymaking for transport infrastructures, they are likely to remain present. The recommendations are formulated with respect to the expertises they concern.

*All the next generation scenario expertises:*

Policymakers keep transaction costs low which is reasonable, but when the benefits of applying certain expertises outweigh the incurred costs (or ‘efforts’) there is an opportunity to improve the utilization:

- When offering expertises, use quantitative analysis to demonstrate whether it is beneficial to apply them.
- Support examples of option analyses with similar quantitative information.
Expertises belonging to adaptive policymaking

Underuse of adaptive policymaking is caused by the desire of policymakers to make straightforward, simple and deterministic policies. The fact that they desire to maintain control in decision-making processes about policies is also a cause of underuse. This requires special attention when offering expertise for adaptive policymaking:

- Provide clear-cut case examples from practice (or fictitious), demonstrating the potential benefits from adaptive policymaking.
- Be moderate in offering multiple option analyses at the same time. Multiple considerations (e.g. to influence uncertainty, to insure, to delay, to accelerate/decelerate, etc.) make the total analysis too complex.
- Keep adaptive policies as simple as possible. They must be easily understandable.
- Apply a multiple discrete time perspective for adaptive policies with few time points only to avoid complex scenarios with a continuous time perspective.
- When using a discrete outlook of the scenarios, keep stressing on the pitfalls of fixing one’s view on point estimates.

With special regard to the options to phase, grow and switch it is recommended to:

- Include few decision options at a time instead of vast decision trees with multiple paths.
- Support each decision option with quantitative information to avoid ambiguity in the policy.

7.3 General Conclusions

Besides the conclusions that are derived from the research steps, some lessons are learned while carrying out this research. Some of these lessons lead to recommendations for further research, which is indicated with an arrow (➤).

The first lesson that is learnt while taking interviews with transport policy advisors is that the way they develop scenarios is strongly affected by the interests of their higher level policymakers. If this was not the case, underuse of expertises would have been present to a lesser extent.

It also appears that the issue of ‘dealing with uncertainty’ in general is gradually getting more attention among policymakers. Most respondents said that a positive trend is the growing awareness of the relevance of uncertainty in policymaking. The way it has to be dealt with still is a topic of many discussions. This has to be discovered by learning from policy failures and success stories in the past. During a congress on ‘Policymaking under Uncertainty’, held on 15 and 16 May 2006 in the Hague, policy scientists and policymakers agreed that we need to accept that we are living in an era of severe changes. Policy actors (i.e. scientists, advisors, politicians, etc.) are required to have a learning attitude to successfully deal with it.
In the literature research many examples of adaptive policymaking are found that concern applications in the private sector. It is possible that advisors in the private sector are more directly responsible for the success of their policies than public advisors are. It seems like the learning curve for successfully dealing with uncertainty in the private sector is steeper than that in the public sector. This could be due to the strong incentives in the private sector to develop effective strategies with the purpose to compete against competitors.

Recommendation for further research:

- Investigate whether adaptive policymaking is also underused in the private sector and whether political barriers are less intensively present. In case there are no barriers restraining the application of adaptive policymaking, it can be useful to offer the expertise in that sector. This recommendation obviously only applies when RAND desires to offer their services to private companies.

Another interesting lesson concerns the desire of local governments (i.e. regional governments and municipalities) to be more flexible, which is restrained by the national government. The Ministry of Transport for example forces local government to reserve sufficient space around the main highway network in the Netherlands. Meanwhile private investors desire to invest in land areas close to highways since those areas are valuable to them due to the accessibility. Besides the benefits for the private investors, there are also advantages for the local government since the investment can be beneficial for the local economy and employment. This example illustrates that local governments are likely to desire more flexible usage of land area alongside the main road network. Such flexible usage requires expertises in adaptive policymaking such as analysing the option to grow. As such, local governments may have more interest and maybe even more experience with adaptive policymaking than the national government.

Recommendation for further research:

- Investigate whether local governments indeed have stronger needs for expertises to make adaptive policies. In case that is true it is important to find out whether national policies still restrain the local governments from being flexible. In case not, it is recommended to offer the expertise to local governments.

