

Risk-aware roadmapping: A scenario-based approach for roadmapping workshops

An evaluation of the City Logistics Case in the Netherlands

J.M.O. Bauwens¹

System Engineering, Policy Analysis and Management, Delft University of Technology

Abstract: Roadmapping is a useful graphical tool to structure the development of a strategic plan within the broader picture of a sector. However, it seems that most of the roadmaps are not respected over years. Likely this is because over 90% of the roadmaps do not deal with uncertainty and risk. This paper seeks for means to incorporate uncertainty in the roadmapping process. Including context scenarios in the roadmapping workshops helps to take future uncertainty into account. The approach of the city logistic roadmap in the Netherlands is evaluated. It can be concluded that the scenario design is just as important as the roadmap itself in risk-aware roadmapping. But the findings of this paper have to be verified by monitoring roadmaps that included scenarios and uncertainties.

Keywords: Pathways, Roadmapping, Scenarios, Strategic Planning, Uncertainty

1 Introduction to roadmapping

City logistics in the Netherlands is a domain that is on a tipping point of change. Slowly there is an awareness that the urban freight distribution does not meet the targets in terms of liveability (Quak, 2008; van Rooijen & Quak, 2010). Urban freight transport is considered of great importance in maintaining the economic vitality of the city. However, the negative impacts imposes benefits of the urban freight transport (Anderson et al., 2005). There are negative impacts on the planet (pollutant emissions), on the people (nuisance and accidents) and on profit (inefficient use of resources, congestion and decreasing accessibility) (Quak, 2008). In November 2014 the Dutch government, the local government and various logistics parties signed a covenant: the Green Deal Zero Emission Stadslogistiek, Green Deal ZES (Rijksoverheid, 2014). The cooperating parties together develop and intensify activities that contribute towards an acceleration of zero emission city logistics. They committed themselves from their own responsibilities and tasks, at least until January 2020 (Rijksoverheid, 2014).

Despite of the covenant and its intentions of the parties, there is an absence of significant changes (Ploos van Amstel, 2015; Tjalma, 2015). The stakeholders are not able to enforce changes in urban logistics to make the urban environment more sustainable. The actions are being postponed, so there is a lack of vigour of the stakeholders. Various studies show city logistic concepts that can contribute to the liveability in the city. However, due to a lack of coordination, it is not clear which stakeholder is responsible for what action and when to act in time. Various techniques are available that have been or are being applied for supporting planning under deep uncertainty, for example Robust Decision Making, decision trees, roadmaps, and several policy planning approaches (Haasnoot et al., 2013). The focus of the paper is on the roadmap that is used for city logistics. Strategic Roadmapping for city logistics may help to coordinate the possible actions. But according to Ilevbare et al. (2014) there is a general lack of attention to uncertainty across the majority of published roadmaps, although uncertainty and risk are fundamental aspects of strategic planning (Noy, 1998; Ruefli et al., 1999).

The aim of this paper is to develop a methodology in order to cope with uncertainty in roadmap planning. By including uncertainty in the roadmap, it improves the likelihood that the roadmap is being respected. The use of scenarios in roadmapping may help to level the intentions for urban freight transport with the covenant's proposition. Uncertainty and risk should be incorporated in the strategic planning and innovation. The inclusion of scenarios in the workshop design for city logistics is tested in this paper.

¹ Corresponding Author.

E-mail address: J.M.O.Bauwens@student.tudelft.nl (J.M.O. Bauwens).

A literature review gives insights in how the existing roadmaps deal with risk and uncertainty and to see how strategic planners can improve the roadmaps by including uncertainties. A case study is done to see how the dynamic roadmap for city logistics in the Netherlands copes with uncertainty by using scenarios. The paper evaluates the approach of the case study on the theory that is used and on the results of the workshop. It provides insights in the improvements compared to previous roadmaps and proposes the main considerations for new roadmaps.

The structure of the paper is as follows. Chapter 2 describes the literature review about the lack of risks and uncertainty in roadmapping. Chapter 3 elaborates on the theory used of scenarios in the development of the roadmap for city logistics in the Netherlands. Chapter 4 presents and evaluates the results of the workshop 'Roadmap Urban Logistics 2025' and its use of scenarios. This chapter also evaluates the contribution of the scenarios for roadmapping. Chapter 5 reflects on the findings of this paper and suggests next steps for risk-aware roadmapping.

2 Literature review of uncertainty in roadmapping

Roadmapping is a powerful and flexible technique for supporting strategic planning. In literature many approaches of roadmapping exist. Studies can be found about proven frameworks to deliver a process or policy design. The roadmap template is used to capture, structure and share knowledge about the area of interest. The roadmap designed for city logistics is for strategic appraisal purposes. It provides a tool for identifying and assessing strategic issues, leading to agreement with strategic planners on appropriate actions (Phaal et al., 2004a).

Roadmapping and its many derivatives, is one of the most used management tools for supporting innovation and strategy. Roadmaps are used at companies, sector and national levels (Phaal & Muller, 2009). Roadmapping enables to draw together the propositions in literature and the innovative solutions. Roadmaps are mostly represented in a layered structure of solution strategies together with a dimension of time (Lee et al., 2015). Roadmaps can also be used for illustrating the sequence of actions in time (Phaal et al., 2004b; Phaal et al., 2009; Robinson & Propp, 2008). The two key elements of customization within a particular context are architecture and process (Phaal et al., 2004a).

The approach of roadmapping exists in two forms: qualitative and quantitative approaches. For each approach there are different purposes. Regarding qualitative approaches there are the following approaches: List (2004) developed a network-based scenario approach to enable the consideration of multiple views of the present and the past, and Saunders (2009) uses a visual technique to collect scenario planning information based on collage construction. Robinson and Propp (2008) addressed multi-path mapping as a means of aligning emerging science and technology. A qualitative roadmap remains conceptual and rely on graphical mapping tools. However, they are incapable of providing a concrete way to facilitate decision making against different future conditions (Ilevbare et al., 2010). The quantitative approach determines the success of actions and pathways in a quantitative manner. Therefore quantitative targets are needed, however, policymakers sometimes choose to keep these targets vague, making it difficult to determine the efficiency of an action and pathway (Haasnoot et al., 2013). A downside is that this approach needs lots of numerous data to analyse the system. Despite of a lack of data the dynamic roadmap use a quantitative approach in a qualitative way, since it provides a step-by-step approach to map dynamic actions. The stakeholders involved in the research are aware of the vulnerabilities in the system. However, they need guidance to turn these insights into actions, and therefor the roadmap is used.

