

Towards 2040: Scenario-based roadmapping in a Dutch construction company

Master Thesis

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16-04-2021



Towards 2040: Scenario-based roadmapping in a Dutch construction company

A thesis submitted in fulfillment of the requirements for the degree of Master of Business Administration at the University of Twente

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**Date:**

16-04-2021

**Place:**

Enschede, the Netherlands

**Organization:**

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**Version:** 1.2

**Changes:** Definitive version.



## **Preface**

In finishing this research, I complete my master's program Business Administration at the University of Twente. This report is the record of the research I conducted during my graduation assignment at the Dutch construction firm VolkerWessels. The research covers the topic of scenario-based roadmapping, both in the theoretical development of a practical model as well as the application of this model at VolkerWessels.

Finding a research topic did not take a long time, nor was it hard to find a company in which to undertake the research. VolkerWessels had already accommodated me in finishing my bachelor's program at Saxion Universities several years ago, which included multiple internships at different VolkerWessels companies. I had already learned that VolkerWessels -or at least the people I came into contact with- welcomed curious interns and gave me all the information I needed. There wasn't any difference this time around, and they courteously let me apply my curiosity for strategic models of which this report is the result.

Many people have contributed to this research, all of which I'd like to thank in this preface. I would specifically like to thank my University supervisors Erwin Hofman and Joop Halman for providing feedback and advice during my several-months long research adventure. I would also like to thank Ron Frazer and Robert Schuurin from VolkerWessels for helping out during the earlier phases of the research, providing me with informative and interesting conversation as well as useful contacts throughout the organization. Finally, I would like to thank Luurt van der Ploeg for assisting in the final phase of the research.

Enschede, 16<sup>th</sup> of April 2021

Paul Potters



## Summary

In order to effectively cope with the continuously changing environment in the housing construction industry and deal with mounting challenges, VolkerWessels could benefit from a dynamic strategic tool. The development and application of a tool to improve the strategic decision making process that can help the company in accomplishing its strategic goals. Based on this presumption, two research objectives are proposed. Objective 1: Develop a scenario based roadmapping method based on current literature and tuned to VolkerWessels; objective 2: Execute the design and analyze the outcome, and translate this into practical recommendations for the company and theoretical recommendations for the academic field of scenario-based roadmapping.

Current scientific literature has been examined on topics of scenario planning, roadmapping and scenario-based roadmapping. Based on this desk research, a conclusion was drawn. This conclusion was then used to design a scenario-based roadmapping method. In applying the design, interviews with external experts were held in order to obtain relevant insights in current trends in the construction industry which were used to tune the scenario-based roadmapping method to the company. This was followed by multiple interviews with VolkerWessels personnel, in order to create multiple scenarios. These scenarios were then assessed through two online sessions. Finally, the design was improved by feedback from research participants. On the whole, a design circle was used: the method was designed, tested, and improved.

It can be concluded that the desired scenario-based roadmapping method is a quick, effective and flexible process that focuses on communication throughout the organization and feedback. The reason why it should be quick and effective is because this would potentially increase the ease with which the process could be repeated over time, increasing the effectiveness of the process and providing a more up-to-date outcome each time. Also, when using scenario-based roadmapping, an organization wants to anticipate changes in the environment and act upon these changes. Therefore, quicker anticipation and quicker reaction are desired. All this asks for a compact, robust design that can be instigated and finished in a relatively short period, which makes it easier to repeat.

Based on a multi-criteria analysis, a design is proposed consisting of three distinct phases: the preparation phase, the execution phase, and the feedback phase. Each phase consists of several steps. To test the design, a fitting case study was prepared. The outlines of the case study were defined in cooperation with an internal facilitator in the form of a VolkerWessels Bouw & Vastgoedontwikkeling executive, in order to maximize usability for the company. In cooperation

with the company, the decision was made to apply the method on the Dutch housing industry in the near future (2020-2040). The Dutch housing industry is broadly defined as the market for homes in the Netherlands, both from newly constructed homes and from renovations.

There are several limitations to this research. There is no method proposed to evaluate the proposed roadmap. An attempt was made to propose a quick and flexible process. Possible disadvantages of this design might be that it lacks depth and detail, which are sacrificed in order to gain as much speed as possible. Regarding the execution of the design: many changes were made during the process. For instance, the design initially proposed a workshop with all participants. This was, however, not deemed possible within the time-frame of the research and because of Covid-pandemic related issues. Improving the final scenario-based roadmap by adding flexpoints would also prove too time-consuming and was therefore discarded. In terms of quality of the final product: quality could have been improved by a more broad approach to the execution of the design. By involving more people from VolkerWessels, as well as involving multiple branches of the company, possibly a qualitatively better result could have been produced, and more valuable recommendations could have been made. The final roadmap could have been improved by adding timescales and linking them to current VolkerWessels products, resulting in a roadmap that shows which products to improve and how to improve them, and when the improvement is supposed to be completed.

An important finding of the research was the concept of neighborhood concepts. Multiple scenarios dealt with the idea of providing corporations with a broad approach in which existing homes were to be renovated and possible new homes would be constructed, but also where the infrastructure of the whole neighborhood would be modified/optimized to fit the needs of the neighborhood. The argument behind this idea is that it would provide corporations with a single party to deal with, which would ease development on the side of corporations and governments. VolkerWessels would be a good candidate to deliver these solutions, as the organization possesses a wide variety of expertise and resources due to its size. A coherent vision on neighborhoods and neighborhood concepts would need to be created, including many aspects regarding city planning and sustainability. It is also important to look at the role of the classical contractor. Already, other companies are pioneering alternative business models and vertical supply chain integration, creating new and different competitors for the organization.



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## **Chapter 1: introduction**

This chapter provides a short introduction on the research. The background of the study will be described, as well as the research objective, research questions, research design, methods of data collection, and theoretical and practical relevance. The chapter will end with a short section outlining the structure of the thesis.

### **1.1 Situation**

The construction industry is a turbulent industry. After facing a serious crisis a decade ago, the industry tries to overcome new challenges. A major difficulty here lies in the fact that the construction industry is not generally seen as an innovative industry (Blaise & Manley, 2004; Xue, Zhang, Yang, & Dai, 2014). The reasons for this are multiple: because of a lack of investment in research and development (Murray, 2003), because the construction industry mostly works on project-basis (Xue et al., 2014), and because there is a lack of repetition (De Valence, 2010), just to name a few often-heard reasons.

In the Netherlands alone, the industry has to cope -among other things- with nitrogen-related issues (“Stikstofimpasse kost bouwsector 70.000 banen”, 2019) and PFAS-related issues (“Na stikstof nieuw probleem voor bouwsector: PFAS”, 2019), and a lack of available manpower (“Bouwers kunnen vraag niet aan”, 2019), and materials (“Bouwupdate juli 2019”, 2019). The recent Covid-19 outbreak only aggravates current problems (“ABM AMRO: Bouw krimpt komende jaren fors door corona”, 2020). The challenges that the construction industry faces in the Netherlands are not contained to the industry itself. Currently, The Netherlands face a housing shortage which is rapidly rising and at the moment amounts to 263,000 houses (“Woningtekort groter dan gedacht”, 2019), a shortage that some sources say might take at least twenty years to resolve (“Passieve houding duwt woningmarkt in moeras”, 2020).

One major player in the construction industry in The Netherlands is VolkerWessels. With 16,000 employees one of the biggest housing construction companies operating in the Netherlands, the company has specialized in real estate development and has already developed creative ways to cope with new challenges. One of them being MorgenWonen, a concept which promises to deliver a house within a day due to modern techniques including modularization, prefabrication, and robotization (VolkerWessels, 2020). The company is challenged with continuously changing

variables in the construction industry nowadays and has shown interest in introducing a method for making flexible strategic choices.

In order to effectively cope with the continuously changing environment in the housing construction industry and deal with mounting challenges, VolkerWessels could benefit from a theory-based strategic tool. Currently, development of new innovations happens in accordance with the opinions of executive staff, who consider investing in new opportunities based on personal opinion and corporate goals. However, there is currently no system in place to select and develop opportunities in a systematic way. The development and application of a tool to improve the strategic decision making process can help the company in accomplishing its strategic goals. VolkerWessels believes that a scenario-based roadmapping method can fulfill this need.

The research goal of this thesis is therefore to develop and test a scenario-based roadmapping method at VolkerWessels in order to attain relevant strategic insights and to offer the company a practical and dynamic method that can be used in the strategic decision making process. This research goal can be subdivided in two distinct parts, described in the next section.

## **1.2 Research objective**

The research has two main objectives, which are as follows:

Objective 1: Develop a scenario based roadmapping method based on current literature and tuned to VolkerWessels;

Objective 2: Execute the design and analyze the outcome, and translate this into practical recommendations for the company and theoretical recommendations for the academic field of scenario-based roadmapping.

## 1.3 Research questions

The main research question has been formulated as follows:

*How can a scenario-based roadmapping method be developed from theory and applied to VolkerWessels Bouw & Vastgoed in order to improve its strategic decision making process?*

This question will be researched through the following three subquestions:

Subquestion 1. What is a scenario-based roadmapping method?

- 1.1 What is scenario planning?
- 1.2 What is technology roadmapping?
- 1.3 What is scenario-based roadmapping?

Subquestion 2. What does a good scenario-based roadmapping design look like?

- 2.1 What can be concluded from the literature?
- 2.2 Which characteristics can be derived from the literature?
- 2.3 What does the scenario-based roadmapping method look like?

Subquestion 3. How can the developed scenario-based roadmapping method best be applied to VolkerWessels and what can be learned from this design?

- 3.1 What are the main outcomes of the application?
- 3.2 How can the developed scenario-based roadmapping method be improved?
- 3.3 What are the limitations and recommendations for further investigation?
- 3.4 Which steps can be taken to introduce a systematic application of scenario-based roadmapping to VolkerWessels?

## 1.4 Research design

This research consists of three distinct subquestions. For the first subquestion, which will explore scenario-based roadmapping in literature, desk research was used. Current scientific literature has been examined on topics of scenario planning, roadmapping and scenario-based roadmapping. Based on this desk research, a conclusion was drawn. This conclusion was then used to design a scenario-based roadmapping method, answering subquestion 2. A schematic representation of the research design can be seen in figure 1.1 below.

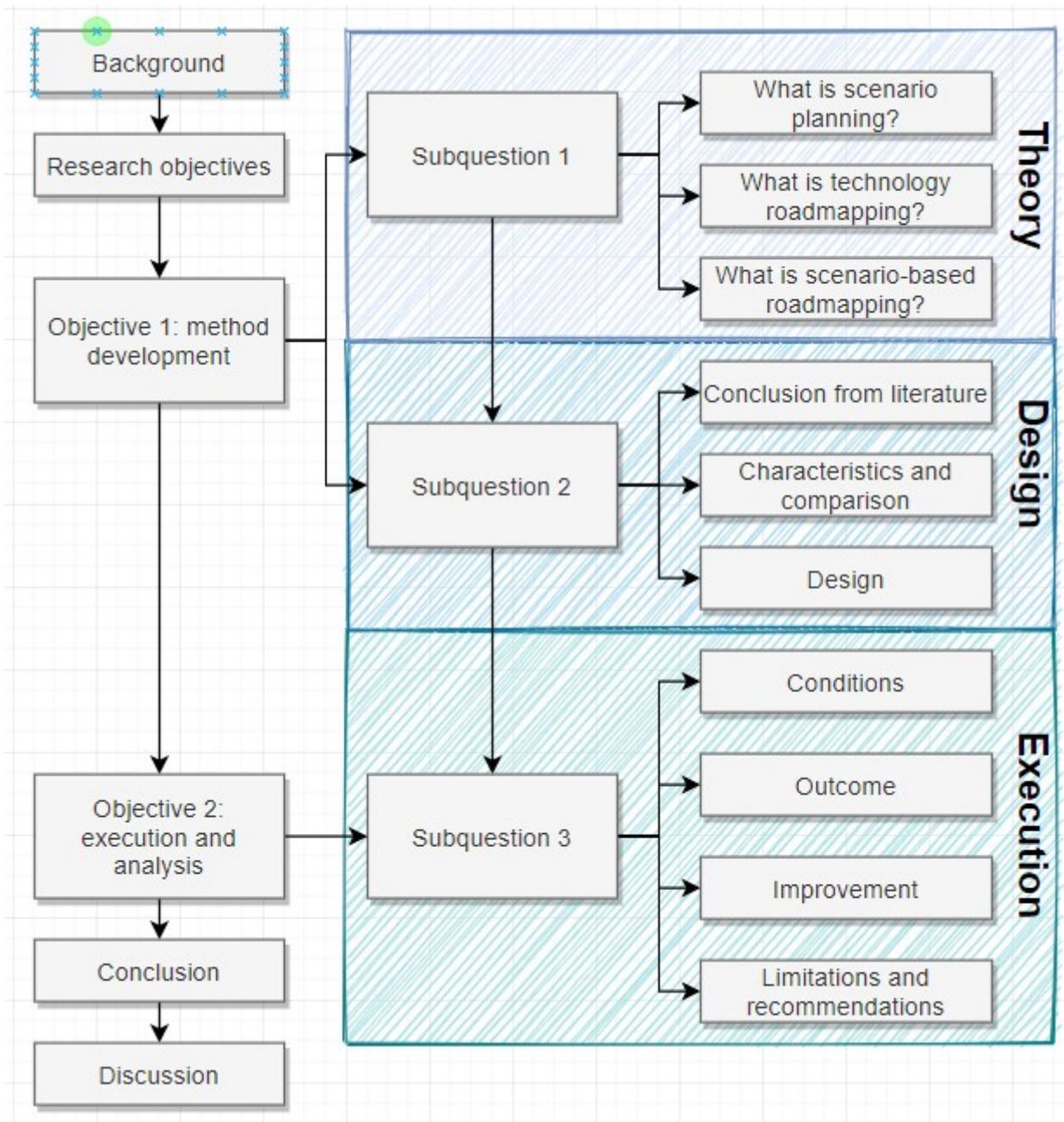


Figure 1.1: Schematic representation of the research design.

In applying the design, expert interviews were held in order to obtain relevant insights in current trends in the construction industry which were used to tune the scenario-based roadmapping method to the company. This was followed by multiple interviews with VolkerWessels personnel, in order to create multiple scenarios. These scenarios were then assessed through two online sessions. Finally, the design was improved by feedback from research participants. This concluded subquestion 3. On the whole, a design circle was used: the method was designed, tested, and improved.

In order to create good qualitative research, there are several criteria that were adhered to. These criteria are: worthy topic, rigor, sincerity, credibility, resonance, significance of the contribution, ethical and meaningful coherence (Tracy, 2010). In the execution of the research, participation of others is used to improve trustworthiness of the research (Burnard, 1991; Drisko, 2005). Non-participating researchers were asked to read transcripts and manuscripts and provide feedback to the researcher in order to increase validity of the research (Burnard, 1991). Good ethics were ensured by ensuring privacy and confidentiality of the research participants (Sales & Folkman, 2000) and by adhering to the Dutch Code of Ethics for Research in the Social and Behavioral Sciences as prescribed by University of Twente. Because the research involves human participants, the research proposal was submitted for ethical approval to the Ethics Committee of the Faculty of Behavioral Sciences of the University of Twente. The research has been approved by the ethics committee on 18-05-2020.

## **1.5 Data collection**

The following data collection methods were used (described per chapter):

### Chapter 1. Introduction

For the introduction, various news sources were used in order to sketch the background of the research. Several highly-cited papers on innovation in the construction industry were used to describe the state of innovation in the construction sector. Also, documents from VolkerWessels were used, both from internal documents and conversations with VolkerWessels personnel.

### Chapter 2. Theoretical framework

Data was collected through literature review. Scientific papers on relevant topics were reviewed in order to develop a scenario-based roadmapping method. Papers were chosen based on subject, number of citations, and the journal in which the paper has been published.

### Chapter 3. Design

For this chapter, in which a design is proposed based on the current literature, the data available from the previous chapter was used.

### Chapter 4. Execution

Expert interviews were held to obtain relevant firm-specific insights in order to tune the developed method sufficiently to the company and to gain useful insight in current trends. Input from all previous subquestions was used in this chapter, which means most previous sources were consulted again. Further consultation with the company was done in order to improve the developed method. Multiple interviews, as well as two sessions were held with VolkerWessels experts and executives to conduct the scenario-based roadmapping method.

### Chapter 5. Discussion and conclusions

No further sources were used in this chapter.

### Chapter 6. Reflection

No further sources were used in this chapter.

## **1.6 Research relevance**

The concept of scenario based roadmapping is a relatively new one. This means that the application of this method means applying relatively new science in practice, making a well executed application relevant to the current state of science. Recommendations of past authors on the subject will be regarded and if deemed promising, can be applied in the current research. In conducting the research, a critical literature study will be executed, adding to the theoretical relevance of the research.

In practice, the company VolkerWessels benefits from a well-developed scenario-based roadmapping method matching the unique characteristics of the firm. Developed in cooperation with company and industry experts, a method has been developed that can help to systematically apply a scenario-based roadmapping technique to the strategic decision making process. This offers the company a new method in applying strategic thought in order to improve medium to long-term results. Also, the company has been provided with a first result of the strategic tool in the form of this report which includes practical recommendations, as well as a learning experience for personnel who have contributed to the results.

## **1.7 Report structure**

This report will continue in chapter 2 with the theoretical framework, in which the theory used in the research will be described. Input from this chapter is then used in chapter 3: design. This chapter sketches a design for a scenario-based roadmapping method. Chapter 4 describes the execution of this method within VolkerWessels. Chapter 5 will describe the conclusions and discussions, followed by chapter 6 which will describe a critical reflection on the research process. The report is completed by a list of references and by relevant appendices.

## **Chapter 2: Theoretical framework**

In this chapter, the theoretical framework is described. The theoretical framework starts with a sub-chapter on scenario planning, which is followed by sub-chapter 2.2 on roadmapping. In sub-chapter 2.3, scenario-based roadmapping is described. The chapter as a whole answers the first sub-question of the research: “What is a scenario-based roadmapping method?”. The setup of each sub-chapter is relatively the same. They start out with a general description of the subject, followed by its goals, several different methods of how to use the subject, good practices, and advantages and disadvantages. Each sub-chapter ends with a short conclusion. The third sub-chapter, on scenario-based roadmapping, ends with a description on current limitations according to the current literature.

A scientific literature study has been executed in order to collect the data for this chapter. Search engines Google Scholar and the University of Twente Library were used to search for literature, using relevant keywords including: scenario planning, technology roadmapping, scenario-based roadmapping, scenario thinking, strategic thinking, and business strategy. Results were assessed based on year of publication, number of citations, relevancy to the current research, and journal in which the study was published. Based on these criteria, a utility score was given to each paper, marking the level of usefulness to the current study. Papers with a high number of citations, published in a well-known journal, and with a relevant subject received a high score. Low-scoring papers were deemed irrelevant and not used for this research. As the research progressed, sources were chosen based on relevancy to the topic, resulting in the use of most of the assessed sources with high scores in the final product. The goal of the literature study was to gain useful insight in the relevant subjects in order to answer the main research question. An overview of the sources assessed in the study is shown in appendix A. The sources used in the final research are shown under references, after chapter 6.

## **2.1 Scenario planning**

### **2.1.1 What is scenario planning?**

Making decisions is an important aspect of doing business. Failure in making the right decision is, however, inevitable. Making the wrong decision is usually the result of an error or an unexpected occurrence. In order to combat this, organizations can sketch plausible alternative future environments – this is known as scenario planning (Chermack, 2004). Scenario planning is an approach to strategy and mainly concerns the search for the optimal strategy. It can be used to improve decision making in firms of all sizes, while it also helps to deal with uncertainty (Coates, 2001; Varum & Melo, 2010).

Korte and Chermack (2007) define scenario planning as a tool that has great potential to develop a dynamic and adaptable organization. It is a tool by which it is possible to make explicit a model that describes organizational reasoning and action, which can then be further developed and challenged. A scenario can therefore be defined as a narrative that follows a particular path into the future. These imaginary future scenarios can help decision makers cope with possible uncertainties (Goodwin & Wright, 2001; Montibeller, Gummer, & Tumidei, 2006). Scenarios can be used to outline aspects of the future and describe a future situation as well as the course of events which allows one to move towards this situation (Amer, Daim, & Jetter, 2013). It might however not be the scenario itself that is the most important outcome of scenario planning: Coates (2001) suggests that it is the learning experience of the scenario creators is the most valuable outcome of the process.

As many tools in strategic decision making, scenario planning has its roots in the military: it emerged after World War II as a method for military planning (Chermack 2004; Varum & Melo, 2010). Scenario planning became a well-known concept after Shell used it during the oil crisis of the 1980's for generating and evaluating strategic options, achieving better results than other major oil companies in the process (Korte & Chermack, 2007; Schoemaker, 1995). Shell is still considered one of the best known users of this tool, which has since then proven to be applicable in planning needs of all large public and private institutions (Amer et al., 2013). The first scenarios were developed in 1972, the preparation of which goes back to 1967. The first set of scenarios consisted of six scenarios and concentrated on economic growth, oil price, and oil supply. One of these scenarios described a sudden price spike, which became a reality following the Yom Kippur war in

1974. Because Shell had a scenario ready, they reacted better than competitors and this proved the importance of scenario thinking (Cornelius, Van de Putte, & Romani, 2005).

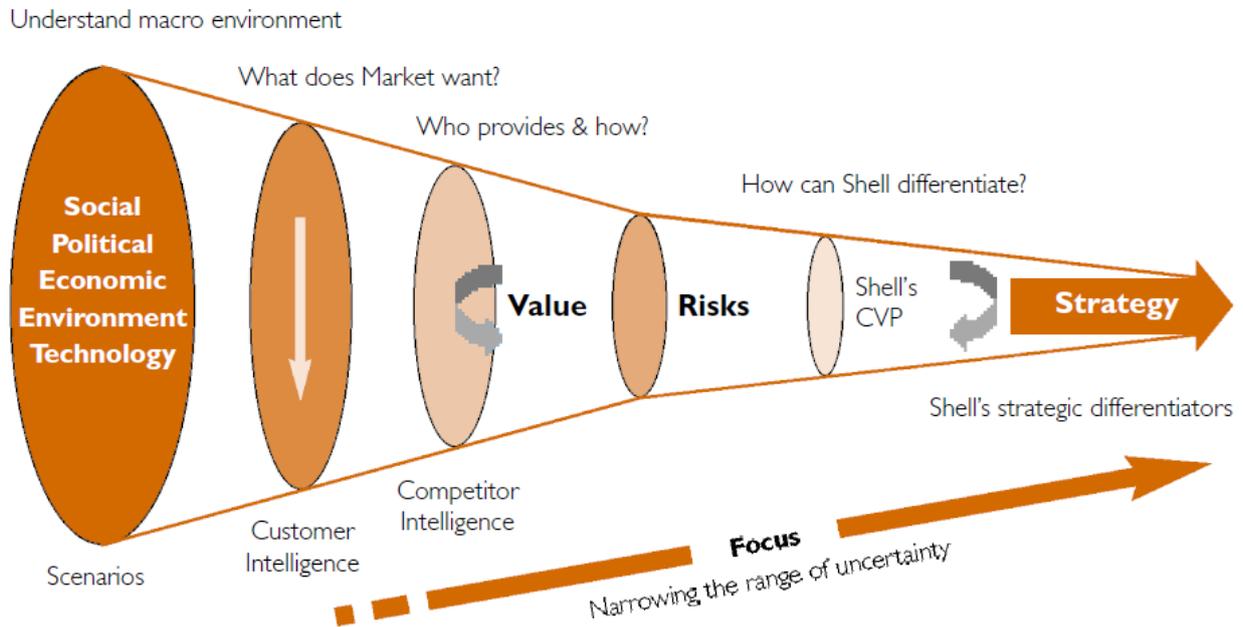


Figure 2.1: How Shell does scenario planning (Cornelius et al., 2005).

According to Cornelius et al. (2005), the approach of Shell to scenario planning is as follows: scenarios are created to understand the macro environment. This information is then combined with customer intelligence to understand how to best serve the market. Competitors are taken into account as well as Shells own strengths and weaknesses. Added to this are the risks. This results in Shells strategy. Figure 2.1 above shows the process as described by the authors.

### **2.1.2 What are the goals of scenario planning?**

The goal of scenario planning is to alter mental models for the purpose of strategic learning, according to Korte and Chermack (2007), thereby providing insights and narratives that can be challenged. Scenario planning attempts to capture the range of possibilities, turning these into easier-to-share narratives used to challenge the prevailing mind-set (Schoemaker, 1995).

It is important to note that the goal of scenario planning is not to predict the future, as this is as of yet not possible using any known method. Scenarios are used to explore multiple plausible future situations. This means scenarios differ from forecasts, as forecasts are used to show a most likely pathway instead of multiple situations (Amer et al. 2013). Scenarios are also not used to describe a complete set of future states; in practice they tend to overlap and are not mutually exhaustive (Schoemaker, 1991).

According to Schoemaker (1991), there are several conditions which would favor the use of scenario planning:

1. Uncertainty is high (relative to one's ability to predict or adjust);
2. Too many costly surprises have occurred in the past;
3. Insufficient new opportunities are perceived and generated;
4. The quality of strategic thinking is low (e.g. because strategic planning has become too routinized);
5. The industry has experienced significant change or is about to;
6. A common language and framework is desired, without stifling diversity
7. Strong differences of opinion exist, each of which has its merits;
8. Your competitors are using scenario planning (pp. 550).

The argument that scenario planning can be used to cope with uncertainty is mentioned by several authors (Coates, 2001; Goodwin & Wright, 2001; Montibeller et al., 2006; Varum & Melo, 2010), while Coates (2001) as previously mentioned argues that the learning experience is important - which would help improving the low quality mentioned in point 4.

### 2.1.3 What methods are used in scenario planning?

Several different methods for scenario planning have been developed, meaning there is no single approach to scenario planning. Amer et al. (2013) describe three different methodologies that aim at generating scenarios that share several common characteristics. These methodologies are: intuitive logics methodology, la prospective methodology, and probabilistic modified trend (PMT) methodology. The main difference between these methodologies is that the latter two are mostly used as a onetime activity to develop or evaluate policy and the first one is mostly used as an ongoing learning activity, aiming at making sense of situations while developing strategy as well.

A method that often returns in the literature is the one defined by Korte and Chermack (2007), based on the work of Schwartz (1996). They describe an 8 step process, which is as follows:

1. Identify the issue;
2. Identify key factors;
3. Research driving forces;
4. Rank key factors and driving forces;
5. Develop scenario logics;
6. Develop scenario details;
7. Consider implications;
8. Identify indicators.

First, the issue is identified. This should be a clear issue or discussion in a practical business situation. Then, key factors are described, which can be done by interviewing a cross-section of the organization. Executives and managers give strategic insight, line workers can give additional perspectives and industry experts foster new thinking in this step. In the third step, the driving forces are described. The driving forces are described by Schwartz (1996) as “the elements that move the plot of a scenario, that determine the story’s outcome, the motive, the things that influence the outcomes of events” (pp. 15) and are identified through external research. The DESTEP model can be used for this. When the driving forces are identified, they can be ranked in terms of importance and impact on the organization by members of the firm. In step five, the outcome of the previous step is turned into a graphical display by dividing the driving forces among two axes, thus creating a logical distribution. In step six, the scenarios are elaborated on by manipulating the driving forces determined earlier within the matrix of step four. Plausibility should also be checked in this step. The result of step six is a list of possible scenarios, checked for plausibility and based on driving forces, sorted by impact on the firm and importance. In step seven, the implications of the developed scenarios for the firm are checked and the initial issue is scrutinized based on the

developed scenarios. In the last step, leading indicators are described, which are signals of actual events that may unfold according to a scenario.

Schoemaker (1995) describes a ten-step approach for scenario planning: (1) define the scope, (2) identify major stakeholders, (3) identify basic trends, (4) identify key uncertainties, (5) construct initial scenario themes, (6) check for consistency and plausibility, (7) develop learning scenarios, (8) identify research needs, (9) develop quantitative models and (10) evolve towards decision scenarios.

Regarding the proper amount of developed scenarios, Amer et al. (2012) have made an overview of the recommended number of scenarios proposed by different authors. Most authors agree that two scenarios is the minimum and one should not draft more than six. The reasoning behind the minimum of two is that using one scenario leaves no room for alternatives, as there is no other scenario to compare the first one two. Using two scenarios usually creates two opposite situations. When using three scenarios, usually two scenarios are opposed while one is the ‘middle road’, which then automatically becomes the most likely scenario. Therefore, four scenarios is usually a good amount. Producing more than six scenarios is possible, but this will result in more difficult evaluation.

Goodwin & Wright (2001) underpin the importance of corporate objectives in scenario planning. They suggest creating a hierarchy of objectives for the organization which should be independently judged, as shown in figure 2.1 below. Creating this hierarchy makes it possible to assess scenarios based on different objectives, while also noting that one objective is more important than another objective.

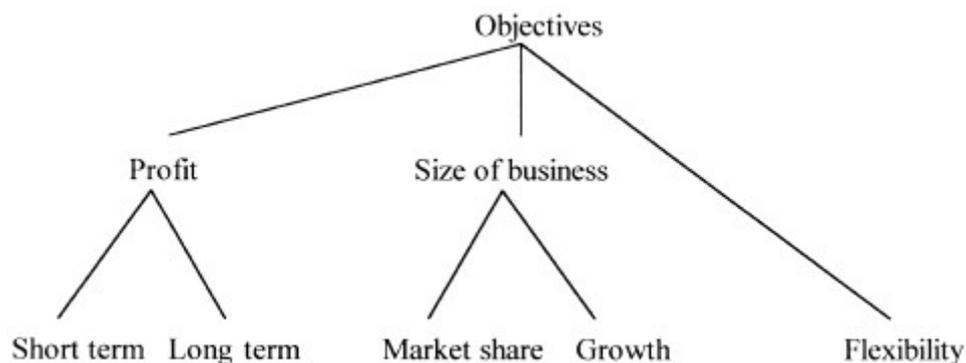


Figure 2.1: Hierarchy of objectives as suggested by Goodwin and Wright (2001)

In this example, a scenario can be assessed based on short-term profit and long-term profit. In this case, short-term profit is more important than long-term profit. Also, profit is more important than market share or growth of the business.