The last recommendation for further research is not based on particular lessons that are learnt from this study, but has to do with the scope of the research. Besides the transport domain, there are other domains in which policymaking is challenged by intensive uncertainties. Any public institution that is charged with long-term policymaking and large irreversible investments may well be interested in the next generation scenario expertise. Examples are the spatial planning domain and the energy sector. The main policymaking institutes in these domains are respectively the Ministry of Public Housing, Spatial Planning and the Environment and the Ministry of Economic Affairs.

Recommendation for further research:

- Investigate within those ministries whether there is a need for the next generation scenario expertise and whether underuse is present. If the identified political
barriers in this research are inherent to policymaking in general, there is a big chance that underuse is also present within those ministries. This research may also be useful to verify whether the identified political barriers are inherent to policymaking in any sector.
REFERENCES


APPENDICES
Appendix A – Respondents

The four lists below contain the experts that have contributed to this research by means of interviews or expert sessions. All deserve gratitude for offering up their time and sharing their knowledge! The first list concerns two RAND experts who have considerably been involved in scenario analyses and studies for adaptive policymaking. They made the major contribution to defining the “next generation scenario expertise” by means of expert sessions. The second list contains two experts from the ministry of transport who took part in the first round interviews only. The third list contains experts who took part in both the first and second round interviews. The fourth list contains names of experts with various backgrounds, each having shared their experience and views to support this research.

### A.1 RAND experts in Scenario Analysis and Adaptive Policymaking

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ir. C.G. van Rhee MBA</td>
<td>Research Leader</td>
<td>Mrs. van Rhee has commissioned the research assignment and supervised the progress.</td>
</tr>
<tr>
<td></td>
<td>RAND Europe</td>
<td></td>
</tr>
<tr>
<td>Dr. O.A.W.T. van de Riet</td>
<td>Research Scientist</td>
<td>Mrs. van de Riet guided this research as a supervisor from TU Delft.</td>
</tr>
<tr>
<td></td>
<td>Faculty of Technology, Policy and Management</td>
<td></td>
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<td></td>
<td>Delft University of Technology</td>
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<td></td>
<td>Former:</td>
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<td></td>
<td>Director</td>
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<td></td>
<td>RAND Europe</td>
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### A.2 Participants of first round interviews only

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tbody>
<tr>
<td>Drs. B. Demoet</td>
<td>Project Leader “Zuiderzee Line”</td>
</tr>
<tr>
<td></td>
<td>Directorate-General for Passenger Transport</td>
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<tr>
<td></td>
<td>Ministry of Transport</td>
</tr>
<tr>
<td>Ir. C. Verstegen</td>
<td>Programme Manager “Railway Policy”</td>
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<td></td>
<td>Railways Department</td>
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<td></td>
<td>Directorate-General for Passenger Transport</td>
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<td>Ministry of Transport</td>
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</table>
A.3 Participants of first and second round interviews (1/2)

R. Batelaan  
Senior Policy Advisor  
Head Department of Strategy and Policy  
Infrastructures Traffic & Transport agency  
Municipcy of Amsterdam  

Dr. O.J.C. Cornielje  
Head of Programme  
Strategy and Economics  
Continental Transport  
Directorate-General for Civil Aviation and Freight Transport  
Ministry of Transport  

Drs. E. Euwe  
Senior Policy Advisor  
Strategy and Economics & Department of Road Transport  
Continental Transport  
Directorate-General for Civil Aviation and Freight Transport  
Ministry of Transport  

Drs. S. Halbesma  
Senior Policy Advisor  
section: Transport and Society  
Transport Research Centre  
Directorate-General of Public Works and Water Management  
Ministry of Transport  

Dr. F. Hofman  
Senior Policy Advisor/Specialist  
Project Leader “Dutch National Model System” developments  
section: Strategic Models and Forecasts  
Transport Research Centre  
Directorate-General of Public Works and Water Management  
Ministry of Transport  