Roadmapping seems to be a useful tool for strategic planners, but Wise et al. (2014) address issues in designing roadmaps. They found that where adaptation action had occurred, this was typically in sectors sensitive or considered to be sensitive to the impacts addressed in the roadmap (e.g., coastal zones, utilities, infrastructure and transport for climate change) and action had most often been implemented at the local scale and facilitated by federal governments. Another striking observation is that strategic planners do not take uncertainty into account. The study of Ilevbare et al. (2014) examined 650 roadmaps in the public domain. Only 10% of those roadmaps contained uncertainty or risk. Eleven of these roadmaps applied scenario techniques to deal with uncertainty or risk. Embedding uncertainty and risk in roadmaps is called 'risk-aware roadmapping'.

Although there is a lack of inclusion of uncertainty in roadmapping, there are growing efforts to get insight and develop methods and processes to support and inform adaptation research and decision-making (Wise et al., 2014). These efforts have focused on developing techniques and tools for dealing with uncertainty, risk and time horizons. Ranger et al. (2010); Weaver et al. (2013) developed decision-centred approaches that provide a complete and pragmatic guidance on scoping problems in complex settings. The decision-centred approaches also identify relevant information, for selecting decision-making methods that are appropriate to the level of uncertainty. Importantly, they also provide practical tools and procedures for incorporating adaptation principles and heuristics. Examples of adaptation principles and heuristics are developed by Fankhauser et al. (1999); Hallegatte (2009) and others when developing context-sensitive, 'no regrets', robust and flexible adaptation strategies. One of them is the use of context scenarios.

In order to overcome the lack of including uncertainties in roadmaps, this paper seeks for a tool that can improve the use of the roadmap. This is done by evaluating the approach of the dynamic roadmap of city logistics. The framework of the roadmap for city logistics is based on the Dynamic Adaptive Policy Pathway framework of Haasnoot et al. (2013). Both for the roadmap of city logistics in the Netherlands as for the roadmap for water management of the Rhine Delta in the Netherlands deals with uncertainty. This is done by including scenarios to identify potential risk and uncertainties in the future for each system. The following chapter elaborates on the theory of the scenarios used in the dynamic roadmap framework.

3 Use of scenarios for ‘risk-aware roadmapping’

This chapter deals with the theory behind scenarios as a tool for roadmapping. It deals with the critics of Wise et al. (2014) & Ilevbare et al. (2014) described in chapter 2. The logic for using scenarios is validated in the case study of city logistics roadmap in the Netherlands in chapter 3. The chapter substantiate that scenario analysis may help to increase the robustness of the roadmap. How the scenarios are used for roadmapping depends on the capabilities of the roadmapping approach, since it must match with the business issues that are being addressed (Phaal et al., 2004a).

3.1 The framework for dynamic roadmapping

The framework of the dynamic roadmapping is presented to get insight in the place of the scenarios in the approach. This section elaborates on two frameworks: the Dynamic Adaptive Policy Pathway framework and the Dynamic Roadmap framework, which is a derivative of the DAPP. The comparison between to frameworks give a better understanding in the position of the scenarios in the research. In the Dynamic Roadmap the scenarios are important since it is an essential source for the qualitative approach.

To deal with roadmapping in deep uncertain sectors, one can design dynamic adaptive plans (Haasnoot et al., 2013; Haasnoot et al., 2011; Hallegatte et al., 2012; Ranger et al., 2010; Swanson et al., 2010). To create a dynamic plan, a strategic vision of the future is required, and short-term actions will guide future actions. To cope with uncertainty in city logistics, a dynamic roadmap is designed. This roadmap is based on the framework that Haasnoot et al. (2013) have developed. The Dynamic Adaptive Policy Pathway (DAPP) is a method to deal with robust decisions in an uncertain world. However, the roadmap of Haasnoot et al. (2013) is based on a quantitative analysis in contrast to the city logistics’ roadmap. Figure 1 illustrates the transformation from framework of the Rhine Delta case in the Netherlands of Haasnoot et al. (2013) into the framework that is used in the city logistics roadmapping.

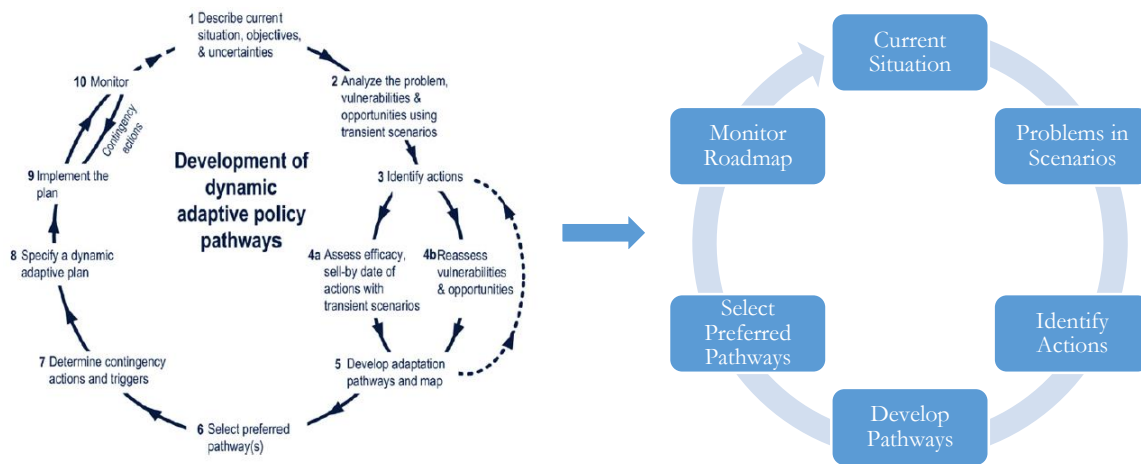


Figure 1: Transformation from DAPP to the Dynamic Roadmap framework

According to Phaal et al. (2004a) the capabilities of the roadmapping approach must be matched with the business issues being addressed. This is achieved through a collaborative and iterative design activity. Since the DAPP approach is too detailed for the purpose of the city logistic roadmap, it is slightly adapted. The main difference between the DAPP and the Dynamic Roadmap approach is that the DAPP deals with quantitative data. In the case of the DAPP research it is used to design a plan to control the water heights in the Rhine Delta (Haasnoot et al., 2013). Governing the water heights is mainly a case of investigating the raise of water level over the years, and the quantitative impact of the measurements. In contrast to the Rhine Delta case, the City Logistics case deals with a vaguer target: the definition of liveability contains more criteria. It is more difficult to make the aim liveability quantitative, therefore a qualitative approach is chosen. In other words, in the case of the Rhine Delta, the knowledge of system functioning is relatively certain: there is a central decision maker and he is easily identifiable, i.e. the water authorities. Next the goals are clearly