#### **2.1.4 What are good practices when conducting scenario planning?**

Multiple good practices can be derived from existing literature. These are:

- At least two scenarios should be created, and each of these scenarios must be plausible. The created scenarios have to be internally consistent, relevant to the organization and they must produce a new and original perspective (Chermack, 2004).
- The probability of the different scenarios should be measured in terms of high, low, or medium probability (Coates, 2001).
- The scenarios must resonate with managers and executives (Korte & Chermack, 2007).
- Scenarios must be focused and analytically detailed for relevance to the business (Varum & Melo, 2010).
- Scenario planning uses the participation of a diversity of people (experts, strategists, managers) (Varum & Melo, 2010).
- The scenarios should be not based on a certain point in time, but broad-based (Chermack, 2001) and focused on the long-term preferably (Amer et al., 2013)
- Users of scenarios should be involved in the creation of the scenarios (Coats, 2001)
- Constructing scenarios should be done in a way that the creator understands what he or she is doing and that when he or she repeats the process, the outcome would be the same (Coats, 2001)

### **2.1.5 What are advantages and disadvantages of using scenario planning?**

Several advantages of scenario planning are described in the literature. Scenario planning has the advantage that it facilitates cultural adaptation and change in organizations due to the fact that the scenarios crystallize in the shared mental models of the organization. Members of the organization must be able to anticipate changing conditions in order to grow the organization (Korte & Chermack, 2007). These shared mental models in the form of stories create a variety of viewpoints about the future and give an easy explanation of the future (Goodwin & Wright, 2001). In this way, scenarios present a set of complex elements in a coherent, systematic, comprehensive and plausible manner (Amer et al., 2013). Managers can construct scenarios in order to overcome the usual errors in decision making, namely tunnel-vision and overconfidence (Varum & Melo, 2010). Scenario construction avoids the need to estimate subjective probabilities, which lessens the effect of personal biases resulting in said errors (Goodwin & Wright, 2001).

Using scenario planning may also prove to have disadvantages. For instance, scenario planning is not designed to choose particular investment projects, because prices and numbers tend to change too much over time. Scenarios should instead be combined with a real options approach and used to identify future options, decide on options and provide input in decision making (Cornelius et al., 2005). Also, it is difficult measuring an organization's performance when using scenario planning. This may lead to poor decisions being made (Goodwin & Wright, 2001).

### **2.1.6 Conclusion**

Scenario planning is a tool that makes it possible not to predict the future, but to better handle a possible situation in the future when it occurs, as well as cope with uncertainty. Creating scenarios results in narratives, which are easy to communicate and internalize within an organization. Creating these stories in itself is a valuable learning process for members of an organization. Using scenario planning makes it possible to create shared mental models within an organization, so that organization members can anticipate changing conditions and therefore more flexibly attain organizational goals. It is important to note that there is no single way to execute scenario planning. Many different methodologies have been created with different approaches and different outcomes.

Scenarios planning can be executed roughly using the following steps:

1. Identifying the issue and the scope, including stakeholders
2. Identify important factors and trends
3. Construct scenarios
4. Assess scenarios based on certain criteria (for example, plausibility)
5. Consider scenario implications and act

The constructed scenarios should adhere to certain standards. They have to be internally coherent, plausible, detailed, broad-based, and they should resonate with managers and executives. They should be easy to communicate.

## **2.2. Roadmapping**

### **2.2.1 What is roadmapping?**

In the current business environment of ever shortening product lifecycles and new technologies, organizations develop new tools to remain flexible. Roadmapping is a tool which organizations have developed to cope with these issues. Roadmapping is a needs-driven planning process that helps to identify, select and develop alternatives for a certain need (Garcia & Bray, 1997) while it provides a long-term view on how to serve markets (Groenveld, 1997). This can be done for specific technologies or for a business as a whole. When conducting planning in an organization, three elements must be linked: customer needs, products/services and technologies (Garcia & Bray, 1997). According to Lehtola, Kauppinen and Kujala (2005), roadmapping links aspects of business to requirements engineering.

Roadmapping was originally developed by Motorola in the 1980's in order to improve the alignment between technology and innovation (Carvalho, Fleury & Lopes, 2013; Phaal & Muller, 2007). It was standardized in the form of the so-called 'Enterprise Roadmap Management System' and sponsored by senior executives from the company. Over time, the roadmaps at Motorola have evolved from paper roadmaps, to digitized roadmaps, to online creation of roadmaps (Richey & Grinnell, 2004).

### **2.2.2 What are the goals of roadmapping?**

There are several goals of roadmapping, depending on the needs of the organization. These goals can be: product planning, capability planning, strategic planning, long-range planning, knowledge asset planning, program planning, process planning, and integration planning. Depending on the goal, the process behind the roadmap will be different, as well as the characteristics (Phaal, Farrukh, & Probert, 2001). Business oriented long-term planning is one of the most common goals (Lehtola et al. 2005).

According to Phaal (2005), a roadmap answers three questions: where is the organization going, where is the organization now and how can the organization get where it wants to go.

### 2.2.3 What methods are used in roadmapping?

The roadmapping process may differ from organization to organization, as different organizations have different needs (Groenveld, 1997). The end result can also be presented differently, but is usually a time-based multi-layer graphical representation that takes into account different factors, as the example in figure shows (Phaal et al. 2001; Carvalho et al. 2012). The actual visual form used to communicate the roadmap differs, as well as the quality of the visual form (Phaal & Muller, 2007). Graphical forms that have been used include: layers, bars, tables, graphs, pictorial representations, flow charts, single layers, and text (Phaal et al. 2001).

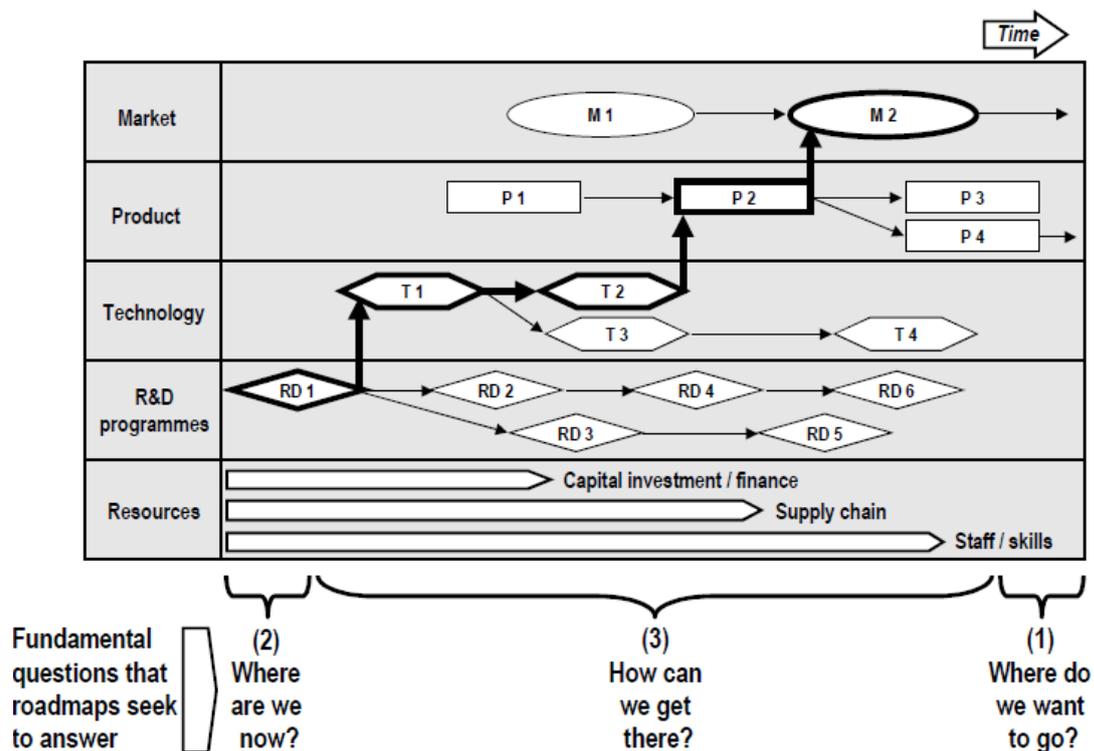


Figure 2.2: Roadmap according to Phaal (2005).

The roadmap in figure 2.2 above describes the current situation, the desired situation and the way to get to that desired situation. It describes this path according to different markets the organization wants to serve, different products the organization wants to offer to these markets, different technologies necessary for these products, R&D programs to develop these technologies, and resources necessary to carry out the R&D programs.

Phaal, Farrukh, and Probert (2004) describe two processes for technology roadmapping: a standard approach and a customized approach. The standard approach comprises four workshops. These workshops focus on the first three layers as seen in figure 2.2. (market, product, technology). A final

workshop then combines the outcomes of the first three workshops in order to construct the chart. This approach is described as a market-pull approach, as the approach starts out with describing the markets, and aims to describe products and technologies that can serve these markets. The authors describe two important challenges to overcome when a company attempts to implement roadmapping, namely keeping the roadmap alive (keeping it up to date) and roll-out (facilitate the adoption of the method in the organization).

Garcia and Bray (1997) define three separate phases in technology roadmapping: the preliminary phase, the development phase, and follow-up activities. In the preliminary phase, essential conditions are set (1), leadership/sponsorship is provided (2), and the scope is set (3). In the development phase, the focus is set (4), the requirements are set (5), the technology areas are specified (6) as well as the technology drivers (7), technology alternatives and timelines are developed (8), a recommendation on which alternatives should be pursued is made (9), and finally a report is made (10). The follow-up activities consist of critique and validation (11), development of implementation plans (12) and recurring reviews and updates (13). Regarding the essential conditions that have to be met before starting, Garcia and Bray (1997) state that there must be a need for the roadmap, different groups have to provide input, various parts of the organization need to contribute, various members of the industry need to provide input, and the process should be needs-driven (as opposed to solutions-driven). The three stages defined by Garcia and Bray are also described by Gerdri, Vatananan, and Dansamasatid (2009), as the initiation stage, the development stage, and the integration stage.

According to Groenveld (2007), the roadmap process is done by a project team. This team sets objectives, builds blocks for the roadmap, selects roadmap scenarios, generate the roadmap through drafts and assessment, and formulates and organizes follow-up activities. He also describes a seven-step process as used by Philips, which is as follows: (1) problem recognition, (2) development of provisional roadmap, (3) discussion, (4) workshop and formulating a draft, (5) upgrading the roadmap, (6) improvement, and (7) repetition of all the previous steps in order to stimulate learning.

Gerdri, Vatananan, and Dansamasatid (2009) define multiple teams, namely the champion idea team, the roadmap operation team and the roadmap support team. The first team is the driving force behind the roadmapping initiative, the second team participates in roadmap development, and the third team acts as an administrative body in support of the first teams.

Regarding the time window: the planning phase consists of 3 years, the vision phase consists of 3-6 years, according to Groenveld (2007). Phaal et al. (2001) argue that the scale changes depending on the situation, and that certain businesses use short timespans (for instance IT) and some will use long timespans (for instance railroads).

Phaal & Muller (2007) also describe the phenomenon of 'roadmapping as a core competence', meaning using roadmapping to develop the organization as a whole and integrating the process within existing organizational processes. This phenomenon starts with the exploratory phase, in which roadmaps emerge from particular individuals (early adopters). This may grow to a common approach as it is picked up by managers and the results are communicated throughout the organization. When a certain critical mass is achieved, roadmapping can be integrated as part of core business processes.

## 2.2.4 What are good practices when roadmapping?

Throughout the literature, various good practices are described in order to execute a successful roadmapping process. These practices include the following:

- The facilitator needs to have skills regarding both the roadmapping process and interpersonal communication. Some of the participants or consultants must know the roadmapping process (Garcia & Bray, 1997).
- A degree of trust is necessary between different departments. Lack of openness may frustrate the roadmapping process (Groenveld, 1997).
- Workshops are important in the roadmapping process, as this brings people together and facilitates discussion. IT-tools can help in these discussions (Phaal & Muller, 2007) and also in creating the roadmap and communicating it (Richey & Grinnell, 2004; Phaal et al. 2001). Software needs to be integrated with the human aspects of roadmapping in order to deliver good roadmaps (Phaal et al. 2004).
- A significant degree of commitment is key to an effective roadmapping process. This commitment should be throughout the organization and should be combined with a clear vision (Phaal et al., 2001). Additionally, senior management should be enthused in such a way that resources are made available and barriers are removed (Phaal et al., 2001).
- Success factors for roadmapping are: a clear need & desire for effective business processes, the right people, commitment, availability of the required information, good timing, effective tools and techniques, and effective facilitation (Phaal et al., 2001).
- The roadmap should be kept 'alive' in the sense that it should be constantly updated with current information. This can be best done by reviewing the roadmap at least once a year (Phaal et al. 2001; Phaal et al. 2004) or even on a daily basis (Gerdtsri et al., 2009). Again, IT-tools can be used to support this (Richey & Grinnell, 2004)
- The roadmap should be communicated in a graphical form to improve understanding of the roadmap throughout the organization (Phaal et al., 2001).

### **2.2.5 What are advantages and disadvantages of using roadmapping?**

Roadmapping has several advantages. Building a roadmap has several communication and networking benefits, as they promote common understanding throughout the organization by bringing from different parts of the organization together. This makes members of the organization collaborate more freely, understand their direction better, and communicate more effectively (Richey & Grinnell, 2004; Phaal et al. 2001; Phaal et al. 2004; Phaal et al. 2005). This is true in particular in aligning technology and commercial perspectives (Phaal & Muller, 2007). The final roadmap can be used as a good tool to communicate ideas to stakeholders (Lehtola et al. 2005; Phaal et al. 2004).

There are also several disadvantages to roadmapping. It is not yet fully understood how to align the roadmap with core business (Phaal & Muller, 2007). Also, roadmapping is commonly used to develop a solution in a specific crisis, which is not the optimal way to use the process (Strauss & Radnor, 2004). A roadmap can be out-of-date practically immediately after its creation, especially in quick-changing branches like IT (Lehtola et al. 2005). Use of roadmapping in sub-optimal conditions will lead to an ineffective process. These sub-optimal conditions can be: over-detailed long-term plans, lack of explicit assumptions regarding the future customers' needs, or rapid and volatile changes in planning (Strauss & Radnor, 2004).

## **2.2.6 Conclusion**

Roadmapping is a needs-driven planning process that helps to identify, select and develop alternatives for a certain need while it provides a long-term view on how to serve markets. There are several goals of roadmapping, depending on the needs of the organization, business oriented long-term planning being one of the most common goals. Roadmapping should answer where is the organization going, where is the organization now and how can the organization get where it wants to go.

The roadmapping process may differ from organization to organization, but is usually a time-based multi-layer graphical representation that takes into account different factors. Graphical forms that have been used include: layers, bars, tables, graphs, pictorial representations, flow charts, single layers, and text.

The roadmapping process exists of three separate phases: a preliminary phase in which the roadmapping process is prepared, an execution phase in which the actual roadmap is developed, and a follow-up stage in which the results of the roadmap are communicated and possible organizational changes are implemented. The process can be done by a single team or by multiple teams, possibly differentiating the roles of the driving force behind the process, the actual development of the roadmap, and possible administrative support of the developers.

For obtaining the best results, roadmapping should be done using workshops led by a facilitator who understands the roadmapping process. Commitment throughout the organization is necessary for an effective roadmapping process, including commitment by senior personnel. The roadmap should be communicated in a clear graphical form in order to improve organizational understanding and the roadmap should be periodically updated if necessary.

Building a roadmap has several communication and networking benefits, as they promote common understanding throughout the organization by bringing from different parts of the organization together. The final roadmap can be used as a good tool to communicate ideas to stakeholders. However, roadmapping is commonly used to develop a solution in a specific crisis, which is not the optimal way to use the process. A roadmap can be out-of-date practically immediately after its creation, especially in quick-changing branches like IT.

## **2.3. Scenario-based roadmapping**

### **2.3.1 What is scenario-based roadmapping**

Early attempts to combine scenario thinking with technology roadmapping were made by Strauss and Radnor (2004). They argued that roadmapping could be improved by scenario planning; this would enhance flexibility and vision and would enable anticipation of a broader range of possible changes. SBRM would, they argued, combine the best aspects of scenario planning and roadmapping, and thereby create a new, more robust and dynamic tool (Strauss & Radnor, 2004). Building on this idea, Lee, Song, and Park (2015) add the notion that such a tool is necessary in rapidly changing markets where innovation cycles become shorter and success may depend on the speed with which a company can adapt to these conditions (Coates, 2000). Combining technology roadmapping with scenario thinking improves a companies' ability to prepare in the event of a range of futures.

As SBRM is a relatively new technique, researchers are still trying to gain a deeper understanding of the technique and how it best can be applied. List (2004) proposed a SBRM-technique using a scenario network instead of a snapshot of scenarios, so the scenarios would not have to be revised in case of a major premise change. Strauss & Radnor (2004) apply the *program evaluation and review technique* (PERT) which makes for a more systematic approach, describing key tasks and critical decision points. Several authors choose a more quantitative approach, introducing calculations and formulas and putting the emphasis on the numbers-aspect. Among these authors are Lee et al. (2015) who introduce Bayesian Networks in SBRM, and Amer et al. (2015) who use SBRM in calculating wind flow in wind turbine arrays.

### **2.3.2 What are the goals of scenario-based roadmapping?**

As the concept of scenario-based roadmapping is relatively new, different ideas exist about what the goals of the exercise should be. Geum, Lee, and Park (2014) suggest that scenario-based roadmapping is meant to extend the application of technology roadmapping in order to better deal with changing demands in markets. Strauss and Radnor (2004) agree and argue that a combination of roadmapping and scenario planning overcomes the limitations of both tools and creates a tool that is better suited for dynamic and volatile environments. Hansen, Daim, Ernst, and Herstatt (2016) conclude that a technology roadmap combined with scenarios results in a graphical format that is both easy to communicate as well as suitable to base strategic decisions on.

### **2.3.3 What methods are used in scenario-based roadmapping?**

Several methods on SBRM currently exist. Saritas and Aylen (2010) propose that scenarios can be used throughout the roadmapping process, thereby clearly distinguishing the two processes. They suggest that roadmapping can be used before, during and after the roadmapping exercise. Before building the roadmap, scenarios can be used to describe the starting condition, the premises on which the roadmap is to be build. During the roadmapping process, scenario thinking can be used to develop different branches, different trajectories to which the roadmap can lead. After the roadmapping exercise, scenarios can be used to test the robustness and develop an overall picture.

Cheng, Wong, Cheung, and Leung (2016) developed a more wholesome approach to SBRM. They define five distinct phases: (1) prerequisite preparation, (2) scenario team formation, (3) scenario building, (4) scenario assessment and selection, and (5) scenario-based roadmapping. In the first phase, the preparation phase, the goal is to determine the goal of the SBRM activity. In this phase, top-management level staff is encouraged to participate as they might best describe the company's strategic needs. At the end of this phase, the background, goals and scope of the study should be clear to all participants. The second phase, scenario team formation, aims to identify participants for the SBRM activity. The participants will be responsible for three tasks and will therefore be divided among three groups. The teams are: scenario building team, scenario assessment team, and decision team. The scenario building team is responsible for creating scenarios, the scenario assessment team should assess the generated scenarios using a quantitative approach. The decision team should consist of managerial staff and should select the best scenarios for use in the technology roadmap. The scenario building team will construct various scenarios in phase three, the scenario building phase. Various methods exist for constructing the scenarios. Cheng et al. (2016) propose a guideline based on the six thinking hats by de Bono (2017), which differentiates thinking in terms of organization, information, emotions, optimism, discernment, and creativity. A specific worksheet was designed In order to guide the SBRM-process. This worksheet provides general information about the SBRM-activity, scope and introductions, and provides six questions for constructing both a positive and a negative scenario. The questions are based on the 5W1H-method by Kipling (what, when, where, who, why, how). Each member is supposed to answer these questions and create a positive and a negative scenario. In the fourth phase, the scenario assessment and selection phase, the scenario assessment team will validate the scenarios generated in phase three. The scenarios will be tested on relevance, completeness, consistency, plausibility and creativity. Concretely, the scenarios will quantitatively assessed based on feasibility, innovativeness, impact, estimated market share, estimated investment, and possible government support. The scenario assessment team will

rate these six aspects on a 5-point scale. The scores can then be aggravated to create an average score for each scenario. If feasibility scores lower than 3, the scenario is discarded. Scenarios with a feasibility score of 3 or higher, remain in the scenario pool. Criteria may then be weighed by industry experts or managers to give priority to a certain criteria. For example, if managerial staff prefers ideas that may come with government subsidies, emphasis can be put on the 'possible government support'-criterion.

After assessment, the scenario selection team can select scenarios for implementation. Scenarios are selected based on relevance, match with purpose and scope, completeness, availability of an action plan, and feasibility score. The final phase, the scenario-based roadmapping phase, aims to finalize the action with the generation of organizational future action plan(s) with a timeline. First, a preliminary scenario-based roadmap is generated in order to visualize the action plan. This preliminary scenario-based roadmap consists of an action plan, a timeline, milestones, internal & external drivers, and stakeholders (individuals involved in the proposed actions). Second, the preliminary scenario-based roadmap can be assessed by the scenario assessment team to generate a comprehensive organizational scenario-based roadmap.

Cagnin & Könnölä (2014) devised a SBRM-method using online questionnaires and interviews with key industry actors. This method consists of nine steps: (1) identify Key Areas of Technology (KATs), (2) linking the results to previous research, (3) define variables, (4) devise a framework, (5) position scenario snapshots, (6) develop snapshots, (7) assess snapshots, (8) discussion, and (9) finalization. The process starts with researching relevant topics, creating a list of topics viable for the scenario-based roadmap based on preselected key areas of technology. These topics are then brought up during the interviews, possibly resulting in more topics. A workshop is organized with all project partners in order to define the main dimensions that influence the key areas of technology previously defined, after which the identified variables are described based on their impact to the main dimensions. In the fourth phase, a framework is designed based on the main dimensions. Different scenarios are then described, defined by Cagnin & Könnölä (2014) as 'snapshots'. These snapshots are mapped to a quadrant based on the main dimensions. The snapshots are then developed further, emphasizing on how the snapshots might behave in the near future. Finally, the results of the activity are discussed and finalized, leading to a certain vision as seen in figure 2.3 on the next page.

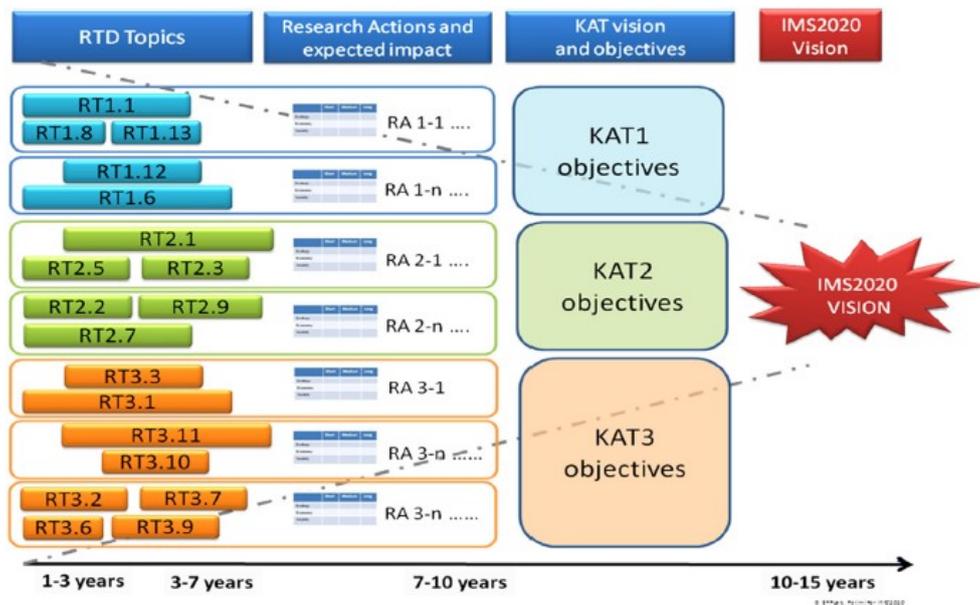


Figure 2.3: Vision (roadmap) according to Cagnin & Könnölä (2014).

Strauss and Radnor (2004) propose a 15-step plan for what they call multi-scenario roadmapping: (1) identify corporate drivers, (2) specify underlying assumptions, (3) assess drivers of change, (4) assess strategic implications, (5) define initial issues, (6) develop scenarios, (7) create roadmaps for each scenario, (8) define checkpoints, (9) consider variations, (10) define window, (11) specify ‘flex’, (12) translate to preliminary Gantt-chart, (13) select most likely scenario and improve Gantt-chart, (14) keep refining scenarios as time continues, (15) re-evaluate and redo the SBRM-activity if deemed necessary.

In the first phase, corporate drivers and the company profile are to be identified. In this stage, characteristics of the company, risk tolerance, dependencies (on assets), the companies’ strategic position and objectives are described. Assumptions and opportunities / weaknesses (SWOT) are described in the second step. In the third and fourth step, drivers of change in the environment and their strategic implications are described. These are then further researched and formed in scenarios. In step 7, a roadmap is created for each scenario. This roadmap consists of a PERT-chart containing a time frame, key tasks, inter-dependency between these tasks, critical decisions, current status of tasks and critical external developments. In the next step, the roadmap is supplemented with checkpoints, progress towards completion, and go/no-go decision moments. The roadmap is then scrutinized to determine when the company can transition into a strategy fitting a certain scenario, complemented with flex points: moments where adjustments can be made. For the last steps, the different roadmaps are translated into a Gantt-chart, putting emphasis on the scenarios deemed most

likely. Step 14 and 15 dictate a continuous feedback improvement loop in order to keep the scenario-based roadmap up to date. The end result is shown in figure 2.4 below.

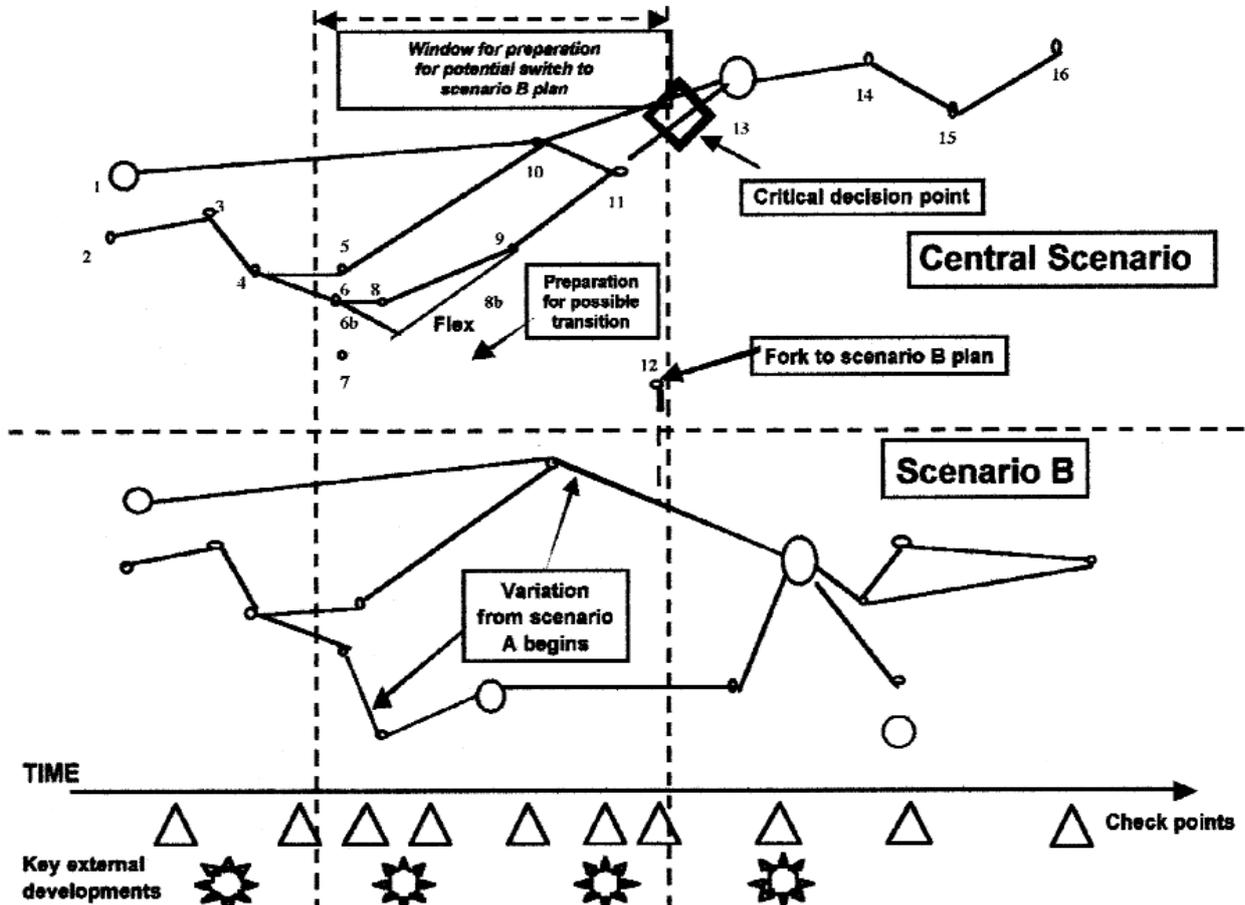


Figure 2.4: Scenario based roadmap based on Strauss and Radnor (2004).

Siebelink, Halman, and Hofman (2016) define six distinct steps in SBRM: (1) preparing the workshops, (2) analyzing the current situation, (3) exploring future business environments, (4) determining robust areas, (5) roadmap design, and (6) implementation. In the first step, workshops are prepared. A project team is to be formed containing internal and external facilitators with adequate expertise. The project team then designs the workshops and recruits workshop attendees. The goal of this step is to prepare a workshop that ensures useful results. In the second step, the current situation is analyzed. This analysis includes environmental elements, called driving forces, on macro-, meso-, and micro levels. The analysis also contains a description of the market the company operates in, strengths and weaknesses (SWOT), and current corporate strategy. In the third step, the future business environments are explored. The driving forces as previously defined are

used to describe several scenarios, resulting in multiple projections per driving force. In the fourth step, robust areas are defined. The scenarios are compared to find commonalities, certain shared implications derived from the driving forces. These robust areas are then taken as a basis for the roadmap. In this step, a SWOT analysis is conducted. The step results in a list of focus areas and preconditions for the roadmap. These can be rated on certain criteria: consistency with strategy and scope, financial feasibility, risks, and clarity. In the fifth step, the business roadmap is designed as shown in figure 2.5 below. The team determines where to put priorities and which products or processes it will develop based on these priorities. In the final step, the roadmap is implemented. This phase includes continuous improvement on a certain level: the roadmap will be occasionally evaluated and improved.