Ir. C. Krooshof  
Policy Advisor  
Programme for infrastructure and transport (MIT)  
Roads and Traffic Safety Department  
Directorate-General for Passenger Transport  
Ministry of Transport  

44 Vervoer en Maatschappelijke Ontwikkelingen (VM)  
45 Strategische Modellen en Prognoses (VMM)
A.4 Participants of first and second round interviews (2/2)

Dr. R. Morsink  
*Senior Policy Advisor*  
Project “Mainport Schiphol”  
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Ministry of Transport

Ir. M. Mulder  
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Transport Research Centre  
Directorate-General of Public Works and Water Management  
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Drs. O. Overbeeke  
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Market Development Decentralized Transport  
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Ministry of Transport

Drs. F. Timmermans  
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Ministry of Transport

Ir. J. van der Waard  
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Transport Research Centre  
Directorate-General of Public Works and Water Management  
Ministry of Transport

Drs. A.A.J. van der Wees  
*Head of “General and Economic Policy Division”*  
Financial and Economic Affairs Directorate  
Ministry of Transport
A.5 Other experts who contributed to the research
These experts shared their views in occasional open interviews, other than the interviews that were planned in the research phases.

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RAND Europe (Cambridge)

Dr. A.R.C. de Haan
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Faculty of Technology, Policy and Management
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Dr. E. Horlings
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RAND Europe

Drs. S. Pronk
Senior Economist
Office of Energy Regulation
Netherlands Competition Authority
Ministry of Economic Affairs

Prof. Dr. W.E. Walker
Professor of Policy Analysis
Faculty of Technology, Policy and Management
Delft University of Technology

Note:
46 Nederlandse Mededingingsauthoriteit
### Appendix B – RIVM/MNP Uncertainty Matrix

<table>
<thead>
<tr>
<th>UNCERTAINTY MATRIX</th>
<th>Level of uncertainty from determinism, through probability and possibility, to ignorance</th>
<th>Nature of uncertainty</th>
<th>Qualification of knowledge base (backing)</th>
<th>Value-ladenness of choices</th>
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</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Statistical uncertainty</td>
<td>Scenario uncertainty</td>
<td>Recognized ignorance</td>
<td>Knowledge-related uncertainty</td>
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<tr>
<td></td>
<td>(range of changes)</td>
<td>(range as &quot;what-if&quot; option)</td>
<td></td>
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<tr>
<td><strong>Context</strong></td>
<td>Biological, technological, economic, social and political representation</td>
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<tr>
<td><strong>Expert judgment</strong></td>
<td>Narrative, storyline, advice</td>
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<tr>
<td><strong>Model</strong></td>
<td>Relations</td>
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<td>Submodels &amp; hardware implementation</td>
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<td>Model inputs</td>
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<td><strong>Data (in general sense)</strong></td>
<td>Measurements; monitoring data; survey data</td>
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<td><strong>Outputs</strong></td>
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</table>

Source of Uncertainty Matrix excluding shaded areas: Sluijs et al., 2003

Main cases of uncertainty when the application of scenario analysis is recommended according to the RIVM/MNP Guidance for Uncertainty Assessment and Communication.
Appendix C – A Process for Adaptive Policymaking

Stage Setting
- Constraints
- Objectives
- Definition of success
- Option sets: Infrastructure, Other

Assembling a Basic Policy
- Necessary conditions for success
- Policy actions
- Mitigating actions
- Hedging actions
- Defending actions
- Vulnerabilities
- Cascades
- Trigger

Unforeseen events
- Changing preferences
- Reinforcement
- Corrective actions
- Defensive actions

Source: Walker, Rahman and Cave (2001)
Appendix D – The Extent to which the Expertises are Applied

Principal Characteristics

<table>
<thead>
<tr>
<th>Character</th>
<th>Not Applied</th>
<th>Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic</td>
<td>8.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Specific</td>
<td>1.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Exploratory</td>
<td>1.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Normative</td>
<td>5.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Discrete time perspective</td>
<td>1.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Continuous time perspective</td>
<td>8.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Environmental</td>
<td>4.2</td>
<td>5.8</td>
</tr>
<tr>
<td>Policy</td>
<td>1.7</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Approach