defined and uncontested, namely the maximum water height in meters. The water protection policy is an incalculable problem and suits to a reductionist approach in decision making (Rittel & Webber, 1973; Stirling & Scoones, 2009). The Rhine Delta case is a relatively closed systems with a central focus of power and unambiguous goals, i.e. safety against flooding and ensure adequate supplies of freshwater. The problem is largely a 'knowledge problem' and can be tackled through capability building and tools for decision making under uncertainty like scenarios (Ranger et al., 2010).

The city logistic sector on its turn faces a more complex challenge that consists of multiple objectives. The objectives of the stakeholders in city logistics should meet the following three broad-defined criteria: a minimum impact on the liveability (environment, noise, vibrations, congestion, safety and city scape), a more efficient logistic process (fully loaded vehicles and the concept of 'sending customers'), and high service for the receiving customer (delivery on-demand, flexible same-day-delivery). The three objectives are hard to contain in one objective. Nevertheless the approach of the DAPP is used, only in a quantitative way to deal with the ill-defined objective.

The DAPP of Haasnoot et al. (2013) elaborates also on the monitoring part of the roadmap, contrary to the city logistics case that does not identified the signposts. The aim of the Dynamic Roadmap framework should meet the objective: provide a dynamic roadmap for city logistics stakeholders in the Netherlands, using future scenarios. With a dynamic roadmap stakeholders can anticipate on what to do or not to do coming years, depending on actions of other stakeholders. What the rationale is behind the use of scenarios to design a robust roadmap is described in the next section.

3.2 The rationale behind scenarios

The rationality of using context scenarios for the development of a robust roadmap is discussed in this section. Context scenarios describes plausible futures in order to prepare and anticipate on potential future events, which makes a roadmap useful in different circumstances. The theory behind this philosophy can be used for designing other roadmaps. This section elaborates on the generation of the scenarios and substantiates to benefits of using future stories to deal with uncertainty.

The question is how context scenarios can contribute in the robustness of a roadmap design. If people are asked how the future will look like, many different views and descriptions will be told. For these stakeholders it is hard imaging how the future will affect the company or the logistic system. Scenarios are developed in order to help people empathize in plausible futures. In this chapter the generation of the scenarios is explained and substantiated to get support for the future stories. Developing scenarios is a process of multiple steps. For generating accepted future scenarios several steps need to be taken, in order to explore potential problems for the stakeholders in the future. Schwartz (1991) his view on scenarios is that the future is uncertain, but that the use of scenarios can help to prepare for it. Scenarios assemble possible futures in story form to help you make better decisions. This statement is aligned with the proposition that scenarios can be used for 'risk-aware roadmapping'.

Scenarios are developed in a few steps. First of all, an understanding of the urban logistics system is needed. This corresponds to the first step in Figure 1 of the Dynamic Roadmap approach. Because factors are complex, they interact and influence each other, relations are still relevant in the future. A literature review can help to describe the system, in the case of city logistics the study of Anand et al. (2012) is used. The depiction of the system can be illustrated in a black box. An example of a black box about a system is illustrated in Figure 2. The use of a black box is useful in three ways for roadmapping: criteria represent the targets that should be met, means describe the means of the stakeholders to influence the system to meet the targets, and external factors of a system determine how the system will be affected over time and those cannot be influenced by the problem owners, so these are relevant to address for scenario development (Enserink et al., 2013). A defined system helps strategic planners to understand the system's demarcation and assumptions on which a dynamic roadmap illustration is based.

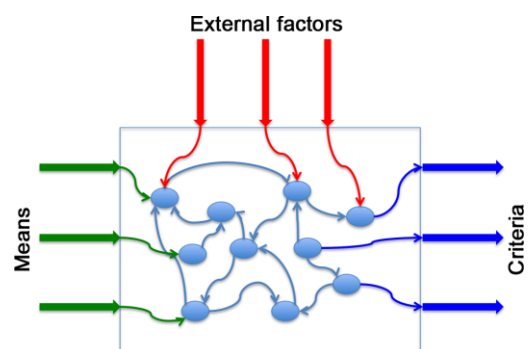


Figure 2: System diagram, adapted from Bots, Van Twist, and Van Duin (2000)

A defined system helps strategic planners to understand the system's demarcation and assumptions on which a dynamic roadmap illustration is based.

The second step is to design the scenarios, this corresponds to the second step in the framework of dynamic roadmapping as well, see Figure 1. The input of the black box is key to validate and reproduce the scenarios. In the case of city logistics the scenarios are reviewed by experts of the sector. They provided feedback on preliminary scenarios to improve the validation of the scenarios. A combination of the black box and interviews have resulted in

four orthogonal context scenarios about city logistics in 2025, which is presented in Figure 3. The scenarios are used as a tool for emphasizing with possible futures. They are developed with the aim to help people from the logistic business to think about future developments and possible problems. The objective of the scenarios is that stakeholders use it in their design to consider how they can make robust logistic system.

The scenarios are used to secure risk-aware roadmapping, since the scenarios cope with uncertainties. The dimensions in the matrix (Figure 3) are used as a starting point to describe plausible futures. Each scenario is located in a different quadrant of the matrix. In each of the plausible futures, the scenarios give insight for the stakeholders of city logistics in the pitfalls they have to overcome, the vulnerabilities of the system and the potential opportunities there are. They are able to test whether the robustness of their operations is sufficient to deal with the future. Since the contributors of the dynamic roadmap have this knowledge, they are able to take the uncertainties into account while they provide input for the roadmap. Using the scenarios in an early stage of roadmapping will ensure that risks and uncertainties are considered. This makes a roadmap more robust like Wise et al. (2014) and Ilevbare et al. (2014) argue.