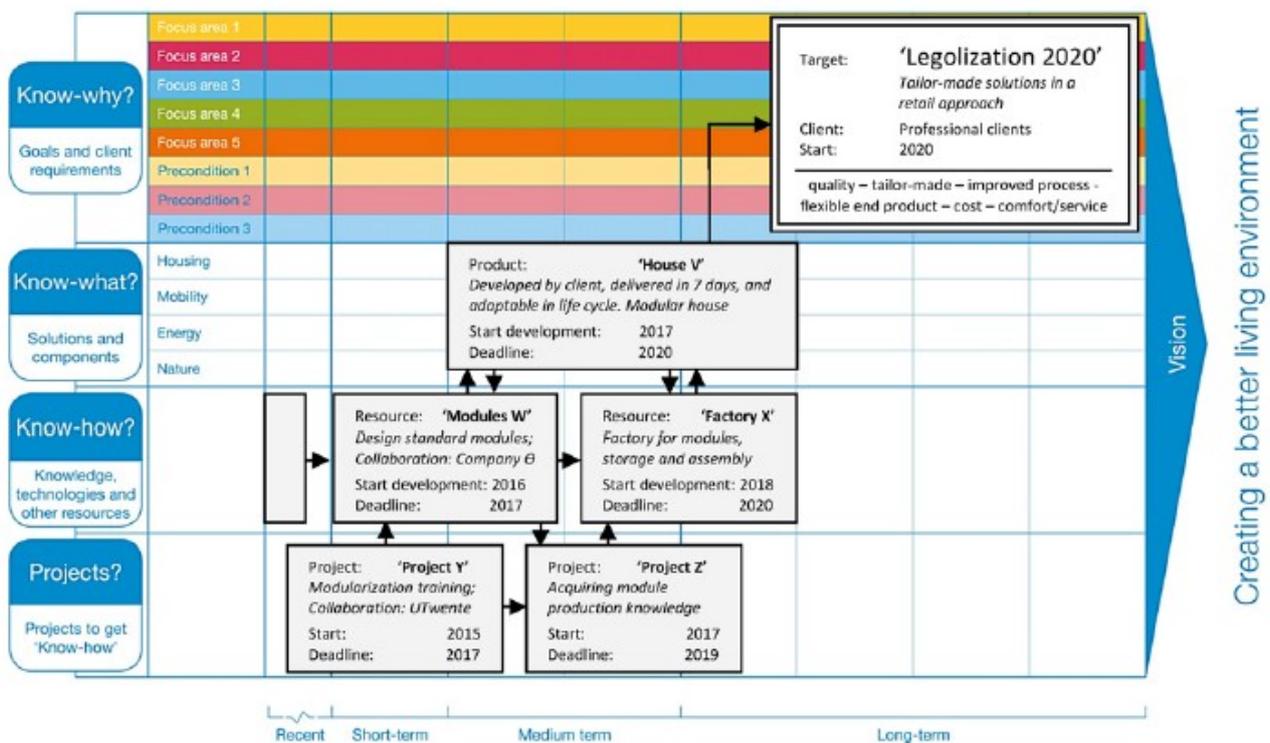
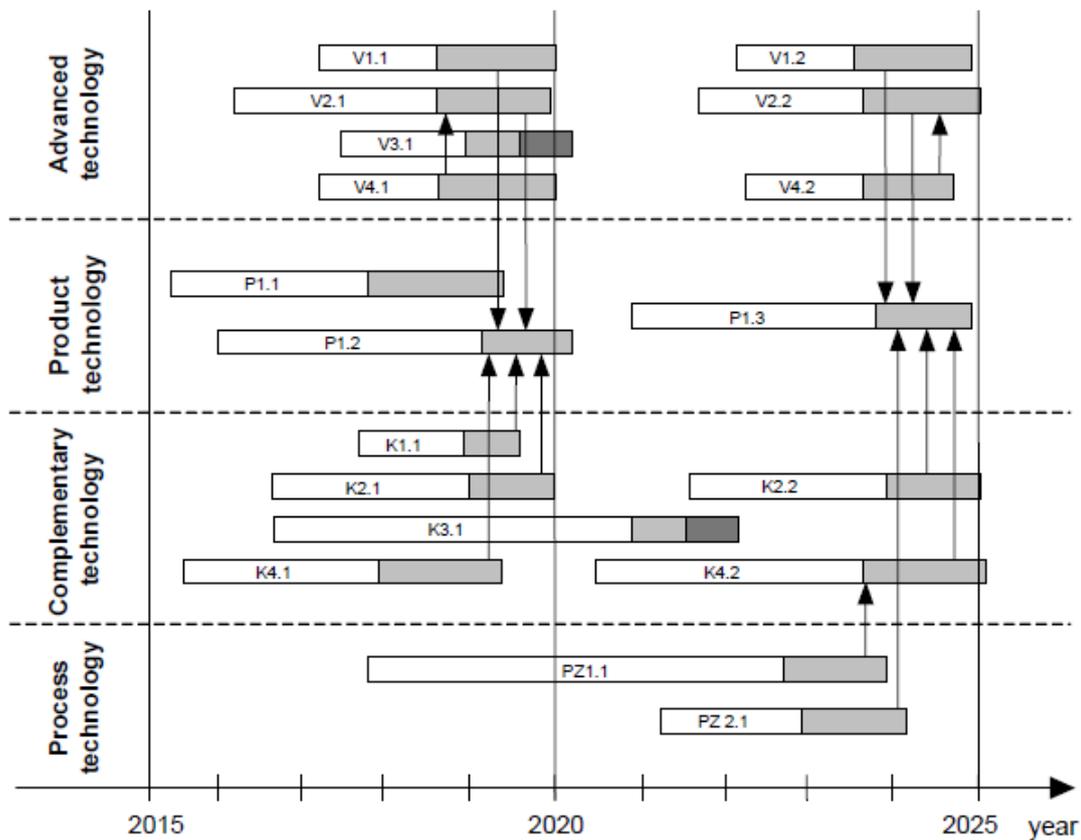


Figure 2.5: A scenario based roadmap according to Siebelink et al. (2016).

The technique of Moehrle, Isenmann, and Phaal (2013) starts with the identification of the technology field. The state of the art of technology is described, as well as all the elements of the technology complex, meaning up- and downstream technologies, complementary and substitute technologies and productive technologies. This is supplemented by an analysis of the current state of knowledge, research and development, patents, pilots and products already on the market. Most important in the description of the current situation is the distinction of the technology under scrutiny from other technologies, and the description of any existing inter-dependencies between

these technologies in the form of an impact matrix. In the second stage, the environment is described. This is done by compiling a list of exogenous factors which have an effect on the technology; legal factors, demographic factors, economic factors. After these factors have been described, projections into the future are made. Projections are made that differ significantly from another, so no more than three projections are described per factor. These factors are then compared with each other in a consistency analysis. Two scenario's are described: one positive and one negative. The different projections are then described using the scenarios, so measures can be described that lead to the preferred future. Long term scenarios are to be divided in interim scenarios based on the companies' mid-term planning periods. In the third stage, the roadmap is developed based on the already developed scenarios. A roadmap is built for each scenario. The results from all the steps are then visualized, after which the final roadmap is drawn as seen in figure 2.6 below.



V1	Methanol service station	V2	LH <sub>2</sub> Service stations	V3	GH <sub>2</sub> Service station
P1	Performance fuel cell			V4	Production capacity
K1	Methanol-Tank	K2	GH <sub>2</sub> Krytank	K3	GH <sub>2</sub> Hybrid tank
PZ1	Precious metal/electrolyte	PZ2	Production process	K4	Reformer

Figure 2.6: Outcome of Moehrle et al. (2013).

#### **2.3.4 What are good practices when conducting scenario-based roadmapping?**

Compared to the literature on roadmapping and scenario planning, not too many good practices can be found on scenario-based roadmapping. This is probably due to the fact that this is a relatively new tool and the literature on the subject is limited. However, the following good practices were formulated based on available literature:

- As a scenario-based roadmap aims to retain the communicative strengths of a business roadmap, it is advisable to pay attention to the graphical representation of the final roadmap and not include too many layers (Siebelink et al. 2016)

### **2.3.5 Limitations according to the theory**

Currently, several things lack to the current theories on scenario-based roadmapping. For example, Cheng et al (2016) find that a gap exists between the roadmap and the definition of future actions at a micro level; there is currently no method to translate the strategic roadmap to concrete organizational and operational goals. They also find that there is a lack of evaluation methods for the constructed roadmaps. Both the suggested scenarios and the scenario-based roadmap are currently not susceptible for evaluation. Lee et al. (2015) propose to put more feedback loops between the steps they have suggested for the creation of a scenario-based roadmap, while also suggesting that the final roadmap is hard to evaluate. Strauss and Radnor (2004) have found possible weaknesses on a different level. They argue that scenario-based roadmapping suffers from a lack of recognition and credibility, especially in volatile and uncertain environments. They add that there is a tendency in companies to underestimate its own vulnerabilities and overestimate its own strengths, referring to the optimism bias inherent to most individuals. Siebelink et al. (2016) suggest that the role of ICT could be explored further, specifically how ICT could improve the time necessary for constructing the roadmap, ease development for the participants, and simplifying development and dissemination of the roadmap.

## **Chapter 3: Design**

In this chapter, the design of the scenario-based roadmapping method is explained. The chapter starts with input from the previous chapter, followed by several comparisons between methods used by other authors. Finally, a design for a scenario-based roadmapping method is proposed. The chapter answers subquestion two, which is: “What does a good scenario-based roadmapping design look like?”.

### **3.1 Input from theoretical framework**

In the previous chapter, information on scenario planning, roadmapping, and scenario-based roadmapping was detailed. In this chapter, this information will be used to design an improved method of scenario-based roadmapping. This will be done by drawing conclusions based on the previous chapter, comparing different methods described in the literature, and finally by proposing a new design.

There are several similarities between scenario planning and scenario-based roadmapping. Both methods are not intended to predict the future, but are designed to better handle different possible situations that can occur in the future. Both are narrative-driven, which makes them easier to communicate throughout the organization. Added to this is the concept of a roadmap, which should answer where is the organization going, where is the organization now and how can the organization get where it wants to go. Building a roadmap has promotes common understanding throughout the organization by bringing from different parts of the organization together, and the final roadmap can be used as a good tool to communicate ideas to stakeholders.

As mentioned in the previous chapter, scenarios planning can be executed roughly using the following steps:

1. Identifying the issue and the scope, including stakeholders
2. Identify important factors and trends
3. Construct scenarios
4. Assess scenarios based on certain criteria
5. Consider scenario implications and act

There are similarities with the roadmapping process, which exists of three separate phases: a preliminary phase in which the roadmapping process is prepared, an execution phase in which the

actual roadmap is developed, and a follow-up stage in which the results of the roadmap are communicated and possible organizational changes are implemented. Points 1 and 2 above can be described as the preliminary phase, point 3 and 4 can be described as the execution phase, and point 5 can be seen as the follow-up stage. Current scenario-based roadmapping methods consist of similar steps and phases, as exemplified by the five-phased method of Cheng et al (2016) ((1) prerequisite preparation, (2) scenario team formation, (3) scenario building, (4) scenario assessment and selection, and (5) scenario-based roadmapping.)

Aside from this, the constructed scenarios should adhere to certain standards: be internally coherent, plausible, detailed, broad-based, they should resonate with managers and executives, and they should be easy to communicate. A roadmap also adheres to this last criterium, as this is usually in the form of a time-based multilayer graphical representation that takes into account different factors.

For obtaining the best results, roadmapping is done using workshops led by a facilitator who understands the roadmapping process. Commitment throughout the organization is necessary for an effective roadmapping process, including commitment by senior personnel. The roadmap should be communicated in a clear graphical form in order to improve organizational understanding and the roadmap should be periodically updated if necessary.

It can be concluded that the desired scenario-based roadmapping method is a quick, effective and flexible process that focuses on communication throughout the organization and feedback. The reason why it should be quick and effective is because this would potentially increase the ease with which the process could be repeated over time, increasing the effectiveness of the process and providing a more up-to-date outcome each time. Also, when using scenario-based roadmapping, an organization wants to anticipate changes in the environment and act upon these changes. Therefore, quicker anticipation and quicker reaction are desired. All this asks for a compact, robust design that can be instigated and finished in a relatively short period, which makes it easier to repeat. The final method should therefore be tested based on flexibility and speed. This means it should be possible to conduct the scenario-based roadmapping process with a relatively small team of 15 persons or less, it should not take more than two full days to describe and assess the scenarios, it should take less than a day to update the final roadmap during the implementation phase.

Possible disadvantages of this design might be that it lacks depth and detail, which are sacrificed in order to gain as much speed as possible. Another possible disadvantage is that it might be harder to formulate operational goals.

### 3.2 Comparisons

Several authors described a scenario-based roadmapping process, as shown in the previous chapter. These described processes differ to an extent that comparisons regarding the described steps cannot be made. The processes however can be quantitatively analyzed according to several criteria through the use of multi-criteria analysis (Dodgson, Spackman, Pearman, & Philips, 2009). The criteria chosen for this research aim to assess whether the scenario-based roadmapping method is a quick, effective and flexible process that focuses on communication throughout the organization and feedback. The criteria are as follows:

**Number of phases / steps** describes the number of phases and steps the author describes. This is for referential reasons only, as no qualitative conclusions can be made based on the number of steps;

**Length of process** defines how long and tedious the process is. A high score denotes a short and concise process. A low score means a long process;

**Flexibility** defines how flexible the process is. A high score means a flexible process that leaves room for multiple different options, a low score means low flexibility;

**Practicality** describes how practical the process is in use. A low practicality means a difficult process that requires many people, a high practicality means an easy process that can be done by less people.

Table 3.1 on the next page shows the multi-criteria analysis.

Table 3.1: multi criteria analysis

Author:	Strauss & Radnor (2004)	Cagnin & Könnölä (2014)	Siebelink, Halman & Hofman (2015)	Geschka & Hahnenwald (2013)	Cheng et al (2016)
Number of phases / steps:	No phases defined, 15 steps	No phases defined, 9 steps	No phases defined, 6 steps	No phases defined, 3 steps	5 phases, 14 steps
Length of process:	Low. Long process which requires constant rework and multiple teams.	Medium. Multiple interviews, long process.	Medium. Team effort with multiple workshops	Low. Laborious process.	Medium. Several interviews. Several workshops
Flexibility:	High. Including flex points and forks to other strategies	-	Medium. Uses robust areas (overlapping implications)	Low. Does not include multiple scenarios.	Low. Multiple teams involved
Practicality:	High. Easy to use and understand	Medium. Use of online questionnaires, but difficult process.	High. Could be applied broadly.	Low. Complicated process.	High. Easy to use and understand

Based on the multi-criteria analysis, it can be concluded that there does not currently exist a short process. All examined methods are either long or medium-long. Regarding flexibility: the methods of Strauss & Radnor (2004), and Siebelink et al. (2015) are the most promising. Therefore, using flex points and robust areas is recommended. Also, the methods by Strauss & Radnor (2004), and Siebelink et al. (2015) are practical in use and can be executed by a relatively small team.

### **3.3 Design**

Based on the multi-criteria analysis, the following design is proposed. The design consists of three distinct phases: the preparation phase, the execution phase, and the feedback phase. Each phase consists of several steps, which are as follows:

#### **Phase 1 – Preparation**

##### (1) Background information & motivation

- Planning: when, where and how should the steps take place
- Objectives: what does the organization want to accomplish with the process?
- Company strategy: how does the company strategy fit in to the process?

##### (2) Team formation

- Selection: who is to take place in the process? (internal and external facilitators with adequate expertise)

End result phase 1: team is selected, are notified of starting conditions and background information

#### **Phase 2 – Execution**

##### (3) External environment

- Drivers: what are the drivers of change in the external environment?
- Market: description of the market

##### (4) Scenario building

- Scenario building: what, where, why, when and how are things going to happen?

##### (5) Scenario assessment & selection

- Assessment: assessment of built scenarios using certain criteria (for instance: qualitative criteria such as relevance, completeness, consistency, plausibility, and creativity; quantitative criteria such as feasibility, innovativeness, impact, estimated market share, estimated investment, and possible government support).

##### (6) Roadmap development

- Roadmap building: sketching a scenario-based roadmap. The roadmap may include: timeline / time frame, action planning / tasks, stakeholders, robust areas, and critical decisions / flex points.

End result phase 2: preliminary scenario-based roadmap created

### **Phase 3 – implementation**

#### (7) Discussion

- Feedback: the preliminary scenario-based roadmap is discussed and improved based on feedback by stakeholders. Based on this discussion, the definitive scenario-based roadmap may be constructed.

#### (8) Implementation

- Communication: the definitive scenario-based roadmap should be communicated through the proper channels within the organization.

- Translation into operational goals: outcomes of the scenario-based roadmapping exercise can be translated into operational goals to facilitate implementation.

- Implementation: necessary changes within the organization should be deployed.

End result phase 3: scenario-based roadmap, implemented and communicated.

The first phase starts with planning and objectives. Objectives can be based on company strategy, planning can be based on what the instigators want to achieve with the scenario-based roadmap, as well as the steps described.

The second step is team formation. To keep the process relatively quick, not too many people should be involved in the process. There should be a good mix of company experts, strategists, and managers in accordance with Varum & Melo (2010)

With the team formed and informed regarding the objectives and planning of the scenario-based roadmapping activity, the first phase is completed.

The second phase starts with a description of the external environment. This can be done using a DESTEP/PETLE or similar analysis. It is also useful to provide a short description of the market in which the organization operates, potentially supplemented with a competitor analysis.

In the fourth step, the actual scenarios are built. The scenarios are built by asking questions that aim to describe what, where, why, when and how are things going to happen, based on the trends in the external environment as described in the previous stage. This means that several trends are taken from the description of the external environment, which are then extrapolated into the future. Then, in order to build the scenario, a description is made of what is going to happen in the environment according to these trends, where it is going to happen, why it is going to happen, when it is going to happen and how it is going to happen. This scenario is then further expanded by describing potential threats and opportunities for the organization, and recommendations on how the organization should react in case the scenario plays out. The final scenario should comprise of a description on how the trends could affect the organization and what the organization should do if this were the case.

During the fifth step, the scenarios created in the previous step are assessed. Assessment criteria that can be used include qualitative criteria such as relevance, completeness, consistency, plausibility, and creativity; and quantitative criteria such as feasibility, innovativeness, impact, estimated market share, estimated investment, and possible government support. After the scenarios are assessed, the full roadmap can be designed. This concludes the second phase of the scenario-based roadmapping process.

The implementation stage starts with a discussion on the preliminary scenario-based roadmap. The team should provide feedback and improvements until the roadmap is satisfactory. After this is done, the final roadmap can be communicated and implemented, preferably by translating it into operational goals.

Figure 3.1 on the next page shows the proposal of the design.

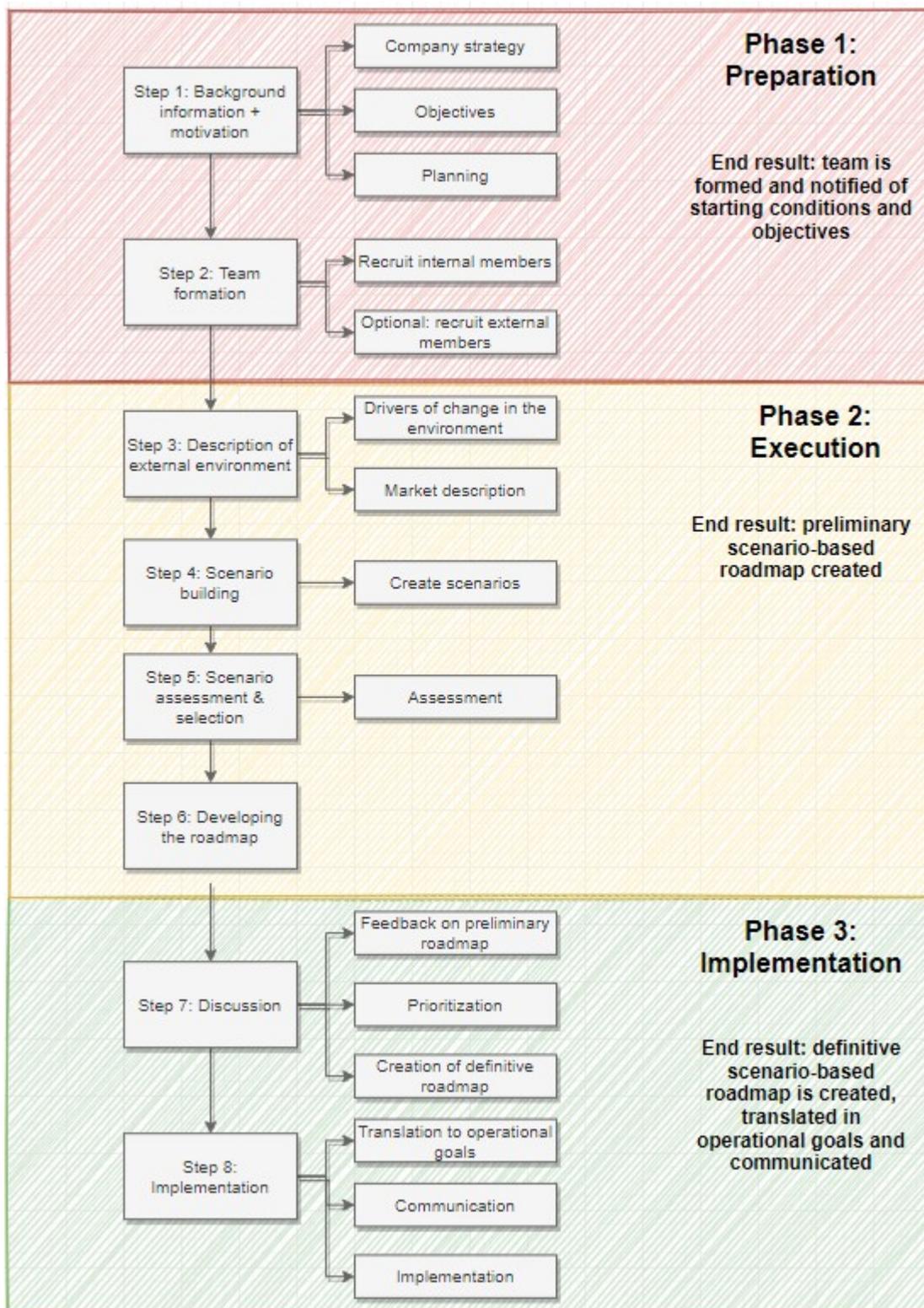


Figure 3.1: proposal of the scenario-based roadmapping method

## **Chapter 4: Execution**

This chapter describes how the design proposed in the previous chapter was applied at VolkerWessels Bouw & Vastgoed. The chapter starts out with a short background on the case study that was used in the application, followed by a subchapter on how the design was applied. In the last subchapter, the outcome of the application is described. This chapter answers subquestion 3.1 of the research: “What are the main outcomes of the application?”.

### **4.1 About the case study**

VolkerWessels is a major player in the Dutch construction industry. The company has specialized in real estate development and has already developed creative ways to cope with new challenges. In line with the research goal, which is to develop and test a scenario-based roadmapping method at VolkerWessels in order to attain relevant strategic insights and to offer the company a practical and dynamic method that can be used in the strategic decision making process, a fitting case study was prepared. The outlines of the case study were defined in cooperation with an internal facilitator in the form of a VolkerWessels Bouw & Vastgoedontwikkeling executive, in order to maximize usability for the company. In cooperation with the company, the decision was made to apply the method on the Dutch housing industry in the near future (2020-2040). The Dutch housing industry is broadly defined as the market for homes in the Netherlands, both from newly constructed homes and from renovations.

## 4.2 Execution of the design

### Phase 1 – preparation

#### (1) Background information & motivation

The planning was done in cooperation with the thesis committee in order to ensure it could be done in the timespan of the research. The decision was made to conduct a preliminary investigation into the drivers of change in the external environment, then interview the VolkerWessels team individually to develop the scenarios, followed by a group session to assess the scenarios, and finally provide feedback to the final product by another round of interviews. Due to the current Covid-epidemic, slight changes to these plans were made: all interviews and sessions were done online, and the group sessions were broken up in multiple sessions due to time constraints. The objectives were chosen in cooperation with the organization, as described in the previous subchapter.

#### (2) Team formation

In cooperation with the internal facilitator, the team was formed. The team consisted of five VolkerWessels Bouw & Vastgoed executives, three managers of different VolkerWessels construction companies, and two specialists. During the research, slight changes to this team were made as people left the company.

Phase 1 ended with notifications to the team on the planning. The communication on this part can be seen in appendix B.

### Phase 2 – execution

#### (3) External environment

The external environment was described by conducting research in current trends, which resulted in a short report which is shown in appendices B and C. In this report, the most relevant trends for the Dutch housing industry have been described. Several expert interviews were held by the author in order to ascertain the trends, after which they were further explained based on information from scientific literature, reports from institutes, news sources, and reports from research groups. The trends have been loosely categorized according to the PESTEL-principle. The goal of the report was to provide readers with sufficient breadth and depth regarding the subject, so as to give them new insights and provide useful background information. The report was written in English (appendix C), then translated in Dutch (appendix D).

#### (4) Scenario building

The scenarios were constructed in a one-on-one setting of the researcher and the team. The researcher made two draft scenarios which were then verified through feedback with the team member. One of the scenarios would describe positive effects for the organization, the other would describe negative effects. Efforts were made to ensure proper diversity in the scenarios. The scenarios are shown in appendix F.

#### (5) Scenario assessment & selection

The scenarios were assessed during two sessions with multiple team members. An online session was held in which the scenarios were discussed and assessed. The scenarios were assessed on the criteria relevancy, plausibility, and impact. Further explanation of these criteria is described in the next subchapter. Each criterium was given a score of one through five – the latter being the highest score. Each scenario was also assessed in terms of internal consistency, and slight changes were made based on input by the team. The positive and negative scenario were merged in one scenario, as splitting them did not provide evident benefits. The final scenarios are shown in the next section. Any remarks on the scores given by the team can be found in appendix F.

#### (6) Roadmap development

The roadmap was sketched by the researcher. Based on the scenarios, robust areas were investigated and different steps were described in terms of markets to serve, products with which to serve these markets, concepts which could be turned into products, and resources necessary for these concepts.

### **Phase 3 – implementation**

#### (7) Discussion

The preliminary roadmap was sent by the researcher to the team members for verification. Based on feedback provided by the members, the final roadmap was created. The final roadmap is shown in the next section.

#### (8) Implementation

For this research, the final roadmap was not communicated to the organization other than to the team members. It was also not translated into operational goals, and therefore it was not implemented.