<table>
<thead>
<tr>
<th>Content focused</th>
<th>Not Applied</th>
<th>Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop policy options</td>
<td>3.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Evaluate policies</td>
<td>4.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Manage risk</td>
<td>9.3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process focused</th>
<th>Not Applied</th>
<th>Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achieve consensus</td>
<td>6.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Train participants</td>
<td>9.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Broaden the mindset</td>
<td>5.8</td>
<td>4.2</td>
</tr>
</tbody>
</table>
### Results from the Comparative Analysis

#### Resulting Scenarios

<table>
<thead>
<tr>
<th>Format</th>
<th>Discrete outlook</th>
<th>Continuous outlook</th>
<th>Qualitative</th>
<th>Quantitative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.5</td>
<td>4.5</td>
<td>0.8</td>
<td>6.7</td>
</tr>
</tbody>
</table>

#### Participation

<table>
<thead>
<tr>
<th>Participants</th>
<th>Analysts</th>
<th>Experts</th>
<th>Problem owner</th>
<th>Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.8</td>
<td>9.2</td>
<td>9.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interaction</th>
<th>One-way</th>
<th>Two-way</th>
<th>Multi-way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9.1</td>
<td>4.5</td>
<td>9.1</td>
</tr>
</tbody>
</table>
Appendix E: Results from the Comparative Analysis

Adaptive Policymaking

- Trigger values: 8.8 Not Applied, 1.3 Applied
- Influence: 7.5 Not Applied, 2.5 Applied
- Investigate: 5.9 Not Applied, 4.1 Applied
- Divide-up risk: 5.4 Not Applied, 4.6 Applied
- Insure: 8.0 Not Applied, 2.0 Applied
- Exit: 8.5 Not Applied, 1.5 Applied
- Diversify: 5.9 Not Applied, 4.1 Applied
- Delay: 6.4 Not Applied, 3.6 Applied
- Phase: 7.1 Not Applied, 2.9 Applied
- Accelerate/ decelerate: 7.7 Not Applied, 2.3 Applied
- Switch: 6.8 Not Applied, 3.2 Applied
- Grow: 5.0 Not Applied, 5.0 Applied
- Adjust operational scale: 6.3 Not Applied, 3.8 Applied
Appendix E – Results from the Comparative Analysis

E.1 Principal Characteristics
See paragraph 5.2.3 “Comparative Analysis” for an explanation of the graphs.
E.2 Approach

- Develop policy options
- Manage risk
- Evaluate policies
- Achieve consensus
- Broaden the mindset
- Train participants
- Underuse
- Appropriate non-use
- Overuse

Numbers:
- 0.0
- 2.9
- 1.8
- 1.3

Legend:
- Appropriate use
- Overuse
E.3 Scenario Results

[Diagram showing a matrix with quadrants labeled as Appropriate use, Overuse, Underuse, and Appropriate non-use. The quadrants are further divided into Discrete outlook, Continuous outlook, Qualitative, and Quantitative. Points are marked on the grid representing different scenarios.]
E.4 Participation

The diagram illustrates the participation patterns in the Comparative Analysis:

- **Appropriate use**
  - Analysts
  - Experts
  - Problem owner
  - Stakeholders
  - Underuse

- **Overuse**
  - One-way
  - Two-way
  - Multi-way

- **Non-use**
  - Appropriate non-use

Numbers indicate the likelihood or frequency of each interaction type, with values ranging from 0.0 to 1.3.
E.5 Adaptive Policymaking (1/2)
E.6 Adaptive Policymaking (2/2)

[Diagram showing various decision phases and overlapping zones labeled as Delay, Switch, Grow, and Adjust operational scale.]

- **Appropriate use**
- **Overuse**
- **Underuse**
- **Robust Policymaking**
- **Dynamic decision-making**

The diagram illustrates the transition between different decision phases and the overlap areas indicating appropriate, overuse, and underuse conditions.