Figure 3: Matrix of the dimensions in City Logistics

The next chapter presents the results of the use of the scenarios in the workshop that served as input generator for the dynamic roadmap of city logistics in the Netherlands. The approach explained in this chapter is evaluated in the results to get a better understanding in the contribution of scenarios for risk-aware roadmapping.

4 The contribution of the scenarios in the City Logistic case

This is the chapter that elaborates on the outcomes of the workshop that is used for roadmapping the city logistic strategy. This chapter follows on the theory of the use of scenarios that is described in chapter 3. The case of city logistics in the Netherlands is used to reflect and evaluate the contribution of the scenarios to the dynamic roadmap. The evaluation of the city logistic case helps to delineate a methodology to cope with uncertainty in roadmap planning.

4.1 The role of scenarios in the workshop of city logistic roadmapping

This section is about the setup of the workshop that functioned as input for the dynamic roadmap. The key premise in group meeting is that the successful integration of the various significant perspectives provides a higher quality basis for decision making (Witte, 2007). There are many input variables that determine the quality of the output of the workshop. This section elaborates on the different elements for the workshop configuration, like the aim of the workshop, venue, participants, facilitators, the program, and the output. This configuration explains the choices about the workshop.

Since the paper seeks for methodology to include risk and uncertainties in dynamic roadmaps, the focus is on the design of workshops to include risk and uncertainty. Workshop forums are considered as a key source for the data input and analysis (Kerr et al., 2012). Context scenarios seem to be a useful tool for dealing with uncertainty and risk, but the benefits and limitations of scenarios in roadmapping are not yet clear. Insight in how risk and uncertainties can be incorporated in the workshop for roadmapping is elaborated.

The setup of the workshop is of great importance in order to get the right results and to use the conclusions. In literature tools are described how to design an interactive and relevant workshop (Beer & Packard, 2012; Gastil, 1993; Kaner et al., 1996). The interaction between the parties provides informed consent about difficulties that have to be overcome. To include multiple perspectives in the dynamic roadmap, different stakeholders are invited to participate in the workshop. Roadmapping workshops are essentially a facilitated mechanism that involves a diverse group of participants for their experience and expertise in order to explore the opportunities and challenges facing a sector (Kerr et al., 2012). The function of a roadmapping workshop is to do a group assessment and to build consensus through combining the stakeholders' cognitive efforts. This represents the concept of human resource pooling (Dougherty, 1992; Hogg, 2000; Weingart et al., 2005) assuming that a group contains a collection of unique knowledge and perspectives distributed among the participants of the workshop.

The scenarios are used in the city logistics workshop as case for the working groups. The group is split up in smaller groups, each to deal with a different scenario. Because multiple scenarios have been worked out, the different scenarios can be compared to see whether roadmap patterns emerge (Kerr et al., 2012). If the pattern of various scenarios corresponds, it can be assumed that a roadmap can be respected in different circumstances, so the roadmap becomes robust. The output of the workshop that includes scenarios can be compared to discover patterns. These patterns

indicate that actions defined in the roadmap are sustainable in changing environments. The following section provides insight in the main results of the workshop ‘Roadmap Urban Logistics 2025’.

4.2 The patterns discovered due to the use of scenarios in risk-aware roadmapping

This section deals with the results of the workshop that is organized to develop a dynamic roadmap. The section deals mainly with the remarkable patterns between the case descriptions, i.e. the scenarios. Similar or differences between the roadmaps of the scenarios are analysed and discussed here. The section ends with a reflection on the results of the workshop. Due to a lack of participants the workshop only uses three cases to elaborate. This is done because a reduction of cases increase the assemblage of unique knowledge distributed among its members per case (Kerr et al., 2012). It seems that context scenarios are a useful tool for risk-aware roadmapping.

The scenarios or cases of the city logistics are based on the matrix in Figure 3. The matrix in Figure 4 provides the position of the four orthogonal scenarios in the urban logistics roadmap. The scenarios can briefly be described as follows. Scenario 1, *Conscious Entrepreneurship*, is dealing with city logistics in an environment with high priority of liveability and mainly a market that should meet the expectations of high standards in the city. The difference of scenario 2 (*Pragmatic Governance*) compared to scenario 1 is that the government is interfering actively by means of adoption of measurements and facilitating platforms. Scenario 3, *Shop Vacancy*, deals with a society that is not mainly concerned with the liveability in the city. There are other problems to focus on than improving the standards, but if there is an improvement, it is initiated by the market force. The fourth scenario, *Resilience of Logistics*, deals also with an environment where standards of living are not the main concern. External events force the government to focus on other issues in society.

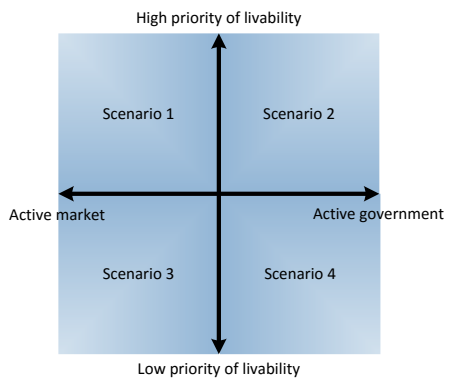


Figure 4: Position of the city logistic scenarios in the matrix

This last scenario was not covered in the workshop, as mentioned, due to a lack of participants. The *Resilience of Logistics* scenario is a bit more radical than the other scenarios, therefore this scenario was chosen not to be elaborated in the workshop. The scenarios were provided as a case to design roadmaps taken the developments described in the scenarios into account to deal with uncertainties over time.