### 4.3 Results

In this subchapter, the results of the scenario-based roadmapping method are displayed. Each scenario is described in a different table, starting out with a short explanation on the table itself. The scores and final results were developed in cooperation with a team consisting of five VolkerWessels Bouw & Vastgoed executives, three managers of different VolkerWessels construction companies, and two specialists during two separate online sessions. After the scenarios, the final scenario-based roadmap is displayed. An explanation of the scenario tables is shown below:

Scenario number & title	Number and title of the scenario
Short description	A short description of the scenario
Possible positive effects	Possible opportunities for VolkerWessels if the scenario plays out
Possible negative effects	Possible threats to VolkerWessels if the scenario plays out
How should VolkerWessels react	Best course of action for VolkerWessels if the scenario plays out
Uncertainties	Uncertainties that play a role in the scenario
Relevance score	<p>How relevant is the scenario for VolkerWessels: score 1 (low) – 5 (high)</p> <p>1= No relevancy of the scenario for VolkerWessels                  2= Low-to-medium relevancy of the scenario for VolkerWessels                  3= Medium relevancy of the scenario for VolkerWessels                  4= Medium-to-high relevancy of the scenario for VolkerWessels                  5= High relevancy of the scenario for VolkerWessels</p> <p>Relevancy means how much the scenario and the events that are described in the scenario are connected to the VolkerWessels organization and the external environment in which they operate.</p>
Plausibility score	<p>What is the chance this scenario will play out: score 1 (low) – 5 (high)</p> <p>1= The scenario will never play out                  2= The scenario will probably not play out                  3= There is a 50/50 chance the scenario will play out                  4= The scenario has a good chance to play out                  5= The scenario is certainly going to play out</p>
Impact score	<p>What is the size of the impact of the scenario on VolkerWessels 1 (small) – 5 (large)</p> <p>1= No impact on VolkerWessels                  2= Small impact on VolkerWessels                  3= Medium impact on VolkerWessels                  4= Large impact on VolkerWessels                  5= Very large impact on VolkerWessels</p> <p>Impact means how much the scenario will impact the organization VolkerWessels – a large impact could mean severe implications on the way VolkerWessels conducts its business, while no impact means that VolkerWessels can continue as they do now.</p>

Scenario number & title	1: New materials
Short description	As the population of the Netherlands keeps growing, so will the housing shortage increase. This is amplified by the decrease in average household size. Material shortages will continue to rise in the following years, leading to an increase in prices. These effects are amplified by the rising housing shortage. This effect will flow down the supply chain and will result in higher prices for end products. The higher prices of materials will lead to quicker adoption of newly developed construction materials, as these will become comparatively more affordable. In 2040, the first neighborhoods will exist completely made out of new materials. Wood will play an important role in these newly developed materials. The Dutch consumer will need time to adapt to these materials, as the popularity of classic brick and mortar will slowly fade.
Possible positive effects	There is much knowledge on wood construction at VolkerWessels which can be used and spread; VolkerWessels has the correct image to capitalize on these trends
Possible negative effects	The end product will become more expensive; New knowledge will be necessary on the subject
How should VolkerWessels react	Change the organizational structure so relevant parts can grow, while divesting in parts that are irrelevant; Develop concern-wide solutions including an overarching strategy, concern-wide cooperation and sharing of profit and risks
Uncertainties	The organizations ability to adapt; Speed in which the scenario will take place; Uncertainties concerning the development of new materials (regarding law, market, technology); The supply of wood (may become more expensive than brick); Lack of uniformity in demand (too many different clients with different demands)
Relevance score	5 – high
Plausibility score	3 – medium
Impact score	3 – medium

Scenario number & title	2: Urbanization
Short description	During the next 20 years, urbanization rates will continue to increase in the Netherlands. The largest 30 municipalities (G30) will grow, outside these municipalities inhabitant levels will stay relatively the same. This means that in these 30 municipalities, high-rise construction will become more important. Also, apartment sizes will decrease as average household-sizes decrease.
Possible positive effects	Growth means more demand; High-rise construction demands more knowledge and financial backing which is available at VolkerWessels; VolkerWessels has a good coverage of the G30; Opportunities arise for upgrading/transforming inner city realty
Possible negative effects	Urbanization leads to more complex projects with higher risks; Prices will rise; It may prove difficult to realize projects within schedule and within budget
How should VolkerWessels react	Develop high-rise concepts; Adapt to change while keeping an eye on macro trends; Critically assess risks; Focus on attaining land in the largest 30 municipalities
Uncertainties	Quality of personnel; Local politics; Possible counter-urbanization movement due to Covid
Relevance score	4 – medium to high
Plausibility score	4,5 – high
Impact score	4 – medium to high

Scenario number & title	3: Circularity
Short description	<p>Average housing prices will rise, due to a shortage of potential construction locations and a decrease in average household size. Pollution will increase in the following years, which will lead to a political reaction in the form of new laws. These laws will increase the demand of circular housing.</p> <p>This demand will also come from societal pressure, as climate change becomes of increased importance in the public mind. The demand for more sustainable housing will increase, which results in an increase in demand of circular housing.</p>
Possible positive effects	VolkerWessels has the knowledge to react on the rise in demand of circular housing
Possible negative effects	Startups or scale-ups might compete against VolkerWessels; Demand might be too geographically dispersed or too low-scaled in order to successfully develop relevant concepts
How should VolkerWessels react	<p>Focus on developing circular housing;</p> <p>Lobby and prepare for new laws;</p> <p>Further develop relevant concepts like CirculairWonen;</p> <p>Connect with universities and government institutions in order to develop relevant concepts</p>
Uncertainties	Usage of newly developed materials may have unforeseen consequences; Timing of the increased demand (how long will it take before the demand is high enough?)
Relevance score	3,5 – medium
Plausibility score	4 – high
Impact score	3 – medium

Scenario number & title	4: Industrialization
Short description	Demand for sustainable housing will rise in the coming years. Housing corporations will demand integral solutions regarding sustainable neighborhoods, comprising of newly built sustainable housing, renovation of older housing in order to make it more sustainable, and development of the surrounding area. Corporations will start looking for partners that are able to deliver these integral solutions on a large scale. There might also exist demands for solutions regarding water retention, as excess water may prove an increasing problem in the Netherlands during the coming years.
Possible positive effects	A certain degree of prefabrication will be necessary which is available at VolkerWessels; VolkerWessels has already developed concepts which can be applied here; Renovation could prove lucrative
Possible negative effects	Third parties (for instance larger maintenance companies) can start competing against VolkerWessels; Low demand could make planning harder
How should VolkerWessels react	Develop concepts related to demanded integral solutions; Focus on selling these concepts rather than just develop them technically
Uncertainties	Low demand makes planning harder; Newly developed concepts need to be proven before they become in demand; Corporations' will to invest and willingness to not interfere too much in the process; There might be a lack of uniformity in the demand
Relevance score	4 – medium to high
Plausibility score	3,5 – medium
Impact score	4 – medium to high

Scenario number & title	5: Climate change
Short description	<p>Climate change will continue the coming years. This results in a higher demand in sustainable construction. Construction materials as well as water and energy will need to be used more efficiently and won back as much as possible. Homes will be made climate-proof and zero-emission. Physical movement of people will decrease, leading to people spending more time in their immediate environment. Traditional neighborhood layouts will have to be revisited, which include revisiting current grid plans and urban plans.</p> <p>Climate change also leads to an increased demand for alternative fuels, circular construction concepts, adoption of new (less polluting) materials, and laws regarding restricting emission of certain chemicals like nitrogen.</p>
Possible positive effects	<p>Many opportunities regarding innovation;          Opportunities to expand business to neighborhood development</p>
Possible negative effects	<p>VolkerWessels does not have the image of a sustainably company</p>
How should VolkerWessels react	<p>Create a long-term vision in order to attain necessary knowledge;          Create new business models regarding sustainability;          Create a sustainable narrative aimed at clients;          Develop new collaboration initiatives with third parties and governments</p>
Uncertainties	<p>New solutions will be more demanding of third parties and government institutions;          May require a shift in mentality of the sector, which may prove hard to realize;          Necessary collaboration initiatives do not exist yet;          New and existing laws may frustrate the process</p>
Relevance score	5 – high
Plausibility score	5 – high
Impact score	3 – medium

Scenario number & title	6: Adaptability
Short description	<p>Supply of smart-homes (easily customizable housing) will rise. This will only happen when the consumer knows the possibilities (technology push). These homes consist of hulls with easy-to-strip walls. These houses will be built and adjusted by small, flexible groups of mechanics, making the most of the current lack of manpower.</p> <p>Constructing homes will no longer be just about building them, but the focus will extent towards the complete lifespan. The classical contractor will move towards service and management of homes.</p>
Possible positive effects	VolkerWessels is large enough and has enough knowledge to develop relevant concepts
Possible negative effects	<p>Vertical chain-integration by competitors will continue, leading to new organizations able to deliver the homes directly to the end-consumer, pushing contractors out the chain;</p> <p>Impact of not going with this trend if it takes off might be big</p>
How should VolkerWessels react	<p>Reconsider the position of the classical contractor;</p> <p>Develop and redevelop relevant concepts;</p> <p>Combine and communicate necessary information on the subject</p>
Uncertainties	<p>It is unknown which parties will be the first to sell these types of homes;</p> <p>A steady amount of demand is necessary;</p> <p>Demand of smart-homes may not prove as high</p>
Relevance score	4 – medium to high
Plausibility score	3 – medium
Impact score	4 – medium to high

Scenario number & title	7: Sustainability
Short description	<p>Increasing laws ensure that corporations will have to increase their efforts to make their housing stock more sustainable in the coming years. Housing corporations will have to take stock and develop action plans. Making the current housing sustainable is a challenge, as there exists currently a shortage of cash and market capacity, which will not be solved in the coming years.</p> <p>Not only the increasingly restrictive laws demand that housing corporations will have to turn sustainable; there is also a societal push for sustainable housing, as the Dutch population is increasingly worried about climate change.</p>
Possible positive effects	High demand leads to more work; Opportunities arise to distinguish VolkerWessels
Possible negative effects	Corporations might choose to work with subcontractors, making the contractor superfluous; Margins might prove lower than expected
How VolkerWessels should react	Invest in industrialization; Use financial reserves to invest; Investigate possibilities of long-term contracts with housing corporations
Uncertainties	The demand is partially based on government policy, which is subject to change
Relevance score	2,5 – low to medium
Plausibility score	5 – high
Impact score	2,5 – low to medium

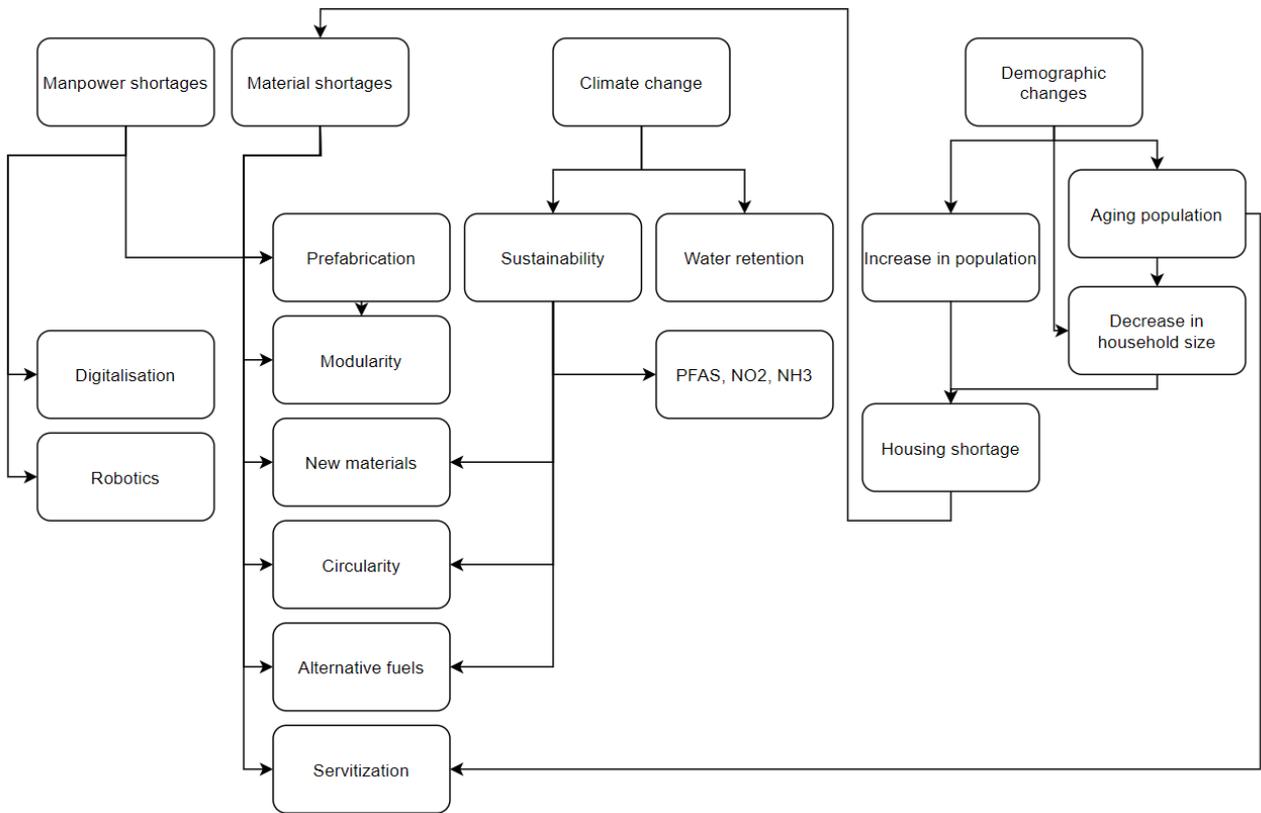
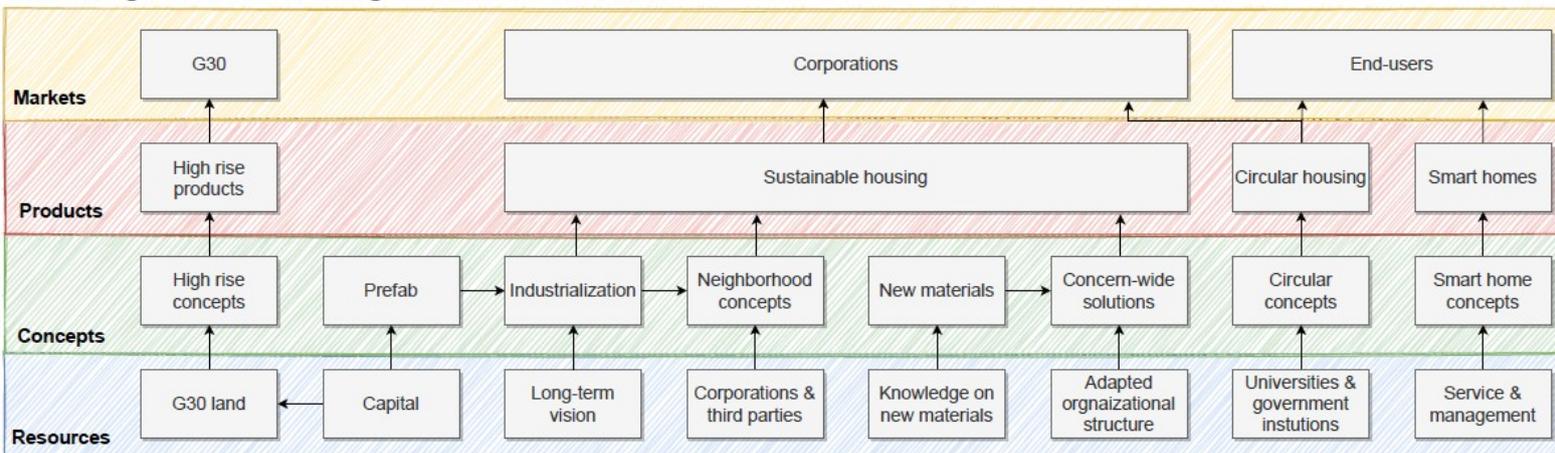


Figure 4.1: Trends in the Dutch housing industry

Figure 4.1 above shows the trends in the Dutch housing industry and how these trends relate to one another. These trends, combined with the described scenarios, result in the roadmap on the next page.

## Servicing the dutch housing market towards 2040



## **Chapter 5: Discussion and conclusion**

This last chapter deals with the limitations of the research, gives suggestions on further research, and deals with the practical implications. The chapter answers the last of the subquestions from subquestion 3: “How can the developed scenario-based roadmapping method best be applied to VolkerWessels and what can be learned from this design?”.

### **5.1 Limitations**

There are several limitations to this research. First of all, scenario-based roadmapping suffers from a lack of recognition and credibility, especially in volatile and uncertain environments. There is a tendency in companies to underestimate its own vulnerabilities and overestimate its own strengths, referring to the optimism bias inherent to most individuals. Scenario-based roadmapping is an inherently biased exercise, making the final result also biased. There is also no method proposed to evaluate the proposed roadmap.

A design was proposed based on a multi-criteria analysis in which the criteria length of process, flexibility, and practicality were used. Other criteria were considered for this step which were more in line with the limitations already found in the theoretical framework, and the chosen criteria might not be optimal. Additionally, a multi-criteria analysis is a qualitative tool in which the bias of the researcher is possibly of influence.

An attempt was made to propose a quick and flexible process. Possible disadvantages of this design might be that it lacks depth and detail, which are sacrificed in order to gain as much speed as possible. In order to propose the process, functional specifications for the design were proposed. These specifications were however not developed in cooperation with the organization, but they were chosen by the researcher. Thus, no formal check on the specifications of the design were made. Therefore, the design could be improved by determining functional specifications and conditions in cooperation with the organization, and then basing the design on these specifications.

Regarding the execution of the design: many changes were made during the process. For instance, the design initially proposed a workshop with all participants. This was, however, not deemed possible within the time-frame of the research and because of Covid-pandemic related issues. Improving the final scenario-based roadmap by adding flexpoints would also prove too time-consuming and was therefore discarded. The scenarios could have been improved by adopting more

comprehensive formal scenario logics, checking these logics and ensuring the scenarios were sketched according to these scenario logics. Making this improvement would require too much time, however, so this was not implemented.

In terms of quality of the final product: quality could be improved by a more broad approach to the execution of the design. By involving more people from VolkerWessels, as well as involving multiple branches of the company, possibly a qualitatively better result could have been produced, and more valuable recommendations could have been made. This is also due to the fact that the case study was narrowed down to the housing industry in the Netherlands. The case study could be made broader, or performed by different parts of the organization. The final product could also have benefited from a timescale, as is common in roadmaps. A better connection could also have been made with current VolkerWessels products, thus improving the practical recommendations by showing exactly which product to improve and why.

## **5.2 Recommendations for future research**

In this research, an attempt was made to propose a quick and flexible process that focuses on communication throughout the organization and feedback. The reason why it should be quick and effective is because this would potentially increase the ease with which the process could be repeated over time, increasing the effectiveness of the process and providing a more up-to-date outcome each time. Also, when using scenario-based roadmapping, an organization wants to anticipate changes in the environment and act upon these changes. An attempt was made to formulate a compact, robust design that can be instigated and finished in a relatively short period, which makes it easier to repeat. The final proposal could be improved by cutting unnecessary parts and details, and further optimized.

### **5.3 Practical implications**

The most important trends in the Dutch housing sector according to the outcomes of this research are: sustainability (as well as circularity), industrialization, and new materials. Sustainability is practically a basis for all other trends, as this is driven by government regulations and public awareness. This trend leads to the adoption of circular concepts, as well as the use of new materials. All other trends are basically derivatives of these ideas, which is why the company would do well in adopting and adhering to relevant standards. Several concepts of VolkerWessels already deal with the suggestions concluded from the scenario-based roadmap. New materials are used in the concept co-developed with Finch, circular concepts are used in the PuurWonen/CirculairWonen-concept, industrialized renovation solutions are covered by the NieuwWonen-concept, the concepts House2Start and Morgenwonen already deal with a high degree of modularity, and all the concepts ZuiverWonen, NieuwWonen, House2Start, Puurwonen, and the Finch concept deal with sustainability.

An important finding of the research was the concept of neighborhood concepts. Multiple scenarios dealt with the idea of providing corporations with a broad approach in which existing homes were to be renovated and possible new homes would be constructed, but also where the infrastructure of the whole neighborhood would be modified/optimized to fit the needs of the neighborhood. The argument behind this idea is that it would provide corporations with a single party to deal with, which would ease development on the side of corporations and governments. VolkerWessels would be a good candidate to deliver these solutions, as the organization possesses a wide variety of expertise and resources due to its size. This concept would, however, require substantial efforts on multiple levels. For instance, long term contracts would be necessary with both corporations and (local) governments, as projects on the suggested scale need guaranteed dedication by all parties involved. Also, a coherent vision on neighborhoods and neighborhood concepts would need to be created, including many aspects regarding city planning and sustainability.

It is also important to look at the role of the classical contractor. Several years ago, the business was fundamentally changed by the crisis, which led to more subcontracting. Further industrialization and personnel shortages may further diminish the role of the contractor. Added to this is the new focus on service and management, which takes into account the complete lifespan and use of a building, instead of merely its construction. Already, other companies are pioneering alternative business models and vertical supply chain integration, creating new and different competitors for the organization.

## Chapter 6: Reflection

In this chapter, the researcher reflects on the research process. It starts out with a reflection on the results and how they could have been improved, and ends with a personal reflection.

Conducting research is an iterative approach, which means that the researcher goes back and forward between parts of his research while conducting it. While this is an effective way to conduct any project, the method may sometimes prove insufficient – mostly because of the researcher, not because of the method. This results in flaws in the research. Some have been corrected, while some have not been. These flaws are partly described in the limitations, and partly here.

The scenarios were described in cooperation with a small team of VolkerWessels executives. Afterwards, they were assessed. This process took several months, mostly because of the busy schedules of those involved. When writing the final thesis, it was discovered that the described and assessed scenarios did not meet certain requirements, resulting in a reduced quality of the end result. Redoing the work would have resulted in better quality, but would have taken several extra months of getting into peoples schedules and conducting the work. The final product could also have been improved by adding a timescale and by linking it to current VolkerWessels products. Doing so would however require substantial research in current VolkerWessels products, which turned out to be harder than expected. Actually, accurately mapping current VolkerWessels products could be a research project on its own. Not adding a timescale stems from this problem: as it is not exactly known what the current state is, it is not known how much time it would take to improve it to a desirable state.

On a more personal note, I found the whole research process relatively smooth. Finding an interesting subject was relatively easy, and as I already knew in which company I wanted to conduct the research starting out went smooth. I had relatively little difficulty in recruiting and contacting the necessary team members, as well as writing the thesis and communication with stakeholders. The only small setback during the whole process had to do with time; as every action I undertook took more time. This resulted in a somewhat longer process than I expected in the beginning, and if I had to do the process all over again I would make some changes in order to expedite the entire ordeal. During the research, I had to deal with different possible setbacks: the impact of Covid-19 and the replacement of an internal supervisor. Both of these issues had in retrospect little to no effect on the outcome of the research, and I did not perceive them as difficulties. While the above mentioned flaws in the research are slightly disappointing, I am satisfied with the overall result.

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## Appendices

### Appendix A – List of sources

Title	Author(s)	Year	Form	Theory	Utility score	Reason utility score	Citations	Journal
A Review of scenario planning	Amer, Daim, Jetter	2013	Paper	Scenario planning	5	Citations	747	Futures
Technology Roadmap Through Fuzzy Cognitive Map-Based Scenarios: The Case of Wind Energy Sector of a Developing Country	Amer, Daim, Jetter	2015	Paper	Scenario-based roadmapping	2	Relevancy	36	Technology analysis & Strategic
Global foresight: Lessons from a scenario and roadmapping exercise on manufacturing systems	Cagnin, Könnölä	2014	Paper	Scenario-based roadmapping	3	Relevancy	21	Futures
An overview of the literature on technology roadmapping (TRM): Contributions and trends	Carvalho, Fleury, Lopez	2013	Paper	Technology roadmapping	5	Citations	330	Technological Forecasting and Social Change
A scenario-based roadmapping method for strategic planning and forecasting: A case study in a testing, inspection and certification company	Cheng, Wong, Cheung, Leung	2016	Paper	Scenario planning, technology roadmapping, SBRM	4	Relevancy	20	Technological Forecasting and Social Change
Improving decision-making with scenario planning	Chermack	2004	Paper	Scenario planning	5	Citations	282	Futures
A Review of scenario planning literature	Chermack, Lynham, Ruona	2001	Paper	Scenario planning	5	Citations	374	Futures
Scenario Planning	Coates	2000	Paper	Scenario-based roadmapping	4	Relevancy	257	Technological Forecasting and Social Change
Three decades of scenario planning in Shell	Cornelius, van de Putte, Romani	2005	Paper	Scenario planning	4	Citations	247	California management review

Fundamentals of Technology Roadmapping	Garcia, Bray	1997	Paper	Technology roadmapping	5	Citations	463	n/a
Dealing with the dynamics of technology roadmapping implementation: A case study	Gerdsri, Vatananan, Dansamasatid	2009	Paper	Technology roadmapping	3	Citations	122	Technological Forecasting and Social Change
Combining technology roadmap and system dynamics simulation to support scenario-planning: A case of car-sharing service	Geuma, Lee, Park	2014	Paper	Scenario planning, technology roadmap, system dynamics	4	Relevancy	47	Computers & Industrial Engineering
Enhancing strategy evaluation in scenario planning: a role for decision analysis	Goodwin, Wright	2001	Paper	Scenario planning	5	Citations	481	Journal of Management Studies
Roadmapping integrates business and technology	Groenveld	1997	Paper	Technology roadmapping	5	Citations	515	Research Technology Management
The future of rail automation: A scenario-based technology roadmap for the rail automation market	Hansen, Daimb, Ernst, Herstatt	2016	Paper	Technology roadmapping, rail automation	2	Relevancy	17	Technological Forecasting and Social Change
Perspectives on roadmaps: how organizations talk about the future	Kappel	2000	Paper	Roadmapping	5	Citations, journal	424	Journal of Product Innovation Management
Changing organizational culture with scenario planning	Korte, Chermack	2006	Paper	Scenario planning	3	Citations	132	Futures
Development of the scenario-based technology roadmap considering layer heterogeneity: An approach using CIA and AHP	Lee, Geum	2017	Paper	Scenario planning, technology roadmap	5	Relevancy	15	Technological Forecasting and Social Change
An instrument for scenario-based technology roadmapping: How to assess the impacts of future	Lee, Song, Park	2015	Paper	Scenario-based roadmapping, Bayesian	4	Relevancy	26	Technological Forecasting and

changes on organisational plans				network				Social Change
Linking the business view to requirements engineering: long-term product planning by roadmapping	Lehtola, Kauppinen, Kujala	2005	Paper	Technology roadmapping	2	Citations	72	IEEE conference on requirements engineering
Scenario Planning the link between future and strategy	Lindgren, Bandhold	2003	Book	Scenario planning, Scenario thinking, strategic thinking	4	Relevancy	4	n/a
Multiple pasts, converging presents, and alternative futures	List	2004	Paper	Scenario-based roadmapping	2	Relevancy	64	Futures
Technology roadmapping for strategy and innovation	Moehrle, Isenmann, Phaal	2013	Book		3	Relevancy	43	n/a
Combining Scenario Planning and Multi-Criteria Decision Analysis in Practice	Montibeller, Gummer, Tumidei	2007	Paper	Scenario planning, Multi-Criteria decision analysis	3	Citations	163	Journal of Multi-Criteria
Scenario orientation and use to support strategy development	O'Brien, Meadows	2013	Paper	Scenarios, developing and evaluating strategic options	2	Citations	85	Technological Forecasting and Social Change
Roadmapping 3G mobile TV: Strategic thinking and scenario planning through repeated cross-impact handling	Pagani	2009	Paper	Scenario planning	2	Citations	84	Technological Forecasting and Social Change
Factors enabling information and communication technology diffusion	Peansupap, Walker	2005	Paper	ICT, ICT implementation	1	Relevancy	183	ITCon
Technology roadmapping —a planning framework for evolution and revolution	Phaal, Farrukh, Probert	2004	Paper	Technology roadmapping	5	Citations	1453	Technological Forecasting and Social Change
Technology Roadmapping:	Phaal,	2001	Paper	Business	4	Citations	229	Centre

linking technology resources to business objectives	Farrukh, Probert			roadmapping				for Technology
Developing a technology roadmapping system	Phaal, Farrukh, Probert	2005	Paper	Technology roadmapping	4	Citations	209	Technological Forecasting and Social Change
An architectural framework for roadmapping: Towards visual strategy	Phaal, Muller	2009	Paper	Technology roadmapping	5	Citations	389	Technological Forecasting and Social Change
Exploring the impact of evaluating strategic options in a scenario-based multi-criteria framework	Ram, Montibeller	2013	Paper	-	4	Relevancy	51	Technological Forecasting and Social Change
Scenarios and early warnings as dynamic capabilities to frame managerial attention	Ramírez, Österman, Grönquist	2013	Paper	Cognitive aspects of sensing	3	Relevancy	67	Technological Forecasting and Social Change
Plausibility and probability in scenario planning	Ramírez, Selin	2014	Paper	Scenario planning	3	Citations	149	Foresight
Evolution of roadmapping at Motorola	Richey, Grinell	2004	Paper	Technology roadmapping	3	Citations, practicality	94	Research Technology Management
Scenario planning: managing for the future	Ringland, Schwartz	1998	Book	Scenario planning	5	Citations	1286	n/a
Multi-path mapping for alignment strategies in emerging science and technologies	Robinson, Propp	2008	Paper	Roadmapping, strategic alignment	2	Relevancy	133	Technological Forecasting and Social Change
Using scenarios for roadmapping: The case of clean production	Saritas, Aylen	2010	Paper	Scenario-based roadmapping	3	Citations	120	Technological Forecasting and Social Change
Scenario planning a collage construction approach	Saunders	2009	Paper	Scenario planning	4	Relevancy	24	Foresight

Scenario planning: a tool for strategic thinking	Schoemaker	1995	Paper	Scenario planning	5	Citations	2145	Sloan Management Review
Scenario-Driven Roadmapping to cope with uncertainty: Its application in the construction industry	Siebelink	2015	Paper	Business roadmapping, scenario planning, SBRM	4	Relevancy	11	Technological Forecasting and Social Change
The Road Ahead business roadmapping	Siebelink	2013	Master Thesis	Innovation, innovation strategy, business roadmaps	5	Master Thesis	1	n/a
Roadmapping for dynamic and uncertain environments	Strauss, Michael Radnor	2004	Paper	SBRM, Roadmapping, Scenario planning	3	Citations	139	Research Technology Management
Directions in scenario planning literature	Varum, Melo	2010	Paper	Scenario planning	5	Citations	389	Futures
Integrated roadmaps and corporate foresight as tools of innovation management: The case of Russian companies	Vishnevskiy, Karasev, Meissner	2015	Paper	Roadmapping, corporate foresight	2	Relevancy	73	Technological Forecasting and Social Change
Application of technology roadmaps to governmental innovation policy for promoting technology convergence	Yasunaga, Watanabe, Korenaga	2009	Paper	-	3	Citations	132	Technological Forecasting and Social Change

## Appendix B – Communication with participants

*Invitation sent to experts for the preliminary research on trends:*

Geachte [participant],

Momenteel ben ik bezig met een vooronderzoek voor mijn masterscriptie over strategische keuzes in de bouwsector. Voor dit vooronderzoek ben ik benieuwd naar trends in de Nederlandse woningbouw die een grote rol gaan spelen de komende 20 jaar. Zou het, gezien uw ervaring op dit gebied, mogelijk zijn om binnenkort een halfuur tot een uur te praten (via Teams of Zoom) over onderwerpen die volgens u van belang zullen zijn? Graag hoor ik van u

Met vriendelijke groet,  
Paul Potters

*Invitation sent to VolkerWessels team members for the first interview:*

Beste [participant],

Momenteel studeer ik in samenwerking met Robert Schuurings af bij VolkerWessels op het onderwerp Scenario-Based Roadmapping, gericht op de woningbouw. Dit is een strategie die gebruikt wordt door onder meer Shell en Heineken om snel te kunnen schakelen bij bepaalde gebeurtenissen. In het kort komt deze strategievorming op het volgende neer:

1. Welke scenario's zouden zich tussen nu en 2040 kunnen voltrekken die invloed hebben op de woningbouw?

Bijvoorbeeld: digitalisering, gebrek aan arbeidskrachten, pandemieën, migratie, vergrijzing, rentestijging, klimaatverandering etc.

2. Als een scenario zich voltrekt, hoe zou ik daar als bedrijf VolkerWessels op reageren?

Bijvoorbeeld: industrialiseren, legoliseren, binnenstedelijke hoogbouw, circulaire woningen, etc.  
Welke product/marktcombinaties kunnen worden bediend met welke technologieën?

3. Uitwerking strategie

Als er voor meerdere scenario's dezelfde maatregelen getroffen zouden worden, dan zou men kunnen overwegen die nu al toe te voegen aan de bestaande strategie, zodat het bedrijf vast voorsorteert op de verwachte toekomst.

Om de scenario's uit te werken zou ik graag een interview af willen nemen via Teams, dit zal ongeveer een uur duren. In een later stadium zal dan in kleine groepen (wederom via Teams) worden gereflecteerd op de scenario's, om zo tot een strategie te komen. Om het beste resultaat te behalen bij de interviews, vergt dit enige voorbereiding in de vorm van het doornemen van twee bijlagen bij deze mail:

1. Een rapport met trends in de Nederlandse huizenmarkt
2. Het interviewprotocol

De eerste bijlage schetst een beeld van de trends die zich voor zullen doen in de Nederlandse huizenmarkt tot aan 2040. De tweede bijlage omvat het interviewprotocol.

Graag zou ik op een van de volgende momenten het interview afleggen:

[date 1]

[date 2]

[date 3]

Ik hoor graag wat uitkomt, of wanneer er nog vragen zijn

Alvast hartelijk dank voor de medewerking!

Met vriendelijke groet,

Paul Potters

[attachments: preliminary research report, interview protocol]

*Invitation sent for the sessions:*

Beste allen,

hierbij alvast de scenario's voor volgende week donderdag. De bedoeling is om deze scenario's gezamenlijk te beoordelen op criteria zoals relevantie, plausibiliteit en impact. Dat wijst zich vanzelf op donderdag. Tot dan!

Met vriendelijke groet,  
Paul Potters

[attachments: scenarios]

## Appendix C – Trends in the Dutch housing industry, 2020-2040

P J Potters

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Date: 07-10-2020

Version: 1.2

*Changes since last version: Minor changes to abstract / samenvatting, changed 'sharing economy' to 'servitization', expanded servitization, expanded digitalisation, expanded robotics, added a list of trends as an appendix*

## Abstract

This report describes several trends in the Dutch housing industry that are currently in effect, and will be for the near future (2040).

In the near future, the demographics of the Netherlands will undergo several changes. To start, the population will increase from 17.430.000 now to about 19 million in 2040. The growth will steadily decrease during this time. The number of people per household will also decrease, resulting in less people per house. The population itself will also change: in 2040, the Netherlands will have a relatively older population as well as a relatively higher number of immigrants.