The workshop is subdivided in four rounds. These rounds help to make clear what the deliverables are and provided a step-by-step approach for the intended results. In the first round the participants have to mention the vulnerabilities and problems for the logistic system in their scenario case. The problems and vulnerabilities are drawn on sticky notes,



(a) Conscious Entrepreneurship



(b) Pragmatic Governance



(c) Shop Vacancy



(d) Resilience of Logistics

Figure 5: Scenarios of city logistics in the Netherlands

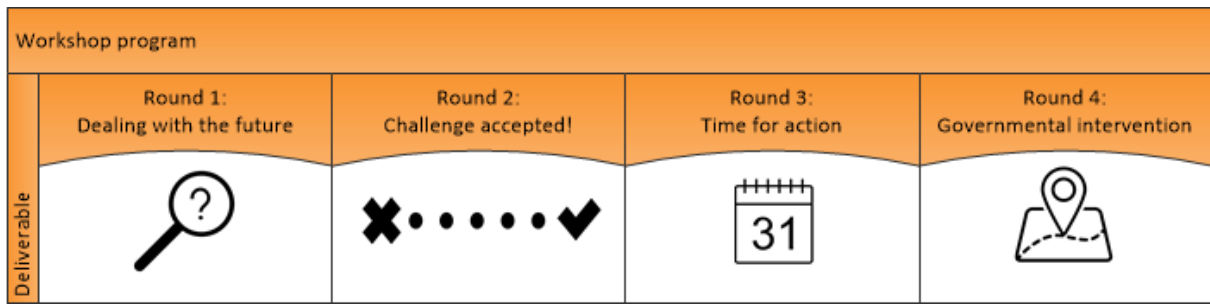


Figure 6: Program of the workshop 'Roadmap Urban Logistics 2025'

clustered per problem owner in city logistics. The second round covered the solutions and action strategies to deal with the vulnerabilities. Again, these actions were clustered per stakeholder. In the third round the participants designed a precursor of the dynamic roadmap. The participants were asked to think about the sequence of the action strategies and stick them to a timeline. The final and fourth round, people from different cases could reflect on the timeline with actions of other cases. During the reflection the reviewers had the opportunity to add extra intervention strategies to the preliminary roadmaps.

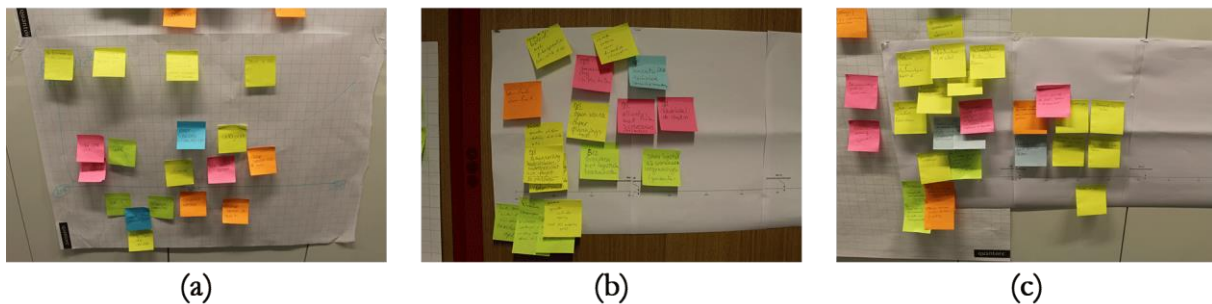


Figure 7: Impression of the results of the workshop 'Roadmap Urban Logistics 2025'. (a) Conscious Entrepreneurship, (b) Pragmatic Governance, and (c) Shop Vacancy.

An impression of the end result of the workshop is presented in Figure 7. The colour of the sticky notes corresponds to a pre-defined stakeholder. Scenarios Pragmatic Governance and Shop Vacancy (b and c) show that not the whole timeline is used. All the action strategies defined have to take place before 2021 according to these deliverables. Indirectly the message is that strategic planners in the city logistics have to speed up the process of change to make the urban area more liveable. The ex post discussion about the roadmap of the Conscious Entrepreneurship case (a) concluded that strategic planners should act decisively as well. So, regardless the scenario, the 'risk-aware roadmap' should be ambitious in meeting the targets.

In all the three scenarios the government (yellow sticky notes) is the action holder in most cases. This implies that whatever the scenario is, the government should act pro-active. The government is in most cases in the lead for speeding up the process of improving liveability in urban areas, even regardless the assumption of an active market.

The action strategies that are termed differ a little between the scenarios. However, the actions do relate to each other, so a consolidation step is done to make the scenarios more consistent. This improves the comparability of the scenarios too. In total the workshop yields from 63 unique actions to 12 consolidated, aggregated action strategies. The unique actions are allocated a date to be carried out. Relying on the motivation of the allocated date, the aggregated actions also have a suggested date of execution. Both the aggregated action as well the due date return in the dynamic roadmap of city logistics.

The decision-centred approaches mentioned in the literature review have inspired the recent developments in adaptation planning and decision support. Haasnoot et al. (2013) started using 'pathways' to help visualise what adaptation is about and provide an analytical approach for exploring and sequencing a set of possible actions based on alternative external changes over time. Haasnoot et al. (2013) explore how various groups with different values and/or perspectives may choose different decision pathways from the set of available options, this is called 'preferred pathways'. Also the final dynamic roadmap of city logistics includes preferred pathways in the graphical representation. These preferred pathways are based on the two dimensions, 'level of priority liveability' and 'degree of activity of the governments', see Figure 3, for developing the scenarios. Regardless of the external developments of the city logistics context, the

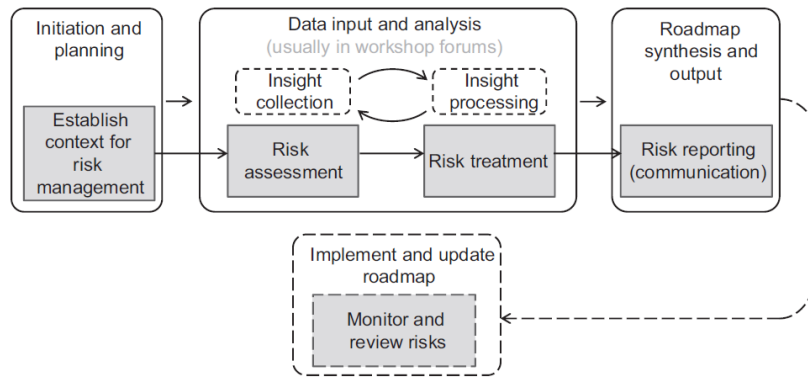


Figure 8: A preliminary conceptualisation of risk-aware roadmapping, retrieved from Ilevbare et al. (2014, p. 402)

roadmap can be respected. In other words, the dynamic roadmap is an example of risk-aware roadmapping as Ilevbare et al. (2014) propose. Because in the initial phase uncertainty and risks are taken into account, it results in a roadmap that is developed by risk-aware roadmapping. This resulted in the pathway roadmap of Figure 9.