The current shortage of houses remains until somewhere between 2025 and 2030, during which the rate of construction will catch up with the rate at which new houses are built. While manpower shortages are currently severe, these problems will lessen too with a steady decline in overall demand.

Demands for increased sustainability will rise, mainly from the population itself. This increases the demand for sustainable solutions and contributes to the 100% circular Netherlands in 2050.

On the technological side, the construction industry will move to 5D BIM, adding schedule as well as costs to already existing 3D-modeling practices. New materials like Cross Laminated Timber (CLT) and 3D-printed concrete will be used in projects that will increasingly be built off-site using prefab and modular techniques. The use of advanced robotics may also prove useful in construction in the near future.

Government regulations are hard to predict, as was shown in the latest 'nitrogen-crisis' which was not foreseen by the construction industry. New government restrictions are always a possibility, as is shown by brand new sound regulations.

Towards 2050, the Netherlands have to work on zero-emission housing, as agreed in the Paris Agreement and the Dutch 'Klimaatakkoord'. Alternative fuels, like green hydrogen, might replace the much-used natural gas in Dutch homes. These homes may also be adapted to an increase in rainfall (but a decrease in available drinking water) by collecting rainwater for in-home use.

As with many reports that have been published lately, it is hard to see what the mid-to-long-term effects of the Covid-19 outbreak are. Whether Covid-19 will change the way we live (and *where* we live) or not is something only time will tell.

The trends described in this report are not quantified or qualified. This is left to the reader. What can be concluded, however, is that all the trends in this report have an effect on all the others, with sustainability one of the leading trends. A full list of the trends described in this report can be found in appendix 1.

## **Samenvatting (Abstract in Dutch)**

Dit rapport beschrijft enkele relevante trends voor de Nederlandse huizenmarkt voor de nabije toekomst, tot aan 2040.

In de nabije toekomst zal de bevolking van Nederland veranderen. Het bevolkingsaantal zal stijgen van 17.430.000 naar ongeveer 19 miljoen in 2040. Deze groei zal echter wel op termijn afnemen. Wat ook zal afnemen, is het aantal personen per huishouden, wat leidt tot een kleiner aantal mensen dat in een huis woont. De opmaak van de bevolking zal ook veranderen: in 2040 zullen er relatief meer ouderen en migranten in Nederland zijn vergeleken met nu.

Het huizentekort dat Nederland nu kent, zal voorlopig stijgen. Tussen 2025 en 2030 zal het aantal gebouwde huizen de vraag naar nieuwe huizen inhalen, waarmee een afname van het tekort kan worden bewerkstelligd. Ook het tekort aan vakmensen in de bouw zal langzamerhand afnemen.

Duurzaamheid is een belangrijk punt in Nederland, en de vraag hiernaar zal vanuit de bevolking verder toenemen. Deze vraag naar duurzame oplossingen zal bijdragen aan een 100% circulair Nederland in 2050.

Aan de technologische kant zal de bouw zich bewegen richting het gebruik van 5D BIM, waarbij ook gecalculeerd en gepland kan worden. Nieuwe materialen zoals Cross Laminated Timber (CLT) en 3D-geprint beton zullen worden gebruikt in projecten waarbij steeds meer in de fabriek wordt voorbereid, gebruikmakend van prefabricage en modules. Ook de toepassing van robotica kan een rol gaan spelen.

Overheidsmaatregelen laten zich lastig voorspellen, zoals gebleken is uit de stikstofcrisis die niet door de bouw voorspeld was. Nieuwe maatregelen zijn altijd een optie, zoals onlangs is gebleken uit de nieuwe geluidsnormeringen voor de bouwplaats.

Richting 2050 zal Nederland moeten werken aan nul-op-de-meter-woningen, voortkomend uit het tekenen van de akkoorden van Parijs en het klimaatakkoord. Hierbij kunnen alternatieve brandstoffen, zoals groene waterstof, het in Nederlandse huizen zo veel gebruikte aardgas gaan vervangen. Deze huizen zullen bovendien aangepast worden voor het opvangen en gebruiken van het zogenaamde grijswater: regenwater dat gebruikt kan worden in en om het huis.

Zoals bij vele rapporten die in deze roerige tijden uitkomen, is het lastig om te voorspellen wat de invloed van de uitbraak van Covid-19 op het geheel is. Vooral de midden- tot langetermijnsgevolgen laten zich lastig voorspellen. Of Covid-19 een blijvend effect zal hebben op hoe en waar we wonen, zal moeten blijken.

De beschreven trends in dit rapport zijn niet gekwantificeerd of gekwalificeerd. Dat is aan de lezer. Wat wel kan worden geconcludeerd, is dat alle trends die in dit rapport zijn genoemd, met elkaar samenhangen. Met name duurzaamheid is een invloedrijke trend. In appendix 1 is een volledige lijst te vinden met de trends die in dit rapport staan beschreven.

## 1 Introduction

This report is the result of a preliminary research on trends that will have an impact on the Dutch housing industry in the near future (2020-2040). The information described in this report is to be used as input for further research on strategic decision making techniques.

In this report, the most relevant trends for the Dutch housing industry have been described. Several expert interviews were held by the author in order to ascertain the trends, after which they were further explained based on information from scientific literature, reports from institutes, news sources, and reports from research groups. The trends have been loosely categorized according to the PESTEL-principle, meaning they have been differentiated based on macro-economic characteristics. The reader may note that some trends seem out-of-place (for instance: the 'Circularity'-trend in the chapter on social and demographic sectors). This has to do with the fact that trends can be explained in multiple ways: there is a social demand for increased circularity, while it is also a technological innovation, as well as a subject of political pressure to adopt certain standards. Figure 1 below shows a description of the methodology behind this report.

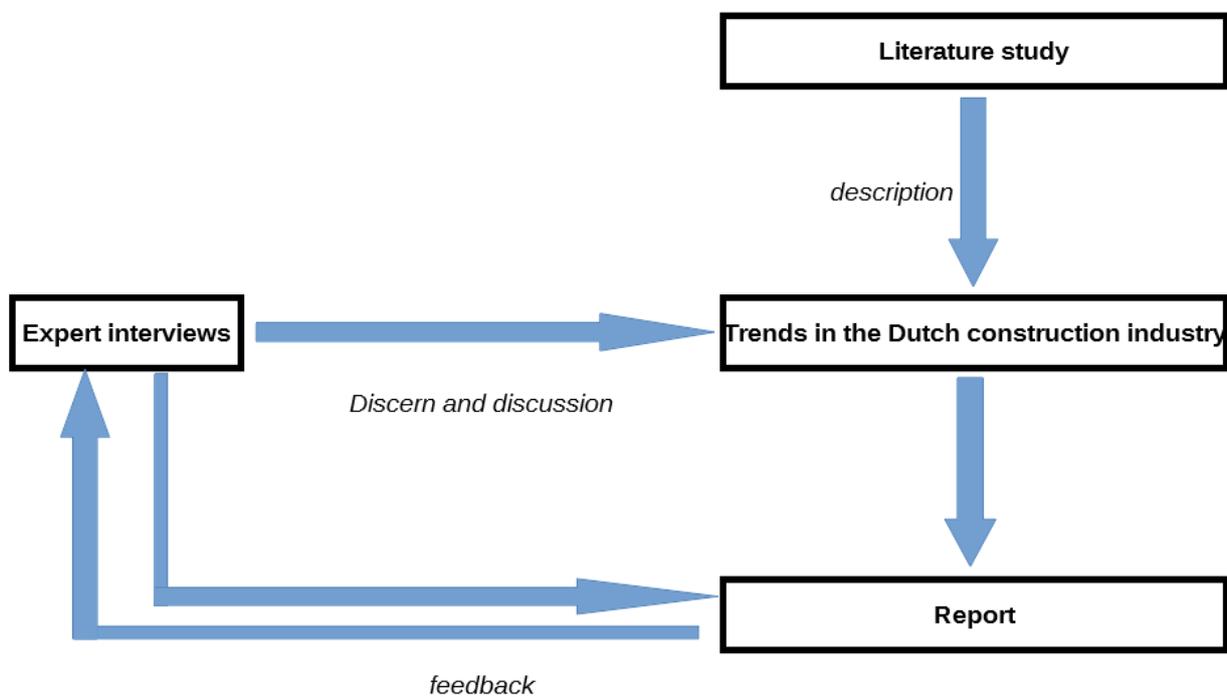


Figure 1: schematic of the methodology behind this report

The goal of this report is to provide readers with sufficient breadth and depth regarding the subject, so as to give them new insights and provide useful background information. The goal is not to quantify or qualify trends, nor to provide an exhaustive list of trends that fully explain the industry.

## 2 Social and Demographic factors

### Population increase

According to Rigo, who base their information on the Dutch Central Bureau for Statistics (CBS), the total population of the Netherlands will increase in the coming years. It is impossible to determine an exact number in this case, as the population trend in the Netherlands can be heavily affected by suddenly increasing migration numbers, as we have seen in the past years. Figure 2 below contains several CBS prognoses from the past – showing how prognoses differ over the years [1]<sup>1</sup>.

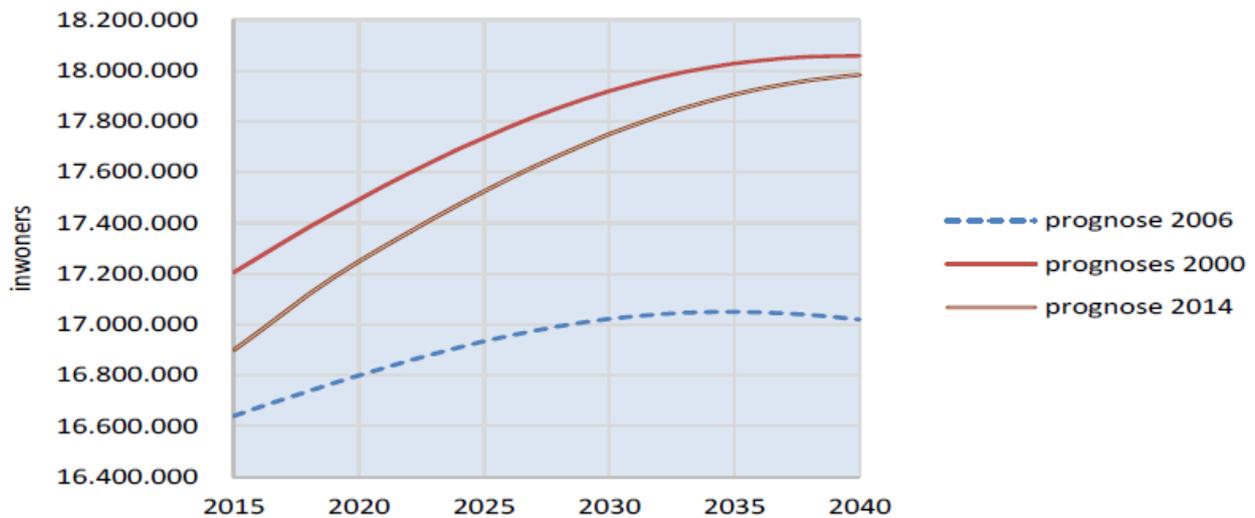


Figure 2: CBS population forecasts [1]

It is highly likely that the population of the Netherlands will grow from 17.430.000 now [2] to about 19 million in 2040 [3]. PBL summarizes the trend in the Dutch population growth as follows:

- In the coming 25 years, the Dutch population will grow
- On the edges of the Netherlands, population will shrink; most growth will happen in the central parts of the Netherlands
- The amount of pensioners will increase in all parts of the Netherlands [4]

It is important to note that the population will increase in the coming years, but the rate at which the population increases will steadily decline (as figure 1 shows).

### Decrease in household size

The population of the Netherlands increases, and so does the total number of households in the coming years. The total number of households, however, grows at a faster rate than the population. As shown in the figure 3, this has to do with a decrease in household size.

1 As will be explained at the end of the fourth chapter, the recent outbreak of Covid-19 may have significant effects on population growth. This only reinforces the point that population forecasts are not reliable in the long term.

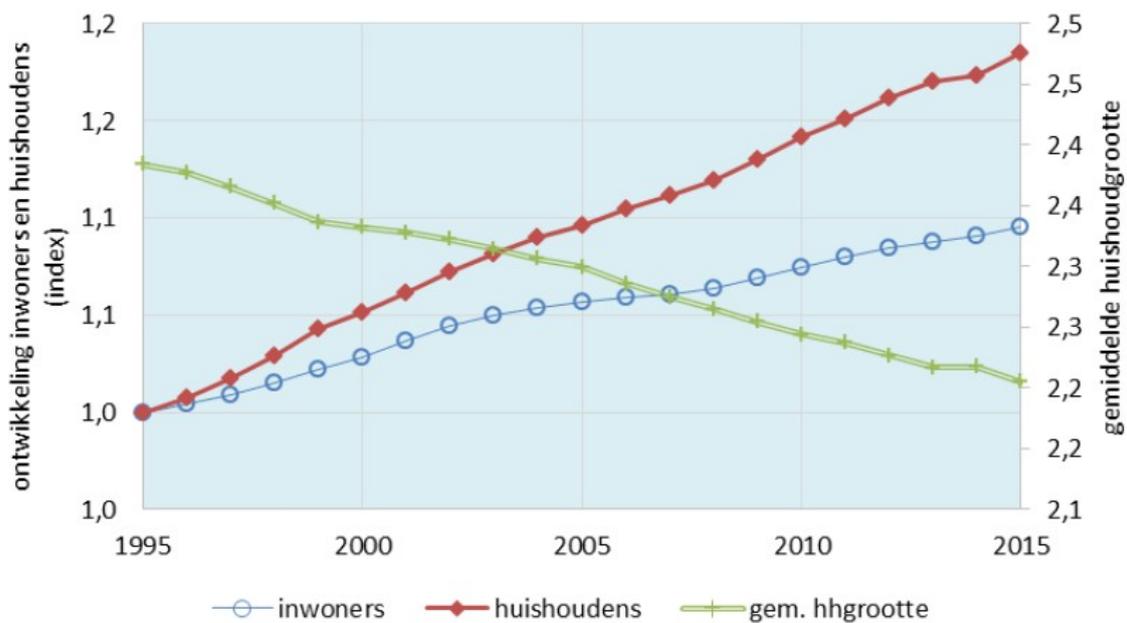


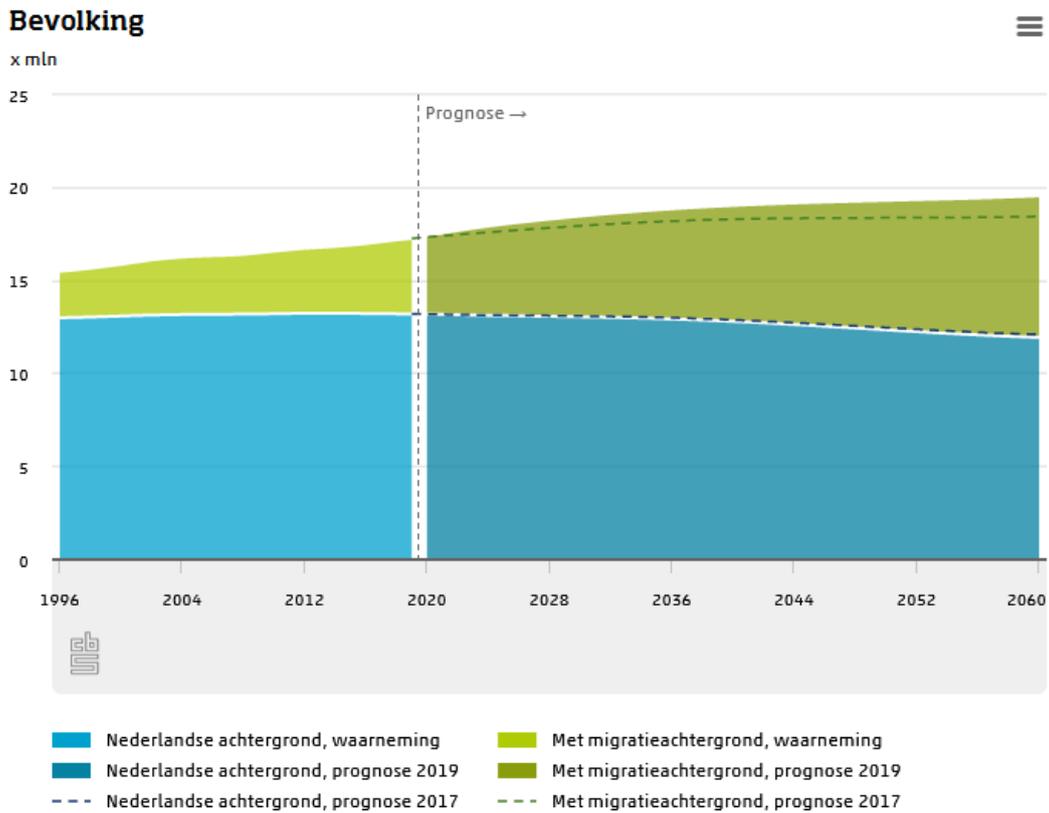
Figure 3: increase in households and population, decrease in household size [1]

There are several factors that lead to this. According to Rigo [1], one of these factors is ‘widowing’ (meaning there will be more widows), while in the recent past this was most often due to divorce and delayed family formation. Students go against this trend, as rising costs of both studying and living forces them to live longer with their parents. They also tend to return to their parents after breakups, as the cost of living alone is rising [5].

### Changing composition of population - nationality

The Netherlands has been a multi-cultural state for some time. In recent years, migrant numbers have grown while the native Dutch population has stayed more or less the same. According to CBS, this trend will continue and this will have an effect on the composition of the Dutch population. As shown in figure 4 on the next page, around 24 % of the Dutch population currently has a migration background. According to prognoses, this number will increase to 33% in 2040 (and 39 % in 2060) [6]. Since 2009, new immigrants in the Netherlands were mainly from Poland, Syria, Germany and the former Soviet Union [1].

Figure 4.



Migration background [6]

### Changing composition of population - age

While already a well-known trend, the increase in life expectancy is expected to climb even further in the coming years. Rigo [1] theorize that an average man of 75 in the year 2040 has about the same chance to live another year as a 70-year old in 2020. To more clearly describe this changing composition, CBS publish the population pyramid [7]. Arguably the most important conclusion to take from these graphs is that the average age in the Netherlands will steadily increase and the amount senior citizens increases as the 'Babyboom'-generation reaches retirement age, as shown in figures 5 and 6 on the next page.

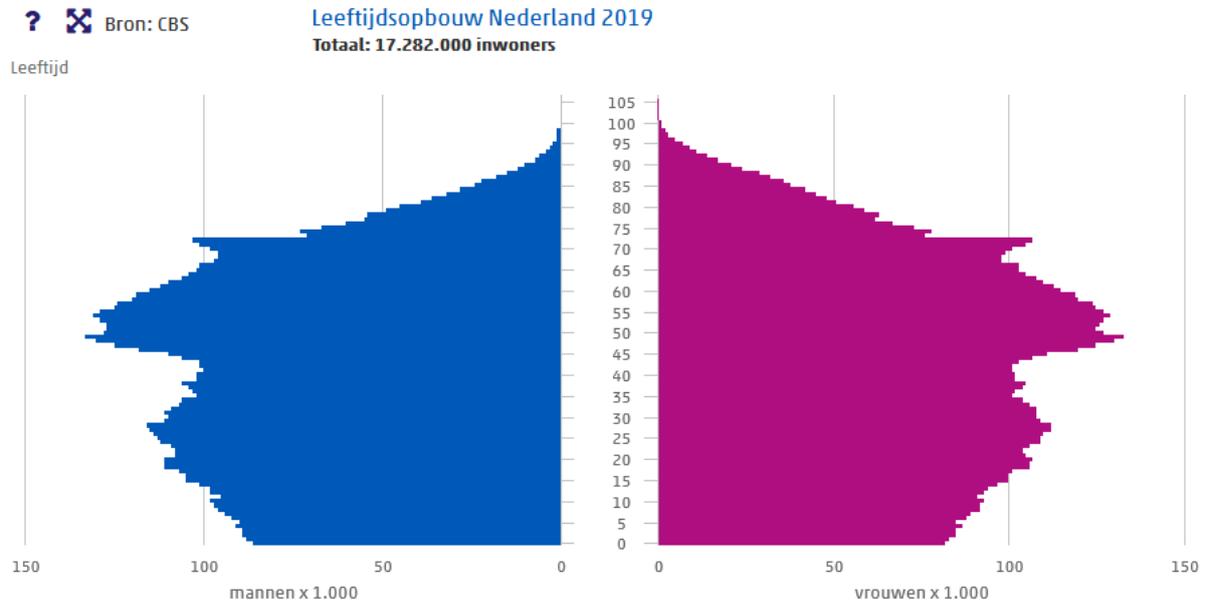


Figure 5: Population pyramid 2019 [7]

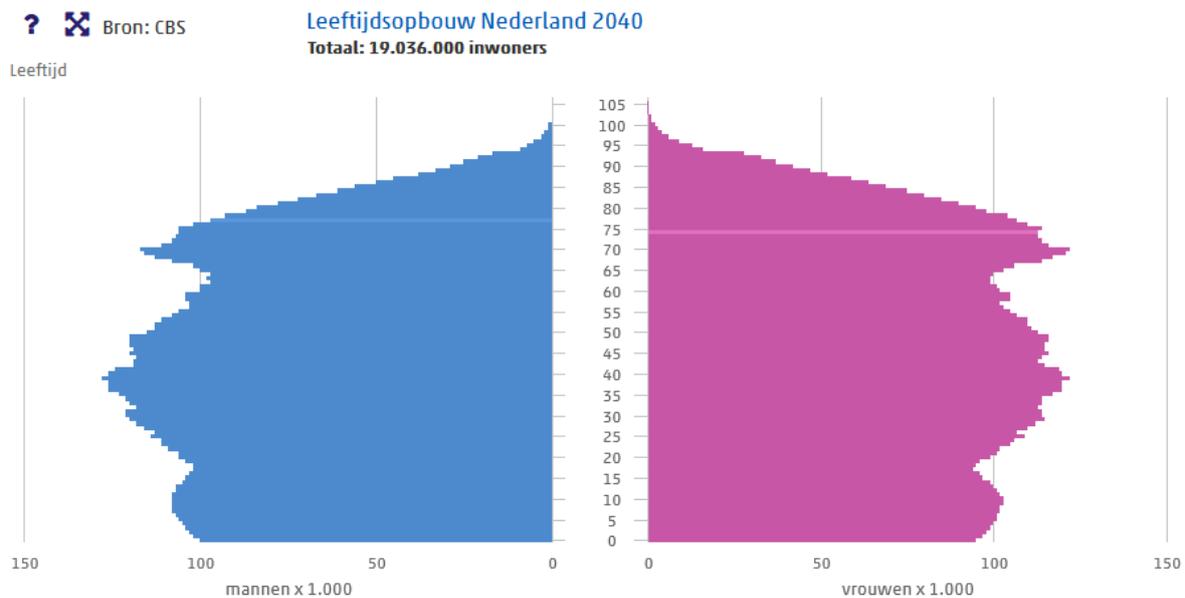


Figure 6: Population pyramid 2040 [7]

### Manpower shortages

The Dutch construction industry is currently facing manpower shortages [8], of which only 45% can be solved by influx of newly trained professionals on short term. The other 55% has to come from other sectors and from hiring foreign professionals. The construction industry also proves to take a toll on older employees -who are already over-represented- [9], but increased attention to prevention and vitality turns out to have a positive effect. While these manpower shortages are currently quite severe, on the mid-to-long term these shortages are expected to decrease [10].

## Housing shortage

The Netherlands currently face a housing shortage of 100.000 to 140.000 houses; a shortage which is mainly faced in Flevoland and de Randstad. As the number of households increases at a faster rate than the number of newly constructed houses, this number is expected to increase further in the coming years [11]. Looking at the longer term (see figure 7 below), CBS argues that the growth in number of households will decrease faster than the number of newly constructed homes, leading to a net increase in number of available homes starting somewhere between 2025 and 2030, potentially lasting until 2050 [12].

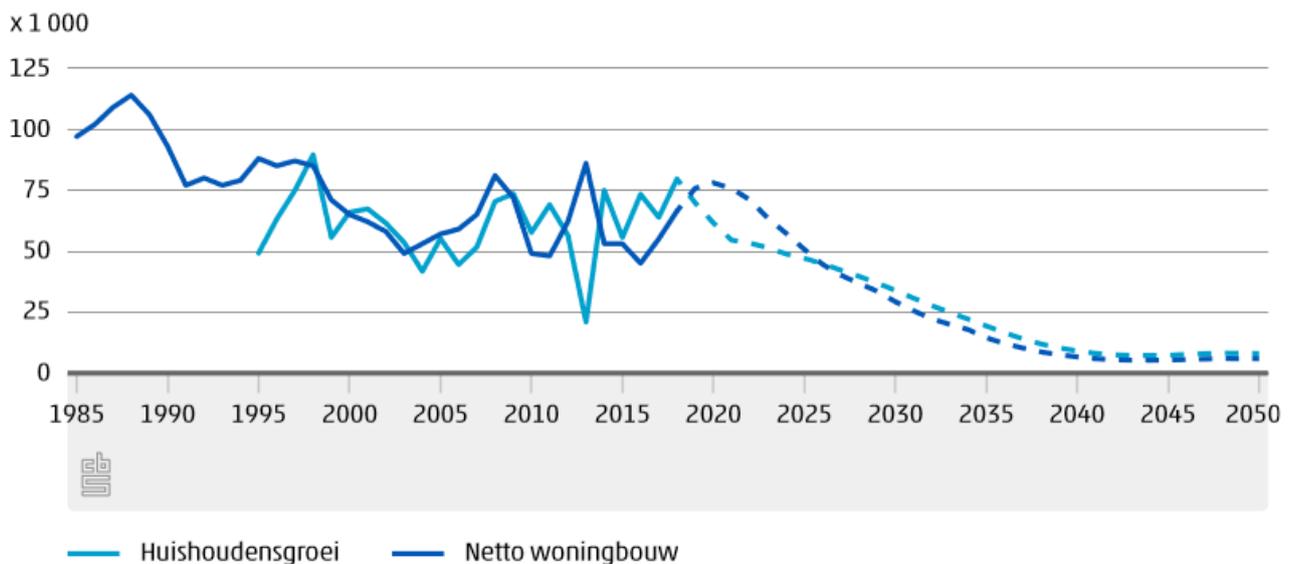


Figure 7: Long term growth in Dutch Households and newly constructed homes [12]

## Circularity

The social pressure for adopting ecological-friendly standards has been on the rise for several years. Circular construction techniques aim to reduce waste by reducing primary material consumption and re-using materials and waste. Trade association Bouwend Nederland aims to have a fully circular construction industry in 2050 [13]. Circular construction is a broad approach and starts at the design phase. It takes into account manufacture and supply, construction, refurbishment and end-of-life [14]. This means that circular construction involves the entire supply chain, including the architect, wholesalers, developers, contractors, suppliers, demolishers and investors [15]. Adopting circular construction techniques improves competitiveness by diminishing the impact of resource shortages and unstable prices and the creation of innovative business opportunities and more efficient production methods [16].

### 3 Economic and Technological factors

#### Material shortages

Most resources necessary in the construction industry are currently still available, although some of them are already becoming scarce [17] due to an expanding population and growing consumption [18]. Local material shortages can exist due to poor estimation of quantity, poor workmanship, inconsistent demand or poor quality of the material, however the biggest challenge in the future will be the actual availability of the materials [19]. Both sand and gravel are already scarce on a level that a black market for them exists [20]. One reason for this is because not all sand and gravel can be extracted, especially in developed countries, since most sand is in natural reserves and other protected areas [21]. Coping with material shortages can be done through waste reduction [19], adopting circular construction practices and developing new materials [22].

#### Servitization

The way personal property works has been changing for some time in our society. The adding of services to products is a growing trend, as well as products completely being turned into services. Different new ideas on this topic have been launched and prove successful. A part of these new ideas are known under the umbrella term ‘sharing economy’. There are peer-to-peer platforms, like AirBNB, where people can rent their houses with relatively little interference from a third party. Zipcar is a company that offers a platform on which private individuals can rent out their car. These new types of businesses focus on ‘sharing’ goods and services, claiming ecological and social benefits [23]. Initiatives in the Netherlands may lead to more individuals sharing energy and parts of their homes (several of these initiatives are shown in figure 8 below), as the focus on possession may shift to a focus on actual use [24].



Figure 8: Several sharing economy companies currently active in the Netherlands [25]

Providing services instead of regular products can provide a steadier source of income, may lower price sensitivity and may prove more profitable due to higher margins and rates of return [26]. In construction, servitization may prove most relevant concerning facility management, gathering and monitoring certain data provided by built-in sensors. The increasing servitization of the construction industry may lead to alternative business models for companies involved, both for construction companies as for end-users.

## Digitalisation

Currently, digitalisation has reached a level at which constructed buildings also fully exist in a digital space (digital twinning); resulting in a process that made it possible to construct a building digitally before it is constructed physically. This increased use of BIM (Building Information Modeling) is expected to result in more efficient use of resources and more effective collaboration between stakeholders [27].

The border between the digital and the physical world may become less obvious in the future, as physical objects may contain sensors and other devices, permanently pairing them to a digital counterpart. This can have positive results for the industry which is among the least digitized, according to McKinsey. They note five trends that will shape construction projects in the future:

- Rapid digital mapping (geolocation) and estimating
- 5-D building information modeling, see figure 9 below
- Digital collaboration, moving towards paperless projects
- Advanced analytics and IoT (Internet of Things)
- Future-proof design and construction [28]

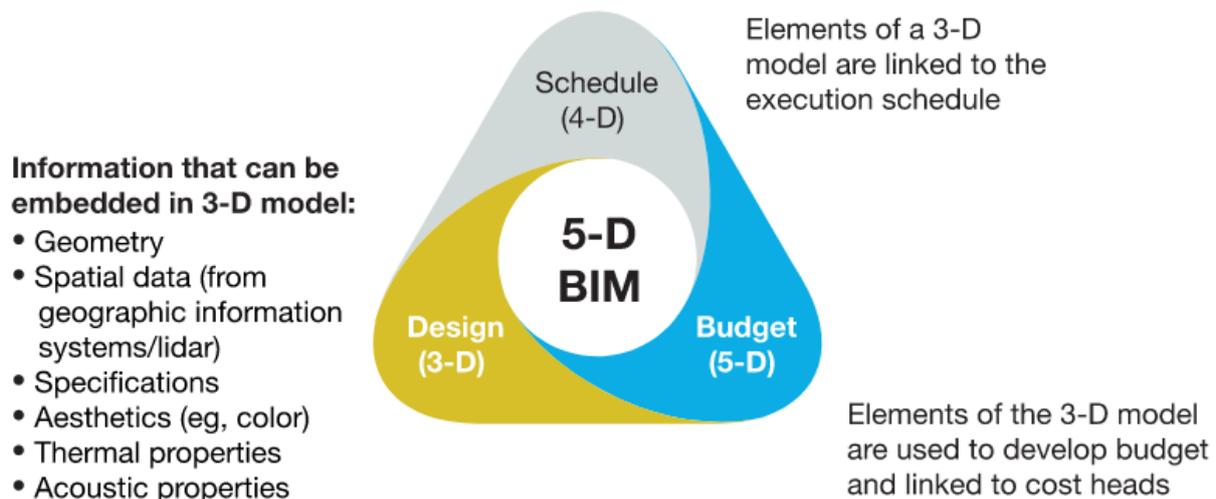


Figure 9: 5-D BIM according to McKinsey [28]

Currently, BIM is also being expanded using model-based systems engineering, which can be explained as a sort of adaptive engineering. Model-based systems engineering (MBSE) is used to integrate system requirements, design, analysis and verification in one model. Combining MBSE and BIM may help decision making during the design phase [29].

## Prefabrication and modularity

As labor prices rise, methods are devised to streamline the construction process. Prefab construction is a promising concept, in which a building is partly constructed off-site, limiting labor-intensive on-site construction to assembly tasks instead of constructing buildings from the ground up. VolkerWessels already exploits these techniques in the Netherlands with their 'MorgenWonen'-concept, in which prefabricated elements are assembled on-site, resulting in one home per day [30].

Modular products are products in which pre-assembled units form the actual structure and fabric of the building. Modularity has the potential to improve functionality of constructed buildings and increase the speed of production [31]. An important factor in modularity is integration of the supply

chain, as increased modularity also asks for more collaboration between manufacturer and construction company (i.e. on design rules) [32]. According to McKinsey, whether a particular market embraces modular construction is mainly decided by real estate demand and the availability (and cost) of skilled construction labor [33].

### **3D printing**

3D printing is also known as additive manufacturing (AM) and can potentially replace traditional methods of construction [34]. Concrete printing already happens in the Netherlands, as BAM showed with their 3D-printed concrete bicycle path [35] (see figure 10 below). Apis Cor shows that this method can be applied for buildings with a fully 3D printed two story office in Dubai [36]. The company claims it takes two weeks to print a house (and at half the cost) and plans to construct the first demo homes in late 2020 [37].



*Figure 10: Concrete printer printing the Gemert bicycle bridge in 2018 [35]*

Other relevant 3D printing techniques include polymer printing, metal additive manufacturing techniques, and using 3D printed moulds [32]. Currently, researchers are working on the development of new material for printing, ways to add metal reinforcement to concrete, improving print speed and assessing total costs. The expectation is that 3D printing will be combined with conventional methods, resulting in an integrated process [39].

### **New materials**

Several new types of materials will enter the construction industry in the coming years, of which Cross Laminated Timber (CLT) is one of the most relevant to the Dutch housing industry. This relatively new type of timber is already used to build multi-story constructions [40] and has been shown to be very efficient in buildings up to 10 stories [41]. Use of CLT panels has even more potential when combined with prefab construction techniques, for which it is appropriate due to the nature of the material. Using wood instead of traditional materials also decreases carbon-dioxide

emissions [42]. Another type of construction materials are biocomposites, which are structural materials made from biodegradable (and renewable) resources [43]. Biocomposites are the combination of natural fibers (made for instance from wood, rice, banana, pineapple, sugar cane, jute, or flax) and polymer matrices (for instance polyethylene, nylon, or polystyrene). Currently, using biocomposites in construction has disadvantages such as low elasticity and variability in mechanical and physical properties [44]. In the future, biocomposites may be used as self-healing building materials or even function as a basis for smart materials, which can adapt to external influences [45].

## Robotics

Since the relative productiveness of the construction industry has lagged behind other industries, solutions are being developed to improve production. One of these is the use of advanced robotics. While the manufacturing industry already uses robots for decades, the nature of the construction industry has so far not allowed their use. However, new research show that robotics can be used in the construction industry. In China, robot-oriented design approaches already made it possible to adapt techniques from the manufacturing industry [46]. Applying robotics has the benefit of potentially diminishing safety risk by providing automated systems for facade installation, inspection and cleaning [47], as seen in figure 11.



Figure 11: facade cleaning robot designed by Fraunhofer Institute [48]

- Other potential benefits of increased use of robotics are
- Deployment of larger-scale prefabrication
  - Enhancing workers' physical skill using exoskeletons
  - Reducing worker risk using automated asbestos removal
  - Automated building disassembly
  - Automated high-rise construction [49]

## 4 Political, Legal and Environmental factors

### PFAS, NO<sub>2</sub>, NH<sub>3</sub> and other regulations

Several chemical substances have been in the news in the Netherlands in the past year. Of these, PFAS (per- and polyfluoralkyl substances), NO<sub>2</sub> (nitrogen dioxide) and NH<sub>3</sub> (ammonia) have been the most infamous. Due to stricter regulations, many construction projects had to be shut down temporarily in what was to be called the ‘nitrogen-crisis’ [50]. The impact of this crisis is shown in figure 12 below. In the end, the government reduced maximum speeds on highways, adapted emergency laws so large projects could continue, and bought out farmers so they could close livestock farms [51].

While construction companies may find new ways to cope with problems arising from PFAS, NO<sub>2</sub> or NH<sub>3</sub>, the government may decide to adopt new regulations. Recently, new sound regulations lead to agitation as existing construction projects may have to be adapted to be more quiet [52].

Government restrictions may prove to be one of the hardest phenomena to predict in a longer period, as new governments are chosen every four years in the Netherlands and their policies may change every time.

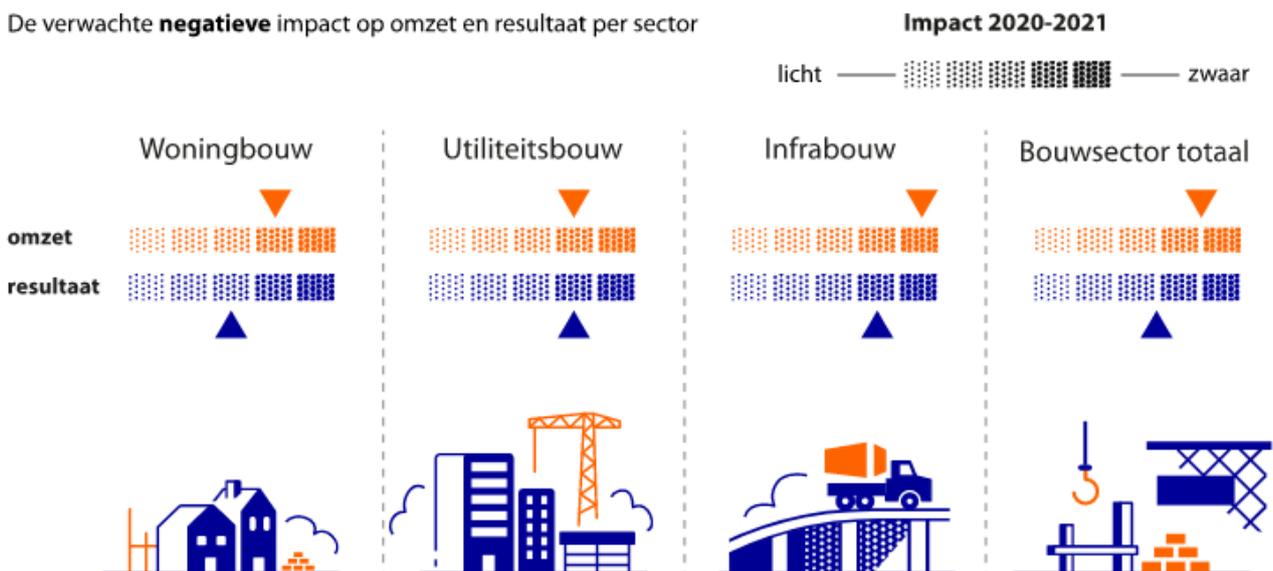


Figure 12: Expected negative impact of the nitrogen crisis on construction in the Netherlands [53]

### Sustainability

The Dutch government signed the Paris Agreement in 2015. This framework developed by the United Nations aims to mitigate the effects of global warming [54]. In the Netherlands, the first goal is to reduce CO<sub>2</sub> (carbon-dioxide) emissions by 50% in 2030 (compared to 1990-levels) [55]. Government and branch organizations plan to reach these goals mainly by reducing the use of natural gas [56], accelerate the rate at which homes are renovated (renovation includes insulation, so less energy is spent in the home), make more use of heat pumps and produce so called ‘Nul-op-de-meter’-woningen (zero emission housing). It is important to note that the government freed up millions in order to finance these changes, which have the ultimate goal of zero-emission real estate in the whole of the Netherlands in 2050 [57].

## Dealing with water

The government in the Netherlands actively promotes the ‘climate-proofing’ of house and garden. Heavy rainfall has increased in the past years, which put a heavier tax on sewers, while drinking water may prove to become more scarce in the future. Ideas to circumvent these problems include collecting rainwater and using it to flush the toilet [58]. Several of these solutions already exist and are currently being adopted by private individuals, an example of which is shown in figure 13 below [59].



Figure 13: schematic display of ‘grey water’-system [59]

## Alternative fuels

Green hydrogen might prove helpful in the future. In situations where a surplus of energy is produced (due to solar panels, windmills), this energy can be transformed into hydrogen. Hydrogen can then fuel boilers or even cars [60]. In time, it is possible that hydrogen (or other fuels) replace natural gas, as the government wants to phase out the use of natural gas before 2050 [56]. Other possible alternatives are biofuels, synthetic fuels, and LPG [61].

## Covid

The effects of the Covid-19 outbreak are not yet fully clear. As of right now, more people are working from home than ever. This might prove to be a lasting trend, having effect on the regional housing demand in the Netherlands – people may accept a longer commuting distance if they only have to visit the office once a week. While in the short term the outlook is bleak for the Dutch housing market, mid-to-long term effects are as of yet unknown [62]. According to ING, the Dutch construction industry is set to shrink at least 5% in 2021, due to a rise in unemployment and financial challenges. Especially the market for newly-built homes will be hit hard [63].

## **5 Conclusion**

The goal of this report is to provide readers with sufficient breadth and depth regarding the subject, so as to give them new insights and provide useful background information. The goal is not to quantify or qualify trends, meaning that no conclusions will be made regarding which trend is to be more likely to be present in the coming years. This is also quite impossible, as no one knows what the future will bring.

One useful observation to make is that, when researching trends, it is important to note the interaction between them. Almost all the trends listed in this report have effect on all the others mentioned. For instance, an increasing population demands more housing, which in effect requires more efficient methods of construction (3d-printing, use of robotics). This effect increases when there is a shortage of skilled labor.

Sustainability is a rather important point. The government and branch organizations have paved the way to a zero-emissions real estate portfolio in 2050. Many trends are affected by this (or even caused by this). For instance: social pressure leads to government regulations which in turn leads to a demand for technical innovation.

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## **Acknowledgments**

The author would like to thank

Hans de Jonge, emeritus professor Real Estate Management TU Delft

Ruben Vrijhoef, professor of Building Future Cities at Utrecht University

Frans Schilder, senior researcher at Planbureau voor de Leefomgeving (PBL)

for sharing their knowledge on the Dutch construction industry, as well as

Erwin Hofman, assistant professor at Twente University

Joop Halman, emeritus professor at Twente University

Robert Schuurings, director at VolkerWessels

for their suggestions and useful feedback during the creation of this report.

## **Appendix 1: list of trends**

What follows is a list of trends described in this report in the order in which they are mentioned:

### *Social and demographic factors*

Population increased

Decrease in household size

Changing composition of population (nationality)

Changing composition of population (age)

Manpower shortages

Housing shortages

Circularity

### *Economic and technological factors*

Material shortages

Servitization

Digitization

Prefabrication and modularity

3D printing

New materials

Robotics

### *Political, legal and environmental factors*

PFAS, NO<sub>2</sub>, NH<sub>3</sub> and other regulations

Sustainability

Dealing with water

Alternative fuels

Covid

## Appendix D - Trends in de Nederlandse huizenmarkt, 2020-2040

Nederlandse versie

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Datum: 07-10-2020

Versie: 1.2

*Aanpassingen sinds laatste versie: kleine aanpassingen aan samenvatting, 'Sharing economy' aangepast naar 'servitization', servitization uitgebreid, digitalisering uitgebreid, robotisering uitgebreid, lijst van trends toegevoegd als bijlage.*

## **Samenvatting**

Dit rapport beschrijft enkele relevante trends voor de Nederlandse huizenmarkt voor de nabije toekomst, tot aan 2040.

In de nabije toekomst zal de bevolking van Nederland veranderen. Het bevolkingsaantal zal stijgen van 17.430.000 naar ongeveer 19 miljoen in 2040. Deze groei zal echter wel op termijn afnemen. Wat ook zal afnemen, is het aantal personen per huishouden, wat leidt tot een kleiner aantal mensen dat in een huis woont. De opmaak van de bevolking zal ook veranderen: in 2040 zullen er relatief meer ouderen en migranten in Nederland zijn vergeleken met nu.

Het huizentekort dat Nederland nu kent, zal voorlopig stijgen. Tussen 2025 en 2030 zal het aantal gebouwde huizen de vraag naar nieuwe huizen inhalen, waarmee een afname van het tekort kan worden bewerkstelligd. Ook het tekort aan vakmensen in de bouw zal langzamerhand afnemen.

Duurzaamheid is een belangrijk punt in Nederland, en de vraag hiernaar zal vanuit de bevolking verder toenemen. Deze vraag naar duurzame oplossingen zal bijdragen aan een 100% circulair Nederland in 2050.

Aan de technologische kant zal de bouw zich bewegen richting het gebruik van 5D BIM, waarbij ook gecalculeerd en gepland kan worden. Nieuwe materialen zoals Cross Laminated Timber (CLT) en 3D-geprint beton zullen worden gebruikt in projecten waarbij steeds meer in de fabriek wordt voorbereid, gebruikmakend van prefabricage en modules. Ook de toepassing van robotica kan een rol gaan spelen.

Overheidsmaatregelen laten zich lastig voorspellen, zoals gebleken is uit de stikstofcrisis die niet door de bouw voorspeld was. Nieuwe maatregelen zijn altijd een optie, zoals onlangs is gebleken uit de nieuwe geluidsnormeringen voor de bouwplaats.

Richting 2050 zal Nederland moeten werken aan nul-op-de-meter-woningen, voortkomend uit het tekenen van de akkoorden van Parijs en het klimaatakkoord. Hierbij kunnen alternatieve brandstoffen, zoals groene waterstof, het in Nederlandse huizen zo veel gebruikte aardgas gaan vervangen. Deze huizen zullen bovendien aangepast worden voor het opvangen en gebruiken van het zogenaamde grijswater: regenwater dat gebruikt kan worden in en om het huis.

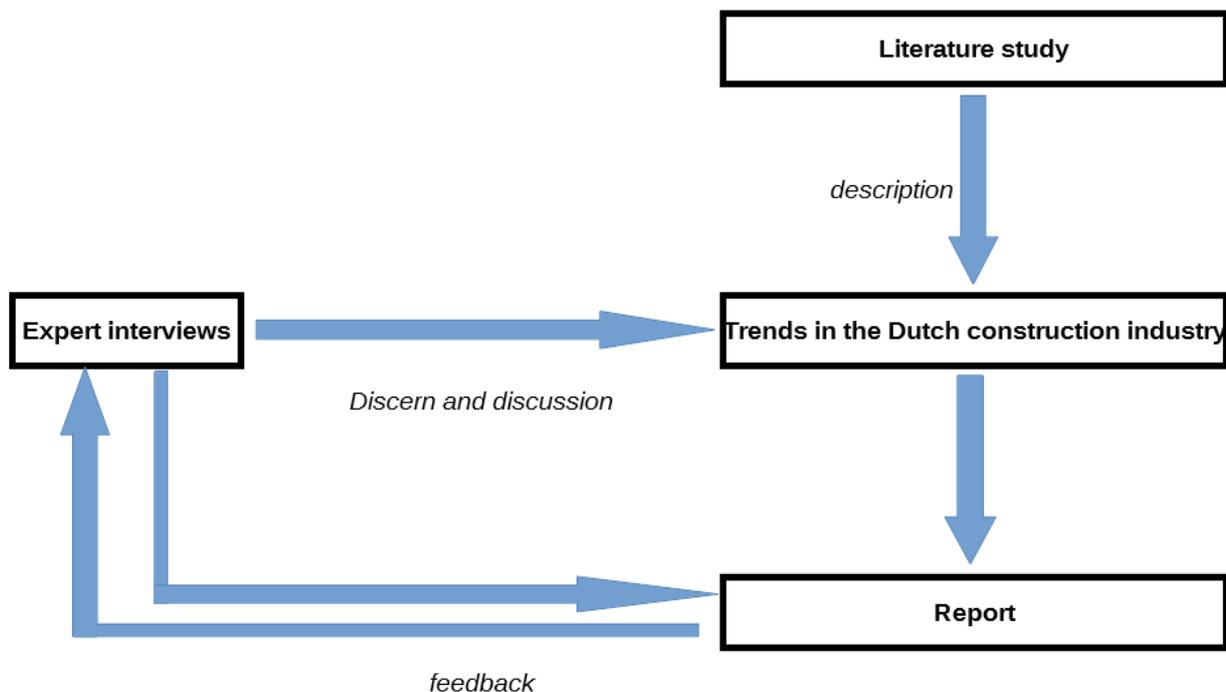
Zoals bij vele rapporten die in deze roerige tijden uitkomen, is het lastig om te voorspellen wat de invloed van de uitbraak van Covid-19 op het geheel is. Vooral de midden- tot langetermijnsgevolgen laten zich lastig voorspellen. Of Covid-19 een blijvend effect zal hebben op hoe en waar we wonen, zal moeten blijken.

De beschreven trends in dit rapport zijn niet gekwantificeerd of gekwalificeerd. Dat is aan de lezer. Wat wel kan worden geconcludeerd, is dat alle trends die in dit rapport zijn genoemd, met elkaar samenhangen. Met name duurzaamheid is een invloedrijke trend. In appendix 1 is een volledige lijst te vinden met de trends die in dit rapport staan beschreven.

## 1 Inleiding

Dit rapport is het resultaat van een vooronderzoek naar trends die een effect zullen hebben op de Nederlandse huizenmarkt in de nabije toekomst, tussen 2020 en 2040. De informatie beschreven in dit rapport is bedoeld als input voor verder onderzoek naar technieken op het gebied van strategische keuzes.

In dit rapport zijn de meest relevante trends voor de Nederlandse huizenmarkt beschreven. Door de auteur zijn enkele experts geïnterviewd om de trends in kaart te brengen, om deze vervolgens aan de hand van wetenschappelijke literatuur, insitutionele rapporten, nieuwsbronnen en onderzoeksrapporten verder uit te breiden. De trends zijn gecategoriseerd op basis van het DESTEP-principe, wat inhoudt dat ze zijn gedifferentieerd op basis van macro-economische eigenschappen. Mogelijk valt het de lezer op dat sommige trends niet onder de juiste categorie lijken te zijn geplaatst (zo is de trend 'circulariteit' geplaatst onder 'sociale en demografische factoren'). De oorzaak hiervan ligt in het feit dat sommige trends op meerdere manieren uitlegbaar zijn: er is een sociale druk voor meer circulariteit, terwijl het ook een technologische ontwikkeling omvat en onderwerp is van politieke discussies. Een schematische weergave van de methodologie achter dit rapport is te zien in figuur 1 hieronder.



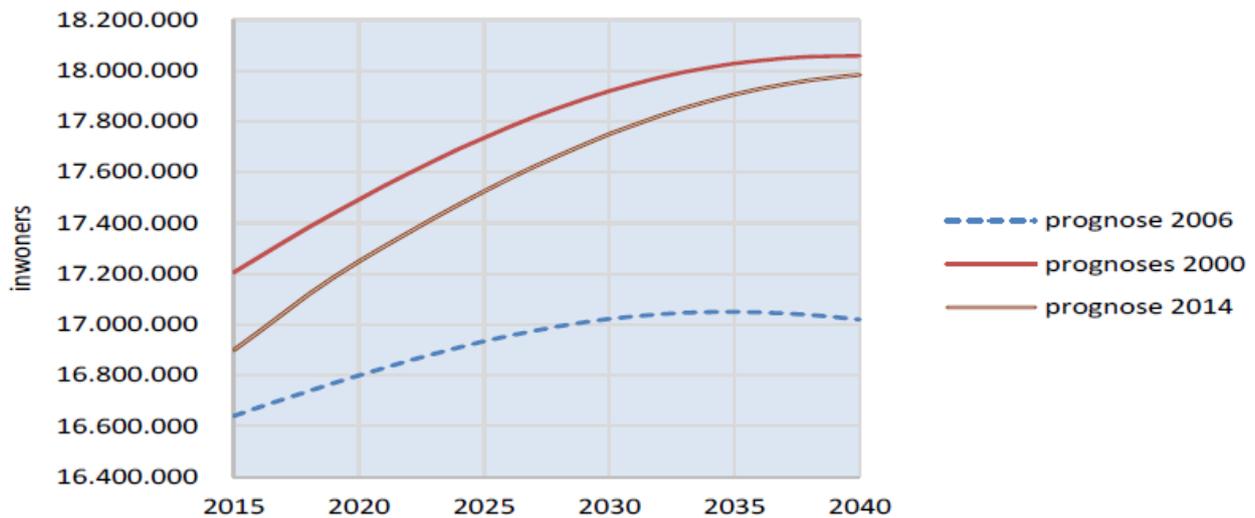
Figuur 1: schematische weergave van de methodologie van dit rapport

Het doel van dit rapport is om de lezers enkele handvaten te bieden betreffende het onderwerp, om zo tot meer inzicht te leiden. Wat niet het doel van dit rapport is, is het kwalificeren en kwantificeren van bepaalde trends, dan wel het bieden van een complete lijst van alle ter zake doende trends. Het is uiteindelijk aan de lezer om te bepalen aan welke trend hij of zij meer waarde hecht, en welke trend mogelijk een rol gaat spelen die niet in dit rapport is genoemd.

## 2 Sociale en Demografische factoren

### Toenemende bevolking

Volgens RIGO, die haar informatie baseert op die van het Centraal Bureau voor Statistiek (CBS), gaat het totale bevolkingsaantal van Nederland de komende jaren stijgen. Het is onmogelijk om hier een exact getal aan toe te kennen, mede omdat deze trend sterk wordt beïnvloed door een (mogelijk snel groeiend) migrantenoverschot, zoals in de afgelopen jaren is gebleken. Onderstaande figuur 2 toont verschillende CBS prognoses uit het verleden; hier blijkt ook het verschil tussen de verschillende prognoses uit [1]<sup>2</sup>.



Figuur 2 CBS bevolkingsprognoses [1]

Het is erg waarschijnlijk dat de totale bevolking van Nederland gaat groeien van 17.430.000 nu [2] naar ongeveer 19 miljoen in 2040 [3]. PBL vat de trends in de Nederlandse bevolking als volgt samen:

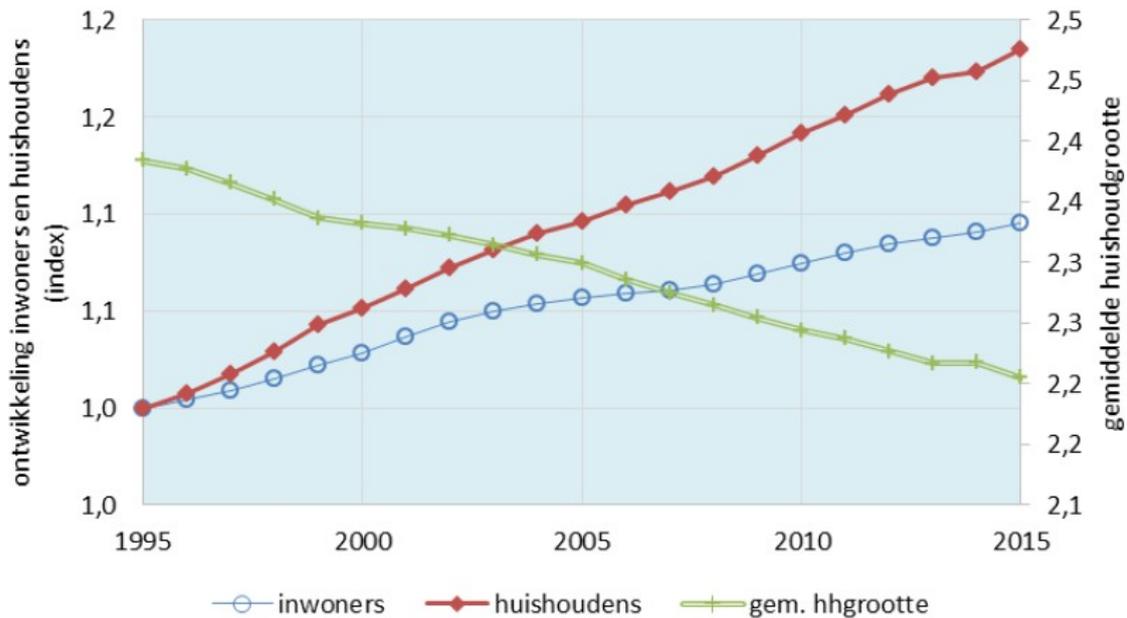
- De komende 25 jaar zal het Nederlandse bevolkingsaantal stijgen
- Aan de randen van Nederland zal er sprake zijn van bevolkingskrimp; de meeste groei is te verwachten in de centrale delen van het land (de Randstad)
- Het aantal gepensioneerden zal in heel Nederland toenemen [4]

Het is van belang om te beseffen dat de bevolking zal groeien de komende jaren, maar dat de mate waarin dit gebeurt geleidelijk zal dalen, zoals ook blijkt uit figuur 1.

<sup>2</sup> Recente ontwikkelingen met betrekking tot de uitbraak van het Covid-19 virus zullen effect hebben op deze getallen. Aan het einde van dit rapport wordt een paragraaf aan deze uitbraak gewijd, maar mogelijk zijn de genoemde getallen dus niet langer accuraat.

### Daling van de huishoudgrootte

Samen met de groei van het bevolkingsaantal, zal ook het aantal huishoudens in Nederland de komende jaren stijgen. Het totaal aantal huishoudens zal echter sneller stijgen dan de bevolkingsgroei doet vermoeden. Onderstaande figuur 3 laat zien dat de oorzaak hiervan gevonden kan worden in een daling van de gemiddelde huishoudgrootte.



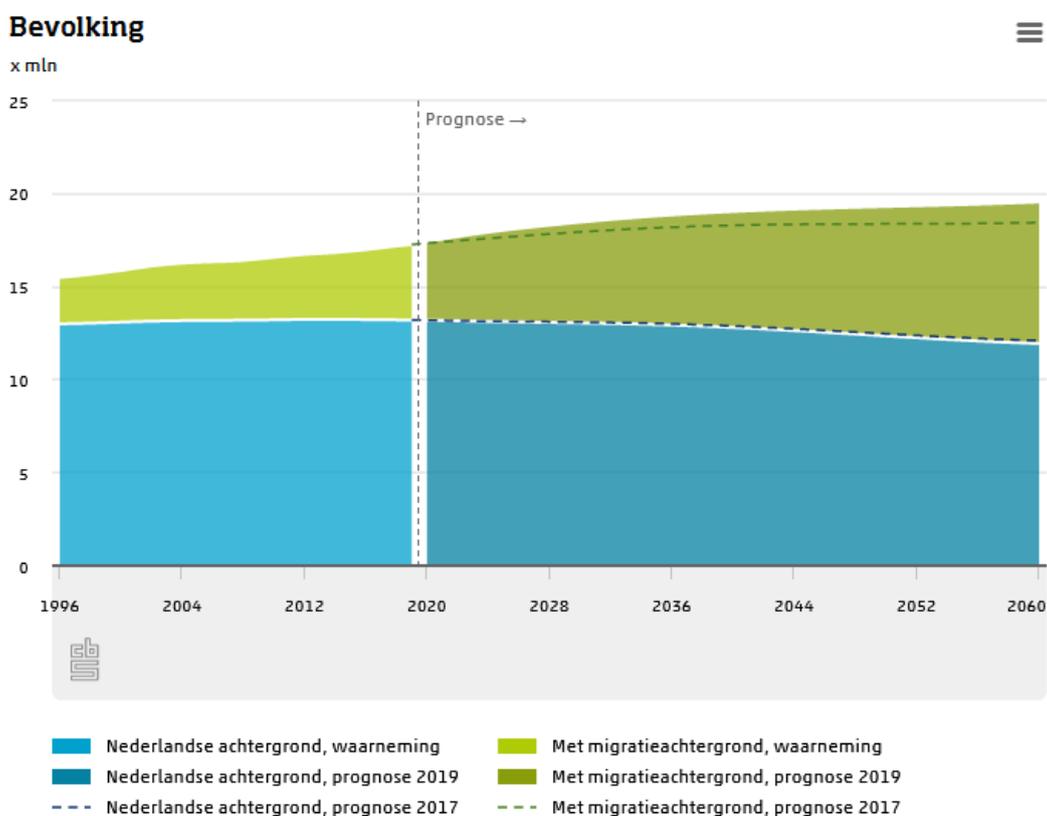
Figuur 3: stijging in het aantal huishoudens en de totale bevolking, daling van de gemiddelde huishoudgrootte [1]

Enkele factoren zijn hierbij van belang. Volgens Rigo [1] is dit onder meer te wijten aan een groei van het aantal weduwen, terwijl in het recente verleden de oorzaak vooral werd gezocht in een groei van het aantal scheidingen en het uitstellen van de gezinsstichting. Studenten gaan tegen deze trend in, omdat zij gezien de stijgende studie- en levenskosten langer in het ouderlijk huis blijven wonen. Daarnaast keren relatief meer jongeren terug naar het ouderlijk huis na een scheiding [5].

### Veranderingen in de bevolkingssamenstelling – nationaliteit

Nederland is een multiculturele samenleving. In recente jaren is het aantal migranten in Nederland gestegen, terwijl het autochtone deel van de bevolking min of meer gelijk is gebleven qua absolute aantallen. Volgens het CBS zal deze trend doorzetten en dit zal een effect hebben op de bevolkingssamenstelling van Nederland. Zoals figuur 4 op de volgende pagina toont, heeft op dit moment circa 24% van de Nederlandse bevolking een migratieachtergrond. Volgens prognoses zal dit aantal toenemen tot ongeveer 33% in 2040 (en 39% in 2060) [6]. Sinds 2009 komen deze nieuwe migranten met name uit landen als Polen, Syrië, Duitsland en de voormalige Sovjet-Unie [1].