The problems and actions identified in the workshop are translated into tactics and strategies that can be used in the pathway roadmap. Involving people from the business in developing pathways contribute to the acceptance of the roadmap. Also the different perspectives of the involved people is of added value since it provides new insights for the roadmap. The pathway roadmap design includes a graphical representation that can be used for strategic planners in communication and for selecting preferred pathways. The pathway roadmap for city logistics is illustrated in Figure 9. In the pathway roadmap the impacts of the strategies on the liveability is displayed. Also the interfering actions of the local government are shown. This enables strategic planners to interfere in the process if needed. The main goal of these roadmaps is to support strategical planners, but this is not the only benefit. Many of the advantages of roadmapping are derived from the roadmapping process, rather than the roadmap itself. The process that brings people together of different responsibilities, sharing information and perspectives, is useful by itself.

Robust Pathways roadmap of city logistics

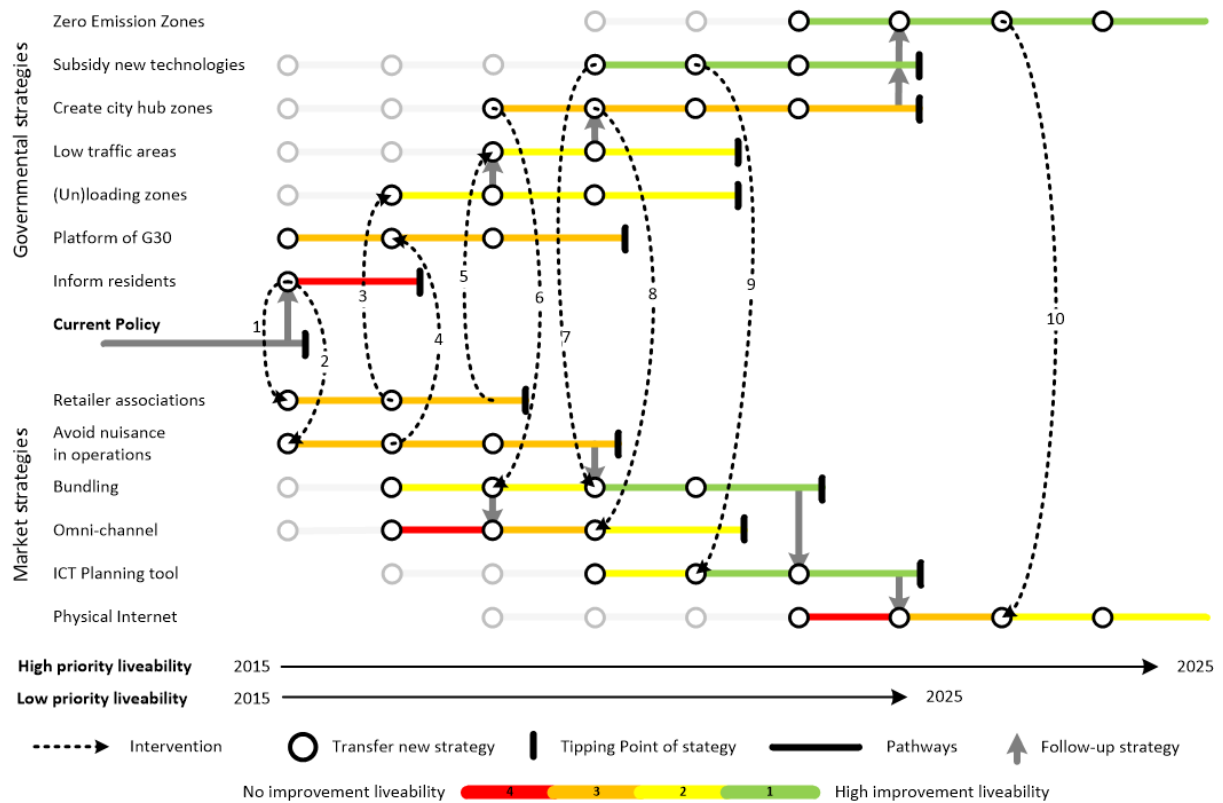


Figure 9: Robust Strategic Pathways Map of City Logistics

4.3 Reflection on the city logistics roadmapping workshop

This section reflects on the approach of risk-aware roadmapping for city logistics. The approach is evaluated by using the conceptualisation of Ilevbare et al. (2014) of risk-aware roadmapping. Along with the shortcomings and vulnerabilities, suggestions are done to improve the validation of risk-aware roadmapping. The framework of the dynamic roadmaps seems to be a good start to take risks and uncertainty into account.

Ilevbare et al. (2014) developed a preliminary conceptualisation of risk-aware roadmapping. This conceptualisation is showed in Figure 8. The Dynamic Roadmap for City Logistics in the Netherlands is evaluated with this conceptualisation in this section. As Figure 8 illustrates, the initiation and planning part is done in the design of the black box for city logistics. The black box shapes the boundaries of the research for city logistics in the Netherlands.

The second step in the preliminary conceptualisation of risk-aware roadmapping concerns the data input and analysis. This is the part where the context scenarios are used. Dealing with the vulnerabilities of the scenarios corresponds to the risk assessment and seeking for action to cope with the uncertainties corresponds to the risk treatment. The final step in the conceptualisation of Ilevbare et al. (2014) is the output and the roadmap synthesis. This matches the dynamic roadmap of city logistics. The dotted line represents the recommendation to update and monitor the roadmap after the acceptance of the first roadmap. This should also be done with the dynamic roadmap of city logistics in the Netherlands. To conclude, the approach of the roadmap of city logistics matches the suggested approach for risk-aware roadmapping proposed by Ilevbare et al. (2014). The city logistic roadmap eliminates the concerns of Ilevbare et al. (2014) and Wise et al. (2014). But also the dynamic roadmap has some shortcomings. The following limitations can be addressed:

1. The scenarios used in the workshop to deal with uncertainty in the roadmap are developed in prior of the workshop. Developing the context scenarios in the workshop will result in a more accepted scenario description and reflects multiple perspectives.
2. The problems and actions are generated by a select group of participants. More participants that help design the pathways of a sector will increase the acceptance of the final pathway roadmap. Also, all types of stakeholders should be included.
3. The roadmapping workshop did not deal with some key variables for the pathway roadmap. The sell-by dates are not handled and did not cover the contribution of action to a liveable environment.
4. The validation of the roadmap is not done after the workshop. A big part of the pathway design is done by the interpretation of the researcher. It means that the pathways are designed from the researcher's perspective and are therefore potentially biased. The validation can be improved by involving the strategic planners in the design process of the pathway roadmap.
5. The pathway roadmap is the first robust roadmap for city logistics in the Netherlands. Since it is a preliminary roadmap it may contain some teething troubles. Also, more strategies and actions can be included.