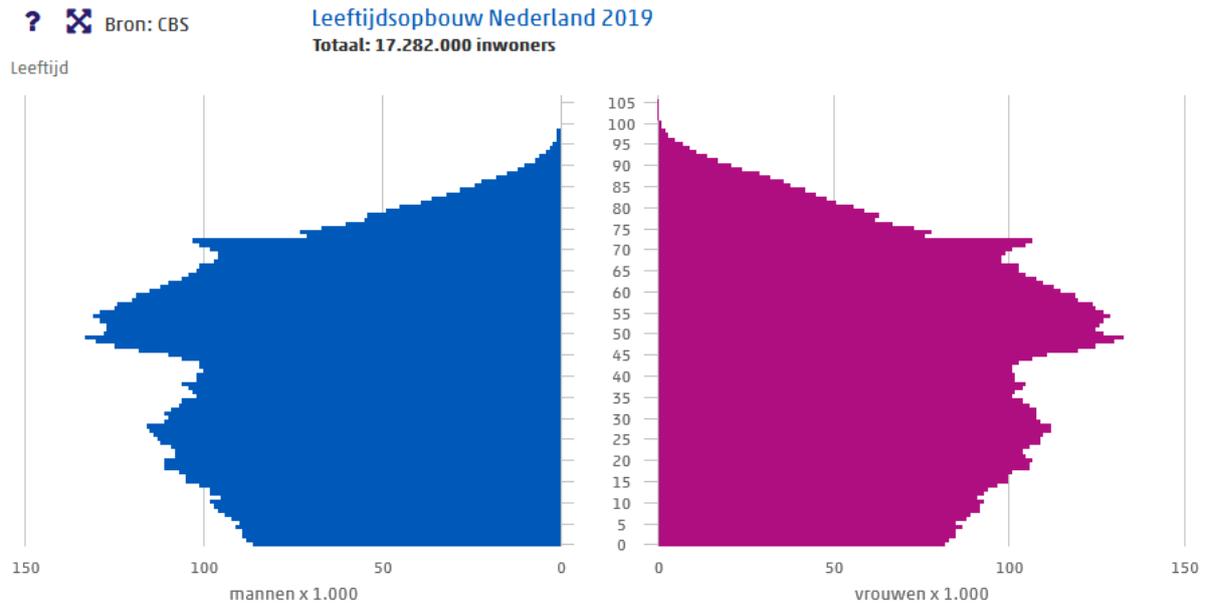
Figuur 4.



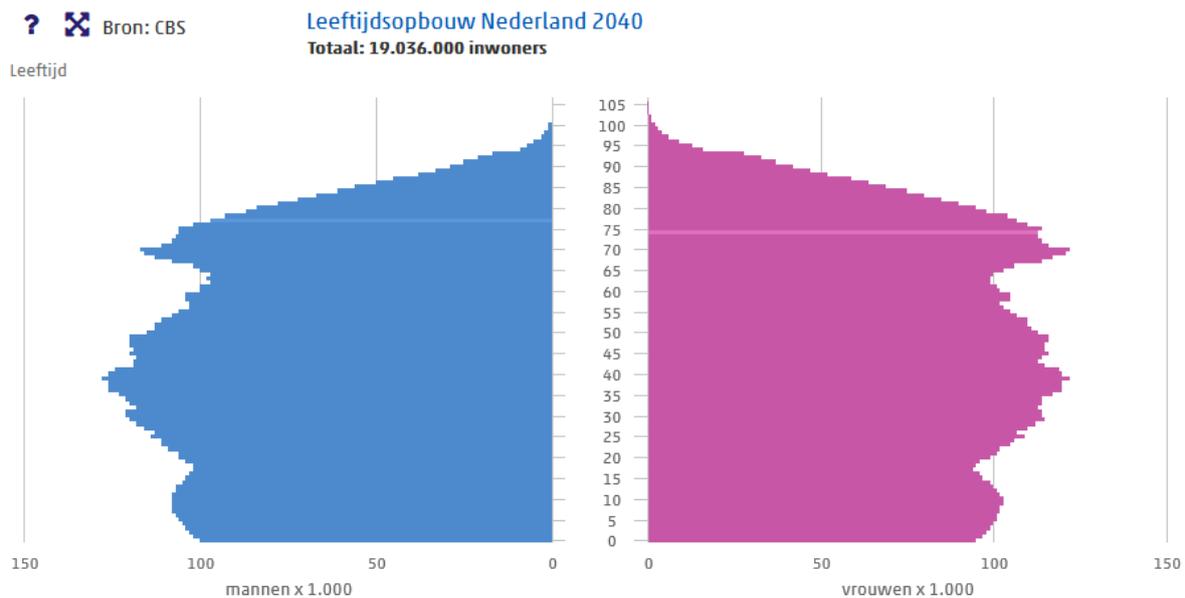
### Migratieachtergrond [6]

#### Veranderingen in de bevolkingssamenstelling – leeftijd

Het is algemeen bekend dat de levensverwachting gaat stijgen de komende jaren. Volgens Rigo [1] zal een gemiddelde man die 75 jaar oud is in het jaar 2040 ongeveer eenzelfde kans hebben om een jaar ouder te worden dan een 70-jarige man in het jaar 2020. Om de veranderingen in de bevolkingssamenstelling te verduidelijken, publiceert het CBS de bevolkingsspiramide [7]. Mogelijk de belangrijkste conclusie die hieruit te trekken valt is dat de gemiddelde leeftijd in Nederland voorlopig gaat stijgen met als gevolg een groei van het aantal senioren, doordat meer babyboomers de pensioengerechtigde leeftijd bereiken, zoals getoond in de figuren 5 en 6 op de volgende pagina.



Figuur 5: Bevolkingspiramide 2019 [7]



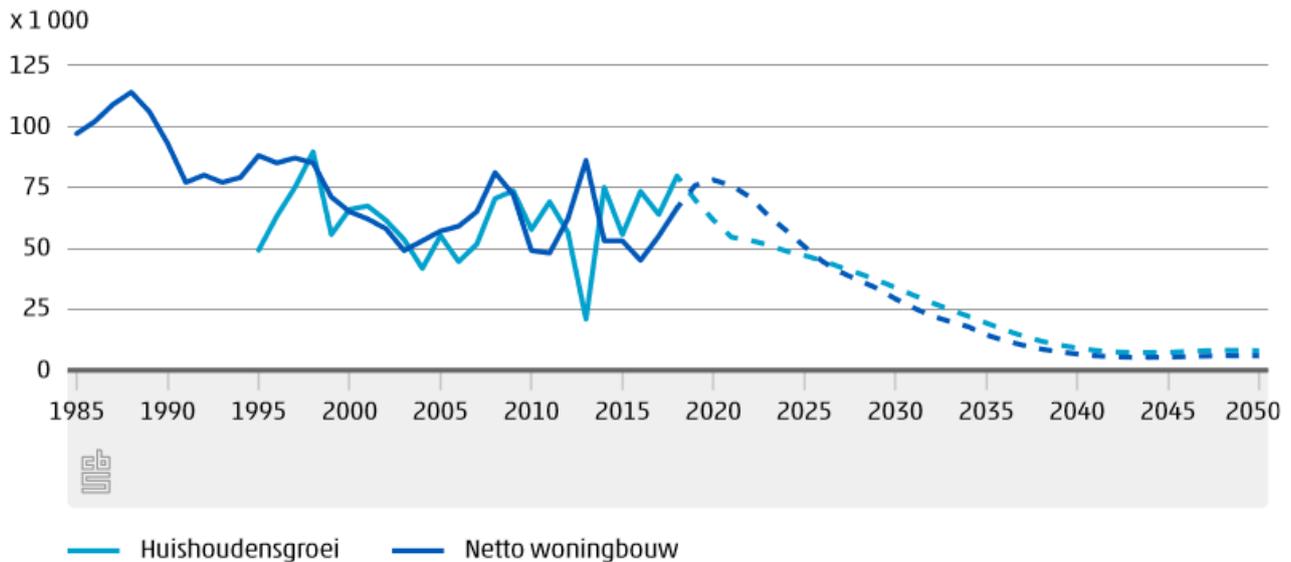
Figuur 6: Bevolkingspiramide 2040 [7]

### Tekort aan mankracht

De Nederlandse bouw heeft al langere tijd te maken met een tekort aan arbeidskrachten [8]. Op korte termijn zou in theorie 45% hiervan kunnen worden opgelost door de instroom van nieuw opgeleid personeel. De andere 55% zal uit andere sectoren of uit het buitenland moeten komen. De bouw eist ook zijn tol van oudere werknemers (die al overgerepresenteerd worden [9]), alhoewel een groeiende aandacht voor vitaliteit een positief effect heeft. Op dit moment zijn de tekorten aan arbeidskrachten relatief groot, verwacht wordt dat deze tekorten iets gaan teruglopen op de middellange en lange termijn [10], mogelijk door technologische ontwikkelingen die werknemers in staat stelt om efficiënter te werken.

## Huizentekort

Nederland heeft op dit moment een huizentekort van tussen de 100.000 en 140.000 huizen, een tekort dat vooral te merken is in Flevoland en de Randstad. Aangezien het aantal huishoudens sterker groeit dan het aantal nieuw gebouwde woningen, ziet het er naar uit dat het huizentekort de komende jaren gaat oplopen [11]. Als we kijken naar de CBS-prognoses voor de langere termijn (zie figuur 7 hieronder) dan blijkt dat de groei van het aantal huishoudens sneller zal dalen dan het tempo waarin nieuwe huizen zullen worden gebouwd, wat tot een netto stijging van het aantal huizen zal leiden ergens tussen 2025 en 2030. Mogelijk zet deze trend door tot 2050 [12].



Figuur 7: Groei in huishoudens en netto woningbouw voor de lange termijn [12]

## Circulariteit

De sociale vraag naar ecologische en milieuvriendelijke standaarden stijgt al gedurende langere tijd. Circulaire technieken hebben als doel om afval te verminderen door het hergebruiken van afval en het gebruik van primaire grondstoffen te verminderen. Bouwend Nederland heeft als doel een volledig circulaire bouwbranche in Nederland in 2050 [13]. Circulair bouwen is een breed begrip en begint al in de ontwerpfase. Er wordt rekening mee gehouden in de gehele keten, van aanvoer tot afbraak [14]. Dit houdt in dat verschillende partijen hierbij betrokken zullen moeten worden, zoals architecten, groothandels, ontwikkelaars, bouwbedrijven, slopers en investeerders [15]. Toepassing van circulaire technieken leidt tot kostenvoordelen doordat materialen efficiënter worden gebruikt en doordat dit innovatieve businessideeën stimuleert.

### 3 Economische en Technologische factoren

#### Tekort aan materiaal

De meeste grondstoffen die nodig zijn in de bouw zijn nu nog prima beschikbaar, maar er dreigt een tekort voor bepaalde stoffen [17] door een groei in de wereldbevolking en een groei van de totale consumptie [18]. Lokaal worden er tekorten zichtbaar, wat doorgaans komt door foute inschattingen, onzorgvuldig gebruik of slechte kwaliteit van het materiaal. In de toekomst zal hier echter de daadwerkelijke beschikbaarheid van bepaalde materialen bijkomen [19]. Zowel bouwzand als gravel zijn op dit moment op internationaal niveau al dusdanig schaars dat er een zwarte markt voor is ontstaan [20]. Een reden hiervoor is dat, alhoewel bouwzand soms lokaal wel beschikbaar is, het niet altijd mag worden gedolven, met name doordat het te vinden is in beschermde gebieden in ontwikkelde landen [21]. Omgaan met materiaaltekorten kan door efficiënter te werken, circulaire methodes toe te passen en nieuwe materialen te ontwikkelen [22].

#### Servitization

De rol van persoonlijke eigendommen in onze maatschappij is al enige tijd aan verandering onderhevig. Het toevoegen van diensten aan producten is een groeiende trend, alsmede het volledig vervangen van producten door diensten. Verschillende ideeën omtrent deze ‘verdiensing’ zijn al gelanceerd en blijken succesvol. Een deel van deze ideeën staan bekend onder de term ‘Sharing economy’. Zo zijn er peer-to-peer platforms, zoals AirBnB, waar particulieren een (deel van hun) huis kunnen verhuren zonder al te veel bemoeienis van een tussenpartij. Zipcar is een bedrijf dat een platform biedt waarom particulieren hun auto kunnen verhuren. Deze nieuwe bedrijven richten zich dus vooral op het delen van diensten en goederen, waarbij ze aanhalen dat dit vooral ecologische en sociale voordelen biedt [23]. In Nederland kan het er toe leiden dat particulieren bijvoorbeeld energie of bepaalde delen van huis huis gaan ‘delen’ (enkele initiatieven staan in onderstaande afbeelding 8). De focus van persoonlijk bezit zal mogelijk verschuiven naar daadwerkelijk gebruik [24].



Figuur 8: Een greep uit enkele ‘sharing economy’ bedrijven op dit moment actief in Nederland [25]

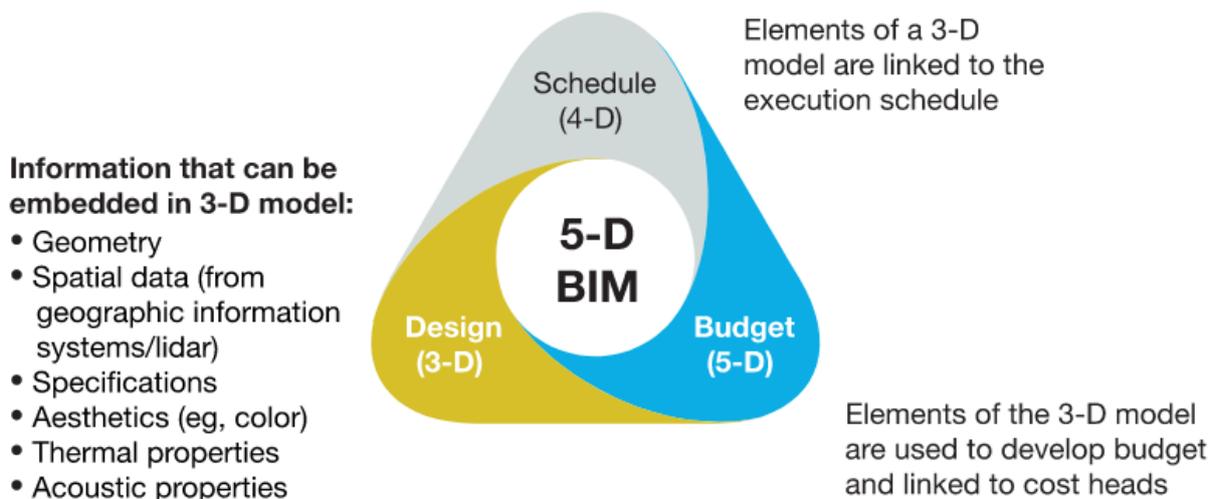
Het bieden van diensten in plaats van goederen kan ook leiden tot een beter gebalanceerde inkomstenbron, kan prijsgevoeligheid verminderen en kan over het algemeen tot betere resultaten leiden, aangezien de marges op diensten doorgaans beter zijn dan die op goederen [26]. In de bouw kan de ‘verdiensing’ relevant zijn op het gebied van facility management, zoals door het verzamelen en verwerken van data aan de hand van ingebouwde sensoren. Een groei van het aantal diensten kan tot alternatieve businessmodellen leiden, voor zowel bouwbedrijven als voor eindgebruikers.

## Digitalisatie

Op dit moment heeft de digitalisatie al het punt bereikt waarop fysieke gebouwen in zijn geheel kunnen bestaan in de digitale wereld (digital twinning), wat ertoe heeft geleid dat het mogelijk is om een gebouw volledig digitaal te 'bouwen' alvorens in de fysieke wereld eraan te beginnen. Deze groei in het gebruik van BIM (Building Information Modeling; Bouw Informatie Model/Modelleren) kan leiden tot een efficiënter gebruik van grondstoffen en een betere samenwerking tussen de verschillende bouwpartners [27].

De grens tussen digitaal en fysiek zal verder vervagen in de toekomst, door het toepassen van sensoren en vergelijkbare apparaten die een fysiek object permanent verbinden aan een digitale tegenhanger. Volgens McKinsey heeft dit positieve gevolgen voor de branche die het minst gedigitaliseerd is; zij schetsen vijf belangrijke trends voor toekomstige bouwprojecten:

- Sneller digitaal in kaart brengen en calculeren
- 5-D BIM, zie figuur 9 hieronder
- Betere digitale samenwerking, tendens richting papierloos werken
- Geavanceerde analytische toepassingen en gebruik van IoT (Internet of Things)
- Toekomstbestendig ontwerp en bouw [28]



Figuur 9: 5-D BIM volgens McKinsey [28]

Op dit moment vinden ook verkenningen plaats voor het toepassen van model-based systems engineering en BIM. Model-based systems engineering (MBSE) wordt gebruikt om eisen, ontwerp, analyse en verificatie in één model te omvatten. Het combineren van BIM en MBSE kan leiden tot verbeteringen in de ontwerpfase [29]

### **Prefabricatie en modulariteit**

De prijs voor arbeid stijgt, wat ertoe leidt dat er methodes worden ontwikkeld om het bouwproces te stroomlijnen. Prefabricatie is hierbij een veelbelovend concept. Hierbij wordt een gebouw gedeeltelijk in een fabriek gebouwd, wat minder arbeid vergt en het proces op de bouwplaats vereenvoudigt tot een assemblageproces. VolkerWessels past deze techniek in Nederland al toe in haar MorgenWonen-concept, waarbij geprefabriceerde elementen op de bouwplaats worden geassembleerd; hierbij kan een huis per dag worden neergezet [30].

Modulaire producten zijn producten waarbij vooraf geassembleerde eenheden de daadwerkelijke structuur van het product vormen. Het toepassen van modulariteit heeft de potentie om functionaliteit van een gebouw te verbeteren en de snelheid van bouwen te verhogen. Een belangrijke factor bij modulariteit is de integratie van de keten, omdat modulariteit veel samenwerking vergt tussen producent en bouwer (denk aan ontwerpafspraken) [32]. Volgens McKinsey heeft het toepassen van modulair bouwen vooral te maken met de lokale vraag naar onroerend goed en het lokale aanbod van vaardig bouw personeel [33].

### **3D printen**

3D printen staat ook wel bekend als additive manufacturing (AM) en heeft de potentie om traditionele bouwmethodes te vervangen [34]. Het printen van beton gebeurt al in Nederland, zoals BAM laat zien met haar geprinte fietsbrug (zie afbeelding 10). Apis Cor toont aan dat deze methode toepasbaar is op complete woningen met haar voorbeeld in Dubai waarbij een kantoorgebouw van 2 verdiepingen is neergezet [36]. Het bedrijf claimt dat het twee weken duurt om een gebouw te printen, tegen de helft van de kosten. Ze verwachten eind 2020 de eerste huizen in de VS neer te kunnen zetten [37].



*Figuur 10: Het betonprinten van de fietsbrug bij Gemert in 2018 [35]*

Andere belangrijke toepassingen met betrekking tot 3D printen zijn: polimeer printen, metaalprinten en het gebruik van 3D geprinte gietvormen [32]. Op dit moment worden nieuwe materialen voor gebruik in de 3D-printer ontwikkeld. Daarnaast wordt er ook gekeken naar methoden om metalen wapening aan te brengen aan geprint beton en naar versnelling van het proces. De verwachting is dat 3D-methodes binnenkort zullen worden toegepast in combinatie met traditionele methoden, wat tot een geïntegreerd proces zal leiden [39].

### **Nieuwe materialen**

Verschillende typen nieuwe materialen zullen worden geïntroduceerd in de bouw te komende jaren. Cross laminated timber (CLT) is een van de meest belangrijke voor de Nederlandse huizenmarkt. Dit nieuwe type hout wordt al toegepast om hoogbouw te plaatsen [40] en is aangetoond efficiënt tot een hoogte van 10 verdiepingen [41]. Het gebruik van CLT-panelen kan goed worden toegepast in combinatie met prefab-technieken, waar het geschikt voor is. Het gebruik van hout in plaats van klassieke materialen zorgt ook voor een kleinere CO<sub>2</sub>-voetrafdruk [42]. Ander relevant nieuw materiaal bestaat in de vorm van biocomposieten. Dit zijn materialen gemaakt van bio-afbreekbare (en dus herbruikbare) grondstoffen [43]. Biocomposieten worden gemaakt van natuurvezels (van bijvoorbeeld hout, suikerriet of jute) in combinatie met bepaalde polymeren (polyethyleen, nylon of polystyreen). Op dit moment heeft het toepassen van biocomposieten nog enkele nadelen, zoals een gebrek aan elasticiteit en een te hoge variatie aan constructieve eigenschappen [44]. In de toekomst zouden biocomposieten kunnen worden gebruikt voor zelf-helend materiaal of kunnen ze de basis vormen voor *smart materials*, die zich kunnen aanpassen aan externe invloeden [45].

### **Robotisering**

De productiviteit van de bouwsector loopt achter vergeleken met andere sectoren, wat ook te zien is in de toepassing van moderne robotica. Deze worden in productieomgevingen reeds decennia toegepast. In de bouw is dit echter lastiger, aangezien het om veelal projectmatige toepassingen gaat en niet om lopende-bandwerk. Nieuw onderzoek toont aan dat ook de bouw geschikt is voor het toepassen van nieuwe technieken op dit vlak. Zo heeft men in China, door rekening te houden met de toepassing van robots gedurende de ontwerpfase, het mogelijk gemaakt om robots te gebruiken in de bouw [46]. Het toepassen van robots zorgt voor een hogere veiligheid, zoals de robot in figuur 11 op de volgende pagina laat zien. Deze robot wordt gebruikt voor de installatie, inspectie en schoonmaken van facades [47].



*Figure 11: Schoonmaakrobot ontworpen door het Fraunhofer Instituut [48]*

Andere mogelijke voordelen van het gebruik van robots in de bouw zijn:

- Toepassing van prefabricatie op grotere schaal
- Fysieke mogelijkheden van bouwplaatsmedewerkers verhogen met exoskeletten
- Verminderen van risico's, bijvoorbeeld door het automatiseren van asbestverwijdering
- Automatiseren van sloopwerkzaamheden [49]

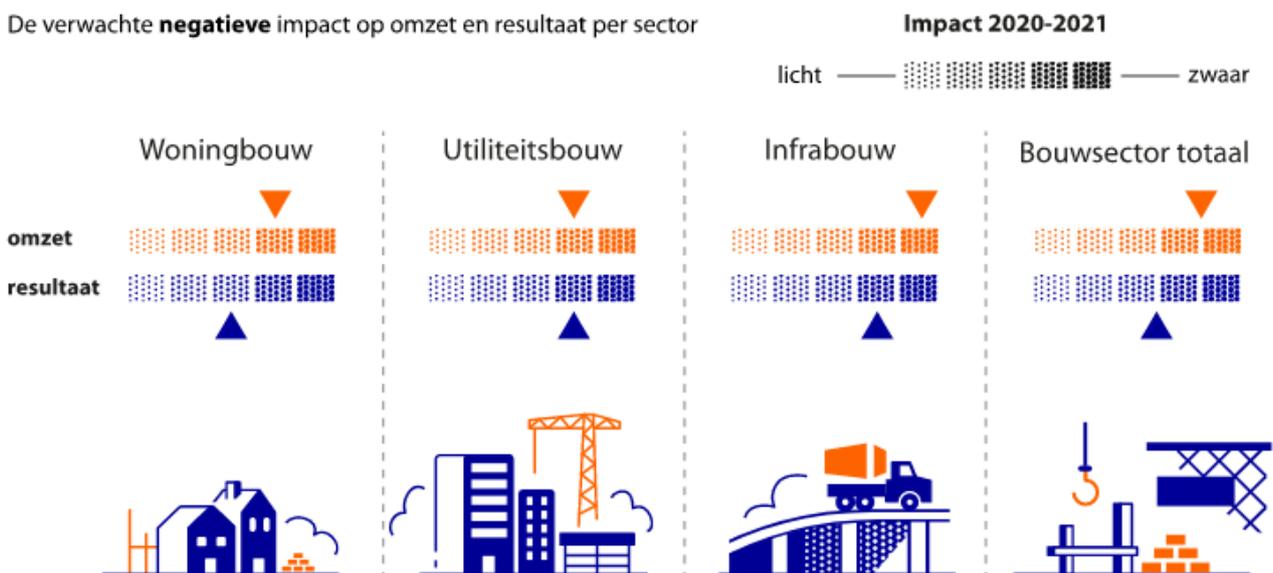
## 4 Politieke, Wettelijke en Milieufactoren

### PFAS, NO<sub>2</sub>, NH<sub>3</sub> en anderen wetten

Verschillende chemische stoffen waren de afgelopen tijd in het nieuws in Nederland. Hiervan zijn PFAS, stikstof en ammoniak de meest beruchte. Door strengere regelgeving zijn er meerdere bouwprojecten stilgelegd in wat de stikstofcrisis genoemd werd [50]. De impact van deze crisis is te zien in figuur 12 hieronder. Uiteindelijk heeft de overheid ervoor gekozen om de maximumsnelheden op snelwegen te verlagen, samen met enkele andere noodmaatregelen, waardoor de bouwwerkzaamheden toch weer konden worden voortgezet [51].

Bouwbedrijven zoeken naar nieuwe oplossingen om met dit soort stoffen om te gaan, waarbij ze moeten anticiperen op strengere regelgeving door de overheid in de toekomst. Ook andere regelgevingen kunnen een rol gaan spelen; zo zijn onlangs nieuwe geluidsnormen aangenomen die ervoor zouden moeten zorgen dat de bouwplaatsen stiller worden [52].

Overheidsmaatregelen blijken een van de lastigste fenomenen te zijn om te voorspellen, zeker over een langere periode.



Figuur 12: verwachte negatieve impact van de stikstofcrisis op de bouwbranche [53]

### Duurzaamheid

De Nederlandse overheid heeft in 2015 de klimaatakkoorden van Parijs getekend. Dit akkoord is ontwikkeld door de Verenigde Naties en heeft als doel om de effecten van de opwarming van de aarde te verminderen [54]. In Nederland is het eerste doel om CO<sub>2</sub> emissies met 50% te verminderen in 2030 (vergeleken met de niveaus van 1990) [55]. De overheid, in samenwerking met brancheorganisaties, verwacht dit doel te bereiken door met name het gebruik van aardgas te verminderen [56]. Ook wil men renovaties gaan stimuleren (die vaak gepaard gaan met energiebesparende maatregelen), het gebruik van warmtepompen stimuleren en zogenaamde ‘Nul-op-de-meter’-woningen produceren. De overheid heeft hiervoor miljoenen vrijgemaakt. Het uiteindelijke doel is om Nederland klimaatneutraal te krijgen in 2050.

### Omgaan met water

De overheid in Nederland stimuleert het ‘klimaatproefen’ van huis en tuin. In de afgelopen jaren is de hoeveelheid zware neerslagbuien toegenomen, wat een grotere tol eist van ons afvalwatersysteem. Daarnaast wordt drinkwater mogelijk schaars in de toekomst. Om met deze zaken om te gaan kan bijvoorbeeld regenwater opgeslagen worden om hiermee het toilet door te spoelen [58]. Dit soort oplossingen bestaan al en worden toegepast door particulieren, een voorbeeld hiervan is te zien op onderstaande afbeelding 13 [59].



*Figuur 13: schematische weergave van een ‘grijswatersysteem’ [59]*

### **Alternatieve brandstoffen**

Het toepassen van waterstof is mogelijk interessant voor de toekomst. Wanneer er eenmaal een overschot aan energie wordt geproduceerd door middel van zonnepanelen en windmolens, kan dit overschot worden omgezet in waterstof. Deze brandstof kan vervolgens worden gebruikt in CV-installaties of in voertuigen [60]. Op den duur is het goed mogelijk dat waterstof (of andere brandstoffen) aardgas zal vervangen. Het beleid van de overheid is erop gericht om geen aardgas meer te gebruiken tegen 2050 [56]. Mogelijke andere alternatieven zijn: biobrandstoffen, synthetische brandstoffen en LPG [57].

### **Covid**

De effecten van de recente Covid-19 uitbraak zijn nog niet volledig duidelijk. Op dit moment werken er meer mensen thuis dan ooit tevoren. Mogelijk is dit een blijvende trend, wat een permanent effect zal hebben op de huizenvraag in Nederland. Immers, wanneer je niet meer naar kantoor hoeft, moet je dan nog in de Randstad gaan wonen? Op de korte termijn lijkt de uitbraak een negatief effect te hebben op de Nederlandse huizenmarkt. Over de middellange en lange termijn valt weinig zinnigs te zeggen [62]. Volgens ING zal de Nederlandse huizenmarkt ten minste 5% krimpen in 2021. Vooral de vraag naar nieuwbouwwoningen zal dalen [63]. Op het moment van schrijven is Nederland in de ban van de ‘tweede golf’, het is dan ook niet ondenkbaar dat er meer golven zullen volgen.

## 5 Conclusie

Het doel van dit rapport is om de lezers enkele handvaten te bieden betreffende het onderwerp, om zodoende tot meer inzicht te leiden. Wat niet het doel van dit rapport is, is het kwalificeren en kwantificeren van bepaalde trends, dan wel het bieden van een complete lijst van alle ter zake doende trends. Dat wil zeggen dat er geen concrete conclusies zullen worden getrokken over welke trend in welke mate zich zal voordoen de komende jaren. Dit is ook vrij lastig, aangezien niemand weet wat de toekomst zal brengen.

Een belangrijk punt om mee te nemen, na het onderzoeken van deze trends, is dat er een bepaalde mate van samenhang is tussen de verschillende trends. Vrijwel alle genoemde trends hebben een effect op de anderen. Zo zorgt bijvoorbeeld een groeiende bevolking voor een grotere vraag naar huizen, waar vanwege het personeelstekort dus weer een groeiende vraag ontstaat naar nieuwe technieken (3D-printen, robotisering, digitalisering).

Ook duurzaamheid is een vrij belangrijk punt. De overheid heeft hier samen met brancheorganisaties bepaalde doelen voor gesteld, met als ultieme doel een CO<sub>2</sub>-neutrale samenleving in 2050. Veel trends zijn door deze doelstellingen gevormd of zelfs bepaald.

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### **Dankbetuiging**

De auteur wil graag de volgende personen bedanken:

Hans de Jonge, emeritus professor Real Estate Management TU Delft

Ruben Vrijhoef, professor Building Future Cities Utrecht University

Frans Schilder, senior onderzoeker bij Planbureau voor de Leefomgeving (PBL)

voor het delen van hun kennis over de Nederlandse bouwbranche. Daarnaast bedankt de auteur:

Erwin Hofman, assistent professor Twente University

Joop Halman, emeritus professor Twente University

Robert Schuurings, directeur industrie bij VolkerWessels

Voor hun suggesties en feedback tijdens het opstellen van dit rapport.