Despite of the limitations of this research, the first pathway roadmap can be useful for strategic planners. The process of making this roadmap is brought together people of different responsibilities, sharing information and perspectives. The city logistic pathway roadmap can function as a good starting point for selecting the preferred pathway for strategic planners.

5 Conclusion and outlook

The dynamic roadmap approach makes use of context scenarios. The effects of this kind of risk-aware roadmapping is evaluated in the city logistic case of the Netherlands. This paper seeks for methodology to include risk and uncertainties in dynamic roadmaps. Context scenarios can be a useful tool for dealing with uncertainty and risk, however, these kind of risk-aware roadmaps do not exist that long. Strategic planners do not yet deal with the risk-aware roadmaps.

Scenarios are highly recommended since it helps with 'risk-aware roadmapping', though the scenarios should be designed in a workshop environment. Workshops are key for roadmapping. A good mix of stakeholders is necessary. Dynamic Roadmaps should be designed by involving strategic planners. 'Risk-aware roadmapping' will increase the feasibility of the dynamic roadmap. Validation is important if the roadmap should be respected by strategic planners.

The capital gain of risk-aware roadmapping using context scenarios strongly depends on the workshop configurations. The degree in which the context scenarios are used in developing pathways determines the risk-awareness and thus the robustness of the roadmap. The goal of making dynamic roadmaps is to support strategical planners, but this is not the only benefit. Many of the advantages of roadmapping are derived from the roadmapping process, rather than the roadmap itself. The process that brings people together of different responsibilities, sharing information and

perspectives, is useful by itself. The first pathway roadmap of city logistics only displays a few strategies to improve the liveability. In order to include more strategies and to increase the acceptance of the pathway map, more stakeholders can be involved in the roadmapping process.

Dynamic roadmapping, and in the city logistic case pathway roadmaps, have lots of potential for other businesses. The main contribution of developing roadmaps is the roadmapping process, rather than a pathway roadmap itself. Next to studies about ontologies and stakeholder analysis, a pathway roadmap can help to frame the problem field. Almost in all the policy top sectors in the Netherlands can benefit from pathway roadmapping. Challenging policy issues that concern many stakeholders and affect lots of people can use pathway maps, for example for implementing smart cities, the energy transition, and the water management. In these policy issues context scenarios are key to deal with future challenges. The pathway mapping can help to coordinate and interfere in the change management process. This research has shown the potential of roadmapping on a local scale, but it also shows potential to be used on a large scale. More research needs to be done in order to assess whether it is applicable on European or even global scale.

6 References

- Anand, N., Yang, M., van Duin, J. H. R., & Tavasszy, L. (2012). GenCLOn: An ontology for city logistics. *Expert Systems with Applications*, 39(15), 11944-11960. doi: <http://dx.doi.org/10.1016/j.eswa.2012.03.068>
- Anderson, S., Allen, J., & Browne, M. (2005). Urban logistics—how can it meet policy makers' sustainability objectives? *Journal of Transport Geography*, 13(1), 71-81. doi: <http://dx.doi.org/10.1016/j.jtrangeo.2004.11.002>
- Beer, J., & Packard, C. (2012). *The Mediator's Handbook: Revised & Expanded Fourth Edition*. New Society Publishers.
- Dougherty, D. (1992). Interpretive Barriers to Successful Product Innovation in Large Firms. *Organization Science*, 3(2), 179-202. doi: [doi:10.1287/orsc.3.2.179](https://doi.org/10.1287/orsc.3.2.179)
- Enserink, B., Kwakkel, J. H., & Veenman, S. (2013). Coping with uncertainty in climate policy making: (Mis)understanding scenario studies. *Futures*, 53(0), 1-12. doi: <http://dx.doi.org/10.1016/j.futures.2013.09.006>
- Fankhauser, S., Smith, J. B., & Tol, R. S. J. (1999). Weathering climate change: some simple rules to guide adaptation decisions. *Ecological Economics*, 30(1), 67-78. doi: [http://dx.doi.org/10.1016/S0921-8009\(98\)00117-7](http://dx.doi.org/10.1016/S0921-8009(98)00117-7)
- Gastil, J. (1993). *Democracy in small groups: Participation, decision making, and communication*. New Society Publishers.
- Haasnoot, M., Kwakkel, J. H., Walker, W. E., & ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global Environmental Change*, 23(2), 485-498. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2012.12.006>
- Haasnoot, M., Middelkoop, H., Van Beek, E., & Van Deursen, W. (2011). A method to develop sustainable water management strategies for an uncertain future. *Sustainable Development*, 19(6), 369-381. doi: <http://dx.doi.org/10.1002/sd.438>
- Hallegatte, S. (2009). Strategies to adapt to an uncertain climate change. *Global Environmental Change*, 19(2), 240-247. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2008.12.003>
- Hallegatte, S., Shah, A., Brown, C., Lempert, R., & Gill, S. (2012). Investment Decision Making Under Deep Uncertainty - Application to Climate Change. *World Bank Policy Research Working Paper*(6193).
- Hogg, M. A. (2000). Social processes and human behaviour: Social psychology.
- Ilevbare, I., Probert, D., & Phaal, R. (2010). *Strategic planning for uncertain futures: a framework integrating scenario planning, roadmapping, and options thinking*. Paper presented at the Proceedings of the R&D Management Conference, Manchester, United Kingdom.
- Ilevbare, I., Probert, D., & Phaal, R. (2014). Towards risk-aware roadmapping: Influencing factors and practical measures. *Technovation*, 34(8), 399-409. doi: <http://dx.doi.org/10.1016/j.technovation.2014.05.006>
- Kaner, S., Lind, L., Toldi, C., Fisk, S., & Berger, D. (1996). *Facilitator's guide to participatory decision-making*. New Society Publishers.
- Kerr, C., Phaal, R., & Probert, D. (2012). Cogitate, articulate, communicate: the psychosocial reality of technology roadmapping and roadmaps. *R&D Management*, 42(1), 1-13.
- Lee, C., Song, B., & Park, Y. (2015). An instrument for scenario-based technology roadmapping: How to assess the impacts of future changes on organisational plans. *Technological Forecasting and Social Change*, 90, Part A, 285-301. doi: <http://dx.doi.org/10.1016/j.techfore.2013.12.020>
- List, D. (2004). Multiple pasts, converging presents, and alternative futures. *Futures*, 36(1), 23-43. doi: [http://dx.doi.org/10.1016/S0016-3287\(03\)00140-X](http://dx.doi.org/10.1016/S0016-3287(03)00140-X)
- Noy, E. (1998). Total business strategy—the missing link. *Long range planning*, 31(6), 927-932. doi: [http://dx.doi.org/10.1016/S0024-6301\(98\)80030-7](http://dx.doi.org/10.1016/S0024-6301(98)80030-7)
- Phaal, R., Farrukh, C., & Probert, D. (2004a). Customizing roadmapping. *Research Technology Management*, 47(2), 26-37.
- Phaal, R., Farrukh, C. J. P., & Probert, D. R. (2004b). Technology roadmapping - A planning framework for evolution and revolution. *Technological Forecasting and Social Change*, 71(1-2), 5-26. doi: [http://dx.doi.org/10.1016/S0040-1625\(03\)00072-6](http://dx.doi.org/10.1016/S0040-1625(03)00072-6)
- Phaal, R., Farrukh, C. J. P., & Probert, D. R. (2009). Visualising strategy: a classification of graphical roadmap forms. *International Journal of Technology Management*, 47(4), 286-305. doi: [doi:10.1504/IJTM.2009.024431](https://doi.org/10.1504/IJTM.2009.024431)