## **Bijlage 1: lijst van trends**

Hieronder volgt een lijst van trends uit dit rapport in de volgorde waarin ze zijn beschreven:

### *Sociale and demografische factoren*

Toenemende bevolking

Daling van de huishoudgrootte

Verandering van de bevolkingssamenstelling (nationaliteit)

Verandering van de bevolkingssamenstelling (leeftijd)

Tekort aan mankracht

Huizentekort

Circulariteit

### *Economische en technologische factoren*

Materiaaltekorten

Servitization

Digitalisering

Prefabricatie en modulariteit

3D printen

Nieuwe materialen

Robotisering

### *Politieke, wettelijke en milieufactoren*

PFAS, NO<sub>2</sub>, NH<sub>3</sub> en andere wetten

Duurzaamheid

Omgaan met water

Alternatieve brandstoffen

Covid

## **Appendix E - Protocols of interview and session**

### **Interview protocol**

#### **Goal**

The goal is to build 2 scenarios per candidate, one positive scenario and one negative scenario based on the drivers suggested by the interviewee. The scenarios must be about the Dutch housing industry 2020-2040.

#### **Candidates**

Suggested list of candidates:

Marinus den Harder - COO VolkerWessels Bouw  
Luurt van der Ploeg - CFO VolkerWessels Bouw  
Martijn Luchjenbroers - Directeur VolkerWessels Projectontwikkeling  
Ron Brons - Directeur Veluwezoom Verkerk (woningbouw en renovatie)  
Alexander de Bonth - Directeur De Bonth van Hulten (renovatie)  
Wim Sturris - Directeur De Groot Vroomshoop (houtbouw)  
Lars van der Meulen - Directeur CSR VolkerWessels  
Eva de Ruiter - Mgt Primum  
Christine Wortmann - Mgt Primum  
Thomas Heye - Duurzaamheid Coördinator bij Boele & van Eesteren  
Jaap Hulshoff - Operationeel Directeur Hyrde (IoT)

#### **Before the interview**

Candidates are sent the ‘Trends in the Dutch housing industry’ report (translated in Dutch) along with a short explanation on the interview and the interview questions.

#### **Interview questions:**

Are there any trends you think are important, but that were not mentioned in the ‘Trends in the Dutch housing industry’ report?

Which five trends do you think will be the most important?

After selecting one trend, building two scenarios based on that trend (one positive, one negative):

- what will happen
- when will it happen
- where will it happen
- who will be affected
- why will it happen
- how will it happen

In the negative scenario, the threats for VolkerWessels will be emphasized. In the positive scenario, opportunities will be emphasized instead.

What will be the implications for VolkerWessels in this scenario?

What would be the best way for VolkerWessels to act in this scenario?

Which uncertainties play a role in this scenario?

**Result**

The result of the interview will be 2 scenarios, these will be send back to the interviewee for feedback. The scenarios will share base characteristics, but will differ from tone. One of the scenarios will be negatively toned in terms of possible threats to the company, the other one will be positively toned in terms of opportunities for the company.

End result of all interviews will be 24 scenarios, 12 positive and 12 negative, which will be used during the workshop.

**Form**

Name of the scenario	
Trend	
Description	
Implications	
Reaction	
Uncertainties	

## Scenario sessies 14-12-2020 + 17-12-2020

### Voorstelronde, kent iedereen elkaar al?

**Doel van vandaag:** enkele scenario's doornemen en beoordelen op basis van relevantie, plausibiliteit en impact. De rangschikking die zo ontstaat zal worden gebruikt als input voor de scenario-based roadmap.

### Scenario beoordelen:

#### 1. Beoordelen op basis van relevantie, plausibiliteit, impact

Relevantie: hoe relevant is dit scenario voor VolkerWessels? 1-5

- 1 = irrelevant
- 2 = een beetje relevant
- 3 = redelijk relevant
- 4 = relevant
- 5 = zeer relevant

Plausibiliteit: hoe groot is de kans dat dit scenario werkelijkheid wordt? 1-5

- 1 = gaat niet gebeuren
- 2 = gaat waarschijnlijk niet gebeuren
- 3 = 50/50
- 4 = gaat waarschijnlijk gebeuren
- 5 = gaat gebeuren

Impact: hoe groot is de impact van dit scenario op VolkerWessels, indien het zich voordoet? 1-5  
*Bij impact: denk aan financiële impact, maar ook aan andere soorten impact. Bijvoorbeeld wanneer men op een andere manier moet gaan produceren of bouwen.*

- 1 = geen impact op VolkerWessels
- 2 = kleine impact
- 3 = redelijke impact
- 4 = grote impact
- 5 = zeer grote impact op VolkerWessels

#### 2. Wat zijn de kansen en bedreigingen voor VolkerWessels in dit scenario?

#### 3. Op / aanmerkingen scenario

#### 4. Verschil positief / negatief scenario

Zijn er verschillen qua relevantie / plausibiliteit / impact?

## **Workshop protocol** (canceled and replaced by sessions)

### **Goal**

The goal is to assess the scenarios constructed by the workshop attendees during the previous phase of the research.

### **Candidates**

List of candidates is the same as with the interview protocol.

### **Before the workshop**

Candidates are individually interviewed, resulting in 2 scenarios per candidate. These are sent back to the candidate for confirmation and feedback.

### **Workshop schedule**

Proposed starting time: 08:00

Welcome / walk-in (07:45 – 08:00)

Introduction / explanation (08:00 – 08:30)

- Introduction of researcher (5 min.)
- About the research (5 min.)
- About scenarios, scenario-based roadmapping (5 min.)
- About the goal of this workshop (5 min.)
- Explanation of what is expected of the attendees (5 min.)
- Elaboration on the outcome of the interviews (5 min.)

Scenario assessment (08:30 – 09:30)

- Dividing the group in subgroups of 3
  - Subgroups each receive 12 scenarios and do the following:
  - Assessment of the scenario in terms of relevance and plausibility (2,5 minutes per scenario)
  - Short description of opportunities and threats for VolkerWessels per scenario (2,5 minutes per scenario)

Coffee break (09:30 – 09:45)

Scenario ranking (09:45 – 10:45)

- Two subgroups of three are combined and discuss their findings (15 minutes)
- Ranking of scenarios, based on plausibility, feasibility and impact (30 minutes)
- Add possible timeframe (15 minutes)

Conclusion (10:45 – 11:45)

- Both groups of 6 present their top 6 scenarios (2,5 minutes per scenario)
- Discussion between all attendees (20 minutes)
- Final list is formed (10 minutes)

Concluding remarks (11:45 – 12:00)

- Explanation of what will be done with the results

**Result:** Scenarios will be assessed based on plausibility, relevance, feasibility and impact. After assessment, the top scenarios will be used to create a scenario-based roadmap.

## Appendix F - Scenarios

Naam scenario	Nieuwe materialen (positief)
Trend	Materiaaltekorten / nieuwe materialen
Description	<p>Materiaaltekorten zullen de komende jaren toenemen, wat leidt tot een prijsstijging van het materiaal. De hele keten zal hiermee te maken krijgen, wat leidt tot een stijgende prijs van het eindproduct (de huizen). Door de stijgende prijs van materiaal zal de vraag naar nieuwe materialen toenemen, wat nicheproducenten in staat zal stellen om op te schalen en in het gat te springen.</p> <p>In 2040 zullen er wijken zijn die volledig zijn opgebouwd van nieuwe, duurzame materialen. Hout zal met name gebruikt worden voor de dragende delen, nieuwe composieten zullen gebruikt worden voor de afwerking.</p> <p>De verandering zal geleidelijk gaan, aangezien de klant (bewoner) niet snel overtuigd zal zijn van het nieuwe materiaal. De voorkeur voor 'ouderwetse' bakstenen zal langzaam verdwijnen.</p>
Gevolgen voor VolkerWessels	Veel kansen omdat er veel kennis is op het gebied van houtbouw (de Groot Vroomshoop). Deze kennis kan worden verspreid.
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Wijzigingen in de organisatiestructuur (relevante onderdelen laten groeien, irrelevante afstoten)</li> <li>– Concernoplossing bedenken (algemene strategie, concernbrede samenwerking, brede winst/risicovisie ontwikkelen)</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Verscheidenheid van mensen (adaptief vermogen van de organisatie)</li> <li>– Snelheid van het scenario (hoe snel worden de nieuwe materialen relevant?)</li> <li>– Onzekerheid in de ontwikkeling van de nieuwe materialen (kan overheid/regelgeving, organisatie, markt het bijbenen?)</li> </ul>

Score relevantie: 5

Score plausibiliteit: 3

Score impact: 3. In de brede zin, vrij laag.

Naam scenario	Nieuwe materialen (negatief)
Trend	Materiaaltekorten / nieuwe materialen
Description	<p>Materiaaltekorten zullen de komende jaren toenemen, wat leidt tot een prijsstijging van het materiaal. De hele keten zal hiermee te maken krijgen, wat leidt tot een stijgende prijs van het eindproduct (de huizen). Door de stijgende prijs van materiaal zal de vraag naar nieuwe materialen toenemen, wat nicheproducenten in staat zal stellen om op te schalen en in het gat te springen.</p> <p>In 2040 zullen er wijken zijn die volledig zijn opgebouwd van nieuwe, duurzame materialen. Hout zal met name gebruikt worden voor de dragende delen, nieuwe composieten zullen gebruikt worden voor de afwerking.</p> <p>De verandering zal geleidelijk gaan, aangezien de klant (bewoner) niet snel overtuigd zal zijn van het nieuwe materiaal. De voorkeur voor 'ouderwetse' bakstenen zal langzaam verdwijnen.</p>
Gevolgen voor VolkerWessels	<p>Het eindproduct zal duurder worden / eventueel wordt er kleiner gebouwd</p> <p>De organisatie kan achter de feiten aan gaan lopen en op termijn niet meer relevant / concurrerend zijn</p>
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Wijzigingen in de organisatiestructuur (relevante onderdelen laten groeien, irrelevante afstoten)</li> <li>– Concernoplossing bedenken (algemene strategie, concernbrede samenwerking, brede winst/risicovisie ontwikkelen)</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Verscheidenheid van mensen (adaptief vermogen van de organisatie)</li> <li>– Snelheid van het scenario (hoe snel worden de nieuwe materialen relevant?)</li> <li>– Onzekerheid in de ontwikkeling van de nieuwe materialen (kan overheid/regelgeving, organisatie, markt het bijbenen?)</li> </ul>

Naam scenario	Verstedelijking (positief)
Trend	Woningtekort, huishoudgrootte, verstedelijking
Description	<p>De trek naar de stad zal de komende 20 jaar blijven doorzetten. Dit houdt in dat de G30 (circa alle steden in Nederland met 100.000+ inwoners) zal stijgen qua inwoneraantal. Buiten deze gebieden zal het inwoneraantal min of meer gelijk blijven.</p> <p>De beperkte ruimte in de G30 zorgt ervoor dat de bouw verder de hoogte in gaat. Mogelijk zal dit ook buiten de G30 plaatsvinden, maar hier zal dat minder urgent zijn.</p> <p>Het gemiddelde woonoppervlak zal kleiner worden. Dit komt door de beperkte ruimte en de daling van de huishoudgrootte.</p>
Gevolgen voor VolkerWessels	<ul style="list-style-type: none"> <li>– Groei is van belang voor VolkerWessels. In dit geval zal er groei zijn in de steden, wat een positief gevolg is</li> <li>– Verdichting in de steden vraagt om meer kennis en financiële slagkracht. Deze zaken zijn aanwezig bij VolkerWessels</li> </ul>
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Flexibel blijven. Schakelen op veranderingen, waarbij de macrotrends blijvend in de gaten gehouden worden</li> <li>– Kritisch kijken naar langetermijnsprojecten, waarbij de lange duur mogelijk teveel risico oplevert</li> <li>– Focus leggen op te verwerven grondposities in de G30</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Kwaliteit van het personeel. Deze verdichting levert complexere projecten op wat meer kennis en kunde vraagt van personeel</li> <li>– Algemene onzekerheden (pandemieën bijvoorbeeld. Dit kan de mate van verstedelijking beïnvloeden)</li> <li>– Wispelturigheid van (lokale) politiek. Meer focus op kortetermijnwinst door lokale politiek levert onzekerheid voor projecten op middellange termijn</li> </ul>

Score relevantie: 4

Score plausibiliteit: 4,5

Score impact: 4 – Hoog.

Naam scenario	Verstedelijking (negatief)
Trend	Woningtekort, huishoudgrootte, verstedelijking
Description	<p>De trek naar de stad zal de komende 20 jaar blijven doorzetten. Dit houdt in dat de G30 (circa alle steden in Nederland met 100.000+ inwoners) zal stijgen qua inwoneraantal. Buiten deze gebieden zal het inwoneraantal min of meer gelijk blijven.</p> <p>De beperkte ruimte in de G30 zorgt ervoor dat de bouw verder de hoogte in gaat. Mogelijk zal dit ook buiten de G30 plaatsvinden, maar hier zal dat minder urgent zijn.</p> <p>Het gemiddelde woonoppervlak zal kleiner worden. Dit komt door de beperkte ruimte en de daling van de huishoudgrootte.</p>
Gevolgen voor VolkerWessels	<ul style="list-style-type: none"> <li>– Verdichting in de grote steden geeft complexere projecten. Deze zijn foutgevoeliger en leveren dus meer risico</li> <li>– De prijs zal waarschijnlijk gaan stijgen</li> </ul>
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Flexibel blijven. Schakelen op veranderingen, waarbij de macrotrends blijvend in de gaten gehouden worden</li> <li>– Kritisch kijken naar langetermijnsprojecten, waarbij de lange duur mogelijk teveel risico oplevert</li> <li>– Focus leggen op te verwerven grondposities in de G30</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Kwaliteit van het personeel. Deze verdichting levert complexere projecten op wat meer kennis en kunde vraagt van personeel</li> <li>– Algemene onzekerheden (pandemieën bijvoorbeeld. Dit kan de mate van verstedelijking beïnvloeden)</li> <li>– Wispelturigheid van (lokale) politiek. Meer focus op kortetermijnwinst door lokale politiek levert onzekerheid voor projecten op middellange termijn</li> </ul>

Naam scenario	Circulariteit (positief)
Trend	Circulariteit, milieu, CO2
Description	<p>De gemiddelde huizenprijs stijgt, doordat er een tekort aan locaties is en de gemiddelde huishoudensgrootte verder daalt.</p> <p>Vervuiling en uitstoot nemen de komende jaren verder toe. De politiek grijpt in om deze vervuiling en uitstoot een halt toe te roepen. Dit zal traag gaan, maar er zal nieuwe wet- en regelgeving komen. Hierdoor zal de vraag naar circulaire woningen toenemen. Deze vraag zal niet vanuit de eindgebruikers komen, maar vanuit opdrachtgevers en nieuwe wetgeving.</p>
Gevolgen voor VolkerWessels	– VolkerWessels heeft de kennis in huis om met deze toenemende vraag naar circulaire woningen om te gaan
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– De focus moet liggen op het ontwikkelen van de juiste duurzame producten</li> <li>– Tijdig voorbereiden en lobby'en</li> <li>– Wachten op de nieuwe wetgeving</li> <li>– Verder doorontwikkelen van relevante concepten (bijvoorbeeld PuurWonen)</li> </ul>
Onzekerheden	– Het gebruik van nieuwe materialen bij circulaire woningen kan onvoorziene gevolgen hebben

Score relevantie: 3,5

Score plausibiliteit: 4 – dit gebeurt eigenlijk nu al

Score impact: 3 – het zal heel geleidelijk gaan

Naam scenario	Circulariteit (negatief)
Trend	Circulariteit, milieu, CO2
Description	<p>De gemiddelde huizenprijs stijgt, doordat er een tekort aan locaties is en de gemiddelde huishoudensgrootte verder daalt.</p> <p>Vervuiling en uitstoot nemen de komende jaren verder toe. De politiek grijpt in om deze vervuiling en uitstoot een halt toe te roepen. Dit zal traag gaan, maar er zal nieuwe wet- en regelgeving komen. Hierdoor zal de vraag naar circulaire woningen toenemen. Deze vraag zal niet vanuit de eindgebruikers komen, maar vanuit opdrachtgevers en nieuwe wetgeving.</p>
Gevolgen voor VolkerWessels	– Dreiging vanuit startups/scaleups die VolkerWessels zullen gaan beconcurreren op dit gebied
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– De focus moet liggen op het ontwikkelen van de juiste duurzame producten</li> <li>– Tijdig voorbereiden en lobby'en</li> <li>– Wachten op de nieuwe wetgeving</li> <li>– Verder doorontwikkelen van relevante concepten</li> </ul>
Onzekerheden	– Het gebruik van nieuwe materialen bij circulaire woningen kan onvoorziene gevolgen hebben

Naam scenario	Industrialisatie (positief)
Trend	Industrialisatie, prefabricage
Description	<p>De vraag naar duurzame woningen zal de komende jaren stijgen. Ook de vraag naar <i>verduurzaamde</i> woningen zal stijgen.</p> <p>Vanuit corporaties zal een vraag ontstaan voor een totaalaanbod als het gaat om wijkinrichting: een combinatie van nieuwbouw/renovatie/omgeving.</p> <p>Corporaties zullen op zoek gaan naar een partij die in staat is om op grote schaal duurzame woningen te produceren en tegelijkertijd bestaande woningen kan verduurzamen.</p>
Gevolgen voor VolkerWessels	<ul style="list-style-type: none"> <li>– Enige mate van prefabricage en industrialisatie zullen nodig zijn om aan deze vraag te voldoen</li> <li>– Kansen voor het plusappartementen concept bij binnenstedelijke bouw</li> <li>– Er zijn goede marges te behalen bij renovatie / verduurzaming</li> </ul>
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Ideeën/concepten ontwikkelen om een totaalaanbod op het gebied van wijkinrichting te vormen</li> <li>– Focus leggen op het vermarkten van deze concepten (het concept moet niet alleen technisch worden ontwikkeld, ook het verhaal erachter moet worden ontwikkeld teneinde het beter te kunnen verkopen).</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Afhankelijkheid van derden</li> <li>– Stabiliteit van zowel rente als (inter)nationale politiek</li> <li>– Nieuwe concepten moeten bewezen worden voordat ze ‘aanslaan’</li> </ul>

Score relevantie: 4

Score plausibiliteit: 3,5 / 4

Score impact: 4

Naam scenario	Industrialisatie (negatief)
Trend	Industrialisatie, prefabricage
Description	<p>De vraag naar duurzame woningen zal de komende jaren stijgen. Ook de vraag naar <i>verduurzaamde</i> woningen zal stijgen.</p> <p>Vanuit corporaties zal een vraag ontstaan voor een totaalaanbod als het gaat om wijkinrichting: een combinatie van nieuwbouw/renovatie/omgeving.</p> <p>Corporaties zullen op zoek gaan naar een partij die in staat is om op grote schaal duurzame woningen te produceren en tegelijkertijd bestaande woningen kan verduurzamen.</p>
Gevolgen voor VolkerWessels	– Andere partijen zullen VW beconcurreren bij het verduurzamen van woningen, denk hierbij aan grote schildersbedrijven die zich hierin gaan specialiseren
Hoe moet VolkerWessels hiermee omgaan?	<p>– Ideeën/concepten ontwikkelen om een totaalaanbod op het gebied van wijkinrichting te vormen</p> <p>– Focus leggen op het vermarkten van deze concepten (het concept moet niet alleen technisch worden ontwikkeld, ook het verhaal erachter moet worden ontwikkeld teneinde het beter te kunnen verkopen).</p>
Onzekerheden	<p>– Afhankelijkheid van derden</p> <p>– Stabiliteit van zowel rente als (inter)nationale politiek</p> <p>– Nieuwe concepten moeten bewezen worden voordat ze ‘aanslaan’</p>

Naam scenario	Klimaatverandering (positief)
Trend	Klimaatverandering, energie, leefomgeving
Omschrijving	<p>De klimaatverandering zal de komende jaren doorzetten. Dit heeft tot gevolg dat de grond verder uitdroogt en op bepaalde plaatsen zal verzakken.</p> <p>Om dit te bestrijden zal er enerzijds moeten worden gekeken naar het duurzamer omgaan met alle grondstoffen die zowel bij de bouw als tijdens gebruik worden gebruikt: werken in kringlopen is van belang voor zowel water, energie, als alle bouwmaterialen. Daarbij zal ook van belang zijn om de mogelijkheden te ontwikkelen wat betreft sparen, hergebruiken en vervangen van energie, energiebronnen en materialen. Dit heeft tot gevolg dat er moet worden gekeken naar het klimaatbestendig en energiezuinig/energie neutraal maken van woningen.</p> <p>Dit laatste zal leiden tot nieuwe innovaties en meer functiemenging (bijvoorbeeld het delen van warmte).</p> <p>Een gevolg van deze toenemende spaarzaamheid zal zijn dat fysieke mobiliteit van personen zal afnemen en mensen zich meer in hun eigen directe omgeving zullen bevinden. De directe leefomgeving zal dus een grotere rol gaan spelen voor de eindgebruiker. Hierbij zal de traditionele wijkindeling opnieuw moeten worden bekeken, inclusief stedenbouwkundig plan en nutsleidingen.</p>
Gevolgen voor VolkerWessels	<ul style="list-style-type: none"> <li>– Veel kansen op het gebied van innovatie</li> <li>– Mogelijkheden om uit te breiden naar gebiedsontwikkeling / wijkontwikkeling</li> </ul>
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Lange termijnvisie creëren om met deze veranderingen om te kunnen gaan en de nodige kennis in huis nemen</li> <li>– Nieuwe businessmodellen creëren omtrent circulariteit</li> <li>– Een duurzaam verhaal creëren richting de opdrachtgevers</li> <li>– Nieuwe samenwerkingen aangaan met publieke (overheids-)partners</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Er wordt meer gevraagd van partners en overheden</li> <li>– Er zal anders moeten worden gedacht, wat lastig is voor een zeer traditionele branche</li> <li>– De nodige samenwerkingen en denkwijzen bestaan op dit moment nog niet</li> </ul>

Score relevantie: 5

Score plausibiliteit: 5

Score impact: 3 – we lopen net zo snel als de rest

Naam scenario	Klimaatverandering (negatief)
Trend	Klimaatverandering, energie, leefomgeving
Omschrijving	<p>De klimaatverandering zal de komende jaren doorzetten. Dit heeft tot gevolg dat de grond verder uitdroogt en op bepaalde plaatsen zal verzakken.</p> <p>Om dit te bestrijden zal er enerzijds moeten worden gekeken naar het duurzamer omgaan met alle grondstoffen die zowel bij de bouw als tijdens gebruik worden gebruikt: werken in kringlopen is van belang voor zowel water, energie, als alle bouwmaterialen. Daarbij zal ook van belang zijn om de mogelijkheden te ontwikkelen wat betreft sparen, hergebruiken en vervangen van energie, energiebronnen en materialen. Dit heeft tot gevolg dat er moet worden gekeken naar het klimaatbestendig en energiezuinig/energie neutraal maken van woningen.</p> <p>Dit laatste zal leiden tot nieuwe innovaties en meer functiemenging (bijvoorbeeld het delen van warmte).</p> <p>Een gevolg van deze toenemende spaarzaamheid zal zijn dat fysieke mobiliteit van personen zal afnemen en mensen zich meer in hun eigen directe omgeving zullen bevinden. De directe leefomgeving zal dus een grotere rol gaan spelen voor de eindgebruiker. Hierbij zal de traditionele wijkindeling opnieuw moeten worden bekeken, inclusief stedenbouwkundig plan en nutsleidingen.</p>
Gevolgen voor VolkerWessels	<ul style="list-style-type: none"> <li>– Ontwikkelen van nieuwe woningen wordt duurder</li> <li>– Hogere eisen voor woningen/wijken</li> </ul>
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Lange termijnvisie creëren om met deze veranderingen om te kunnen gaan en de nodige kennis in huis nemen</li> <li>– Nieuwe businessmodellen creëren omtrent circulariteit</li> <li>– Een duurzaam verhaal creëren richting de opdrachtgevers</li> <li>– Nieuwe samenwerkingen aangaan met publieke (overheids-)partners</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Er wordt meer gevraagd van partners en overheden</li> <li>– Er zal anders moeten worden gedacht, wat lastig is voor een zeer traditionele branche</li> <li>– De nodige samenwerkingen en denkwijzen bestaan op dit moment nog niet</li> </ul>

Naam scenario	Flexibiliteit (positief)
Trend	Flexibiliteit, customization, remontabelheid, duurzaamheid, circulariteit
Description	<p>Het aanbod van smarthomes / eenvoudig aanpasbare woningen zal stijgen. De vraag hiernaar zal pas stijgen als de uiteindelijke bewoner weet wat mogelijk is (<i>technology push</i>). Dit zal beantwoord worden door eenvoudig tot casco te strippen woningen op de markt te brengen die makkelijk en flexibel in te vullen zijn.</p> <p>De focus van woningen zal verlegd worden van het eenvoudig neerzetten van woningen naar de totale levensduur. De woningen kunnen door kleine, flexibele monteursgroepen worden neergezet / omgebouwd / gedemonteerd.</p> <p>De klassieke aannemer zal meer risicogestuurd worden; de gevolgen hiervan zullen worden doorberekend naar de klant. Service en beheer zullen belangrijker worden.</p>
Gevolgen voor VolkerWessels	– Mogelijkheden tot het ontwikkelen van concepten hieromtrent, hiervoor is genoeg kennis en kunde in huis
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Positie van de klassieke aannemer heroverwegen</li> <li>– Blijvend (her)ontwikkelen van nieuwe bouwstandaarden</li> <li>– Kennis hieromtrent bundelen en informatievoorziening stroomlijnen</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Onbekend welke partijen dit soort woningen als eerste zullen vermarkten</li> <li>– De vraag is of het aanbod vanuit de ‘klassieke’ aannemerij zal komen of vanuit andere (nieuwe?) aanbieders</li> </ul>

Score relevantie: 3

Score plausibiliteit: 4

Score impact: 3

Naam scenario	Flexibiliteit (negatief)
Trend	Flexibiliteit, customization, remontabelheid, duurzaamheid
Description	<p>Het aanbod van smarthomes / eenvoudig aanpasbare woningen zal stijgen. De vraag hiernaar zal pas stijgen als de uiteindelijke bewoner weet wat mogelijk is (<i>technology push</i>). Dit zal beantwoord worden door eenvoudig tot casco te strippen woningen op de markt te brengen die makkelijk en flexibel in te vullen zijn.</p> <p>De focus van woningen zal verlegd worden van het eenvoudig neerzetten van woningen naar de totale levensduur. De woningen kunnen door kleine, flexibele monteursgroepen worden neergezet / omgebouwd / gedemonteerd.</p> <p>De klassieke aannemer zal meer risicogestuurd worden; de gevolgen hiervan zullen worden doorberekend naar de klant. Service en beheer zullen belangrijker worden.</p>
Gevolgen voor VolkerWessels	– Verticale ketenintegratie door leveranciers zal doorzetten, waarmee zij mogelijk VolkerWessels direct kunnen beconcurreren met het neerzetten / ombouwen / demonteren van de woningen. Deze kunnen direct aan de eindgebruiker geleverd worden.
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Positie van de klassieke aannemer heroverwegen</li> <li>– Blijvend (her)ontwikkelen van nieuwe bouwstandaarden</li> <li>– Kennis hieromtrent bundelen en informatievoorziening stroomlijnen</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– Onbekend welke partijen dit soort woningen als eerste zullen vermarkten</li> <li>– De vraag is of het aanbod vanuit de ‘klassieke’ aannemerij zal komen of vanuit andere (nieuwe?) aanbieders</li> </ul>

Naam scenario	Verduurzaming (positief)
Trend	Verduurzaming, wetgeving, industrialisatie / prefabricage
Beschrijving	<p>Strengere wet- en regelgeving zorgt ervoor dat corporaties hun huidige woningbestand de komende jaren moeten verduurzamen. De komende jaren zullen de corporaties hun bezit in kaart brengen en zullen ze een plan van aanpak creëren om de verduurzaming te bewerkstelligen.</p> <p>De opgave is zeer groot. Het gaat om veel woningen in Nederland die, gezien de verschillende klimaatakkoorden, op relatief korte termijn moeten worden aangepakt.</p> <p>Het verduurzamen van al deze woningen wordt een uitdaging, aangezien er op dit moment zowel een tekort aan geld als aan marktcapaciteit is. De komende jaren zullen deze tekorten niet zijn opgelost.</p>
Gevolgen voor VolkerWessels	<ul style="list-style-type: none"> <li>– Er is vraag naar verduurzaming, dus genoeg werk</li> <li>– Kans om je te onderscheiden als VolkerWessels</li> </ul>
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Inzetten op industrialisatie (in dit geval specifiek op renovatiegebied)</li> <li>– Financiële slagkracht gebruiken om te innoveren</li> <li>– Met corporaties onderzoeken of langetermijncontracten mogelijk zijn</li> </ul>
Onzekerheden	<ul style="list-style-type: none"> <li>– De vraag wordt gedreven door overheidsbeleid. Wanneer dit beleid verandert, verandert de vraag mogelijk mee</li> </ul>

Score relevantie: 2,5

Score plausibiliteit: 5

Score impact: 2,5

Naam scenario	Verduurzaming (negatief)
Trend	Verduurzaming, wetgeving, industrialisatie / prefabricage
Omschrijving	<p>Strengere wet- en regelgeving zorgt ervoor dat corporaties hun huidige woningbestand de komende jaren moeten verduurzamen. De komende jaren zullen de corporaties hun bezit in kaart brengen en zullen ze een plan van aanpak creëren om de verduurzaming te bewerkstelligen.</p> <p>De opgave is zeer groot. Het gaat om veel woningen in Nederland die, gezien de verschillende klimaatakkoorden, op relatief korte termijn moeten worden aangepakt.</p> <p>Het verduurzamen van al deze woningen wordt een uitdaging, aangezien er op dit moment zowel een tekort aan geld als aan marktcapaciteit is. De komende jaren zullen deze tekorten niet zijn opgelost.</p>
Gevolgen voor VolkerWessels	– Corporaties werken liever samen met onderaannemers, waardoor de klassieke aannemer een onnodige tussenpersoon is geworden
Hoe moet VolkerWessels hiermee omgaan?	<ul style="list-style-type: none"> <li>– Inzetten op industrialisatie (in dit geval specifiek op renovatiegebied)</li> <li>– Financiële slagkracht gebruiken om te innoveren</li> <li>– Met corporaties onderzoeken of langetermijncontracten mogelijk zijn</li> </ul>
Onzekerheden	– De vraag wordt gedreven door overheidsbeleid. Wanneer dit beleid verandert, verandert de vraag mogelijk mee