- Phaal, R., & Muller, G. (2009). An architectural framework for roadmapping: Towards visual strategy. *Technological Forecasting and Social Change*, 76(1), 39-49. doi: <http://dx.doi.org/10.1016/j.techfore.2008.03.018>
- Ploos van Amstel, W. (2015, August 11). [Roadmap for urban logistics]. personal communication.
- Quak, H. (2008). *Sustainability of Urban Freight Transport: Retail Distribution and Local Regulations in Cities*. (Ph.D. thesis), Erasmus Research Institute of Management (ERIM), Rotterdam. Retrieved from <http://hdl.handle.net/1765/11990> (EPS-2008-124-LIS)
- Ranger, N., Millner, A., Dietz, S., Fankhauser, S., Lopez, A., & Ruta, G. (2010). *Adaptation in the UK: a decision-making process*. Environment Agency.
- Rijksoverheid. (2014). *C-173 Green Deal Zero Emission Stadslogistiek*. The Hague: Rijksoverheid Retrieved from <http://lean-green.nl/nl-NL/gemeenten/lean-and-green-en-nu/lean-and-green-work/green-deal-zero-emissie-stad/>.
- Rittel, H. J., & Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(2), 155-169. doi: 10.1007/BF01405730
- Robinson, D. K. R., & Propp, T. (2008). Multi-path mapping for alignment strategies in emerging science and technologies. *Technological Forecasting and Social Change*, 75(4), 517-538. doi: <http://dx.doi.org/10.1016/j.techfore.2008.02.002>
- Ruefli, T. W., Collins, J. M., & Lacugna, J. R. (1999). Risk measures in strategic management research: auld lang syne? *Strategic Management Journal*, 20(2), 167-194. doi: 10.1002/(SICI)1097-0266(199902)20:2<167::AID-SMJ9>3.0.CO;2-Q
- Saunders, S. G. (2009). Scenario planning: A collage construction approach. *Foresight*, 11(2), 19-28. doi: <http://dx.doi.org/10.1108/14636680910950129>
- Schwartz, P. (1991). *The Art of the Long View: Planning for the Future in an Uncertain World*. New York: Currency Doubleday.
- Stirling, A., & Scoones, I. (2009). From Risk Assessment to Knowledge Mapping: Science, Precaution, and Participation in Disease Ecology. *Ecology & Society*, 14(2).
- Swanson, D., Barg, S., Tyler, S., Venema, H., Tomar, S., Bhadwal, S., . . . Drexhage, J. (2010). Seven tools for creating adaptive policies. *Technological Forecasting and Social Change*, 77(6), 924-939. doi: <http://dx.doi.org/10.1016/j.techfore.2010.04.005>
- Tjalma, P. (2015, August 10). [Roadmap for urban logistics]. personal communication.
- van Rooijen, T., & Quak, H. (2010). Local impacts of a new urban consolidation centre – the case of Binnenstadservice.nl. *Procedia - Social and Behavioral Sciences*, 2(3), 5967-5979. doi: <http://dx.doi.org/10.1016/j.sbspro.2010.04.011>
- Weaver, C. P., Lempert, R. J., Brown, C., Hall, J. A., Revell, D., & Sarewitz, D. (2013). Improving the contribution of climate model information to decision making: the value and demands of robust decision frameworks. *Wiley Interdisciplinary Reviews: Climate Change*, 4(1), 39-60. doi: 10.1002/wcc.202
- Weingart, L., Cronin, M., Houser, C., Cagan, J., & Vogel, C. (2005). Functional diversity and conflict in cross-functional product development teams: Considering representational gaps and task characteristics. *Understanding Teams*, 89-110.
- Wise, R. M., Fazey, I., Stafford Smith, M., Park, S. E., Eakin, H. C., Archer Van Garderen, E. R. M., & Campbell, B. (2014). Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change*, 28, 325-336. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2013.12.002>
- Witte, E. H. (2007). Toward a Group Facilitation Technique for Project Teams. *Group Processes & Intergroup Relations*, 10(3), 299-309. doi: 10.1177/1368430207078694