1. Scoping of scenario field

2. Identification of key factors

3. Analysis of key factors and their dependencies

4. Scenario generation

5. Scenario transfer paths

Participatory scenario building

A tool for city planners

Riitta Molarius | Nina Wessberg | Jaana Keränen

VTT

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Cover image: Heidi Auvinen (Figure) and Riitta Molarius (Photo)

Preface

Today there exist major trends towards urbanization and mega cities. This creates a need for consciousness and understanding what kind of opportunities do these mega trends provide in terms of city administration, construction, the maintenance of buildings and infrastructure as well as land use. Strong internal migration trends from the countryside to cities, together with migration inside Europe as a whole increase the population in cities, and accordingly cultural diversity.

This workbook supports city decision makers in understanding and anticipating forthcoming changes, including opportunities and threats. In addition, the tool creates opportunities to influence actors towards favourable city development and to build a vivid, vital and secure environment for all citizens.

This workbook is prepared as a part of the EU_HARMONISE project (A Holistic Approach to Resilience and Systematic Actions to Make Large-Scale Built Infrastructure Secure).

Contents

Abstract
Tiivistelmä

List of symbols

FAR   Field Anomaly Relaxation

HARMONISE   A Holistic Approach to Resilience and Systematic Actions to Make Large Scale Built Infrastructure Secure

PESTE   Political, Economic, Social, Technical and Ecological / Environmental key factors

1. Introduction

Urbanisation is one of the major drivers in the current world. Cities and their ever increasing impact in creating meaning in society are constantly changing. Cities are important and powerful decision makers whose decisions shape the future. Innovativeness, beauty, safety, sustainability and climate-conscious decisions all attract citizens and various other actors to live and operate in the city.

Today's cities are smart cities in many ways, resilience being one of their most important features. **A resilient city is one that has the ability to overcome failures, unexpected changes in demographic changes, natural hazards, the operating business environment, and terrorism amongst other things**. Such a city is strong and dedicated to tackling various kinds of risks, but also innovative and open to new opportunities and challenges.

The targets of a resilient city can be identified and designed in a foresight process. The aim of foresight processes is to make oneself aware of the future, and at the same time to create that future. In a foresight process the potential changes are systematically identified, mapped, and analysed in the operational environment and in the city composition within a chosen time scale.

This participatory scenario-building tool is intended to support decision makers in planning future scenarios for resilient cities.
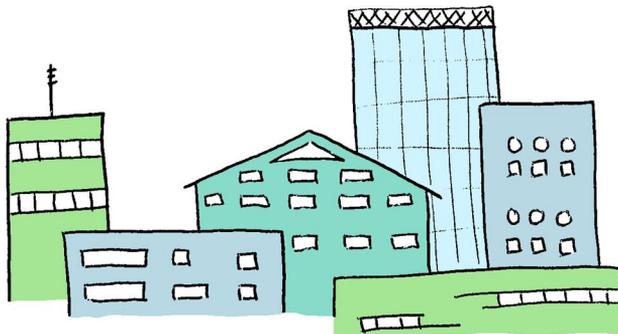
2. Object of the participatory scenario tool

The object of this participatory scenario-building tool is to support decision makers in illustrating the future city and its constraints. Scenarios help to concretely outline the potential challenges, changes, new actors, risks and opportunities to create the resilient city while the participatory approach enables multidisciplinary cooperation and hence, creates commonly acceptable results.
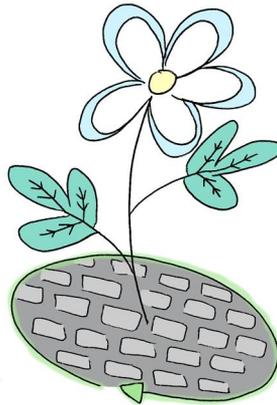
This book is formulated as a form of interactive workbook with internal and external links. Internal links help users to move quickly from one step of scenario-building to another. The book includes an example of how the method was used in the case of Vantaa city in Finland, which includes links in the guideline texts, and can also be found as an attachment. The external links to other guidelines found on the Internet are also available in each step of the scenario-building.

The tool is a part of the HARMONISE – A Holistic Approach to Resilience and Systematic Actions to Make Large-Scale Built Infrastructure Secure – project. The aim of the project is to develop a comprehensive concept for the enhanced security, resilience and sustainability of urban infrastructure and development.

3. About the content of the workbook

This workbook supports the city's decision makers to ensure that they will identify their vision with their strategic work. The vision presents the desired future state of the city. The starting points for city planning are the foresight approach **(Chapter 5.3)** and the resilient cycle (**Chapter 5.1**) from the Harmonise project.

   This workbook clarifies why foresight and participatory approaches (Chapter 5.4) are beneficial in creating future resilient cities. There are studies that show that participatory methods can create new knowledge **(Chapter 5.5)** by combining participant's tacit knowledge and explicit knowledge. It describes the scenario-building method in the context of resilient city planning and maintenance **(Chapter 5.2)**.

   The workbook is directed towards regional and local decision makers' needs. The text includes example boxes and tips with further information and material. The scenario process is described step by step (**Chapter 4**) towards the end and extra information concerning the scenario process, and foresight and knowledge creation in this process is clarified.

4. The scenario-building process
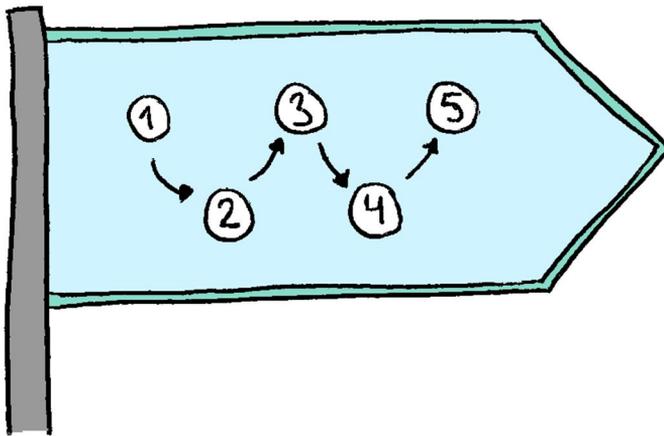
Scenarios are one option in a palette of foresight methods (see e.g. UNIDO 2005, Popper 2008). They provide alternative views of the future in that they identify some significant events, main actors and their motivations, and they convey how the world is thought to function in the specified circumstances. Scenario-building helps decision makers to understand how things interact and what their interdependencies are. By using the built scenarios one can explore what the future might look like and what are the needed or likely changes which boost the scenario realization. A well-crafted scenario allows an organization or society to become proactive, working purposefully towards their desired future.

Scenario-building can be a social and creative process that relies not only on issue definition and extrapolation, but also involves interactive processes that create new combinations of existing knowledge and hence create new and expanding ways of thinking. A participatory scenario-building process (Chapter 5.4) collects stakeholders to create scenarios. While creating scenarios, stakeholders simultaneously construct their future and embed to it.

Scenarios are based on creating a series of 'different futures' generated from a combination of known factors. In broad scope these include demographics, political, economic, social, technical, legal, and environmental trends as well as values and cultural aspects. In the case of city resilience, the factors can be similar to

those presented later in Chapter 5.2 (Resilience in City planning and mainte-nance) which are more specific and focused towards regional-level decision mak-ing. The goal is to build up diverging imaginary worlds by extrapolating selected factors. The objectives of scenario development may be:

- Generating knowledge about the present and the future of a resilient city, possibly even identifying the limits of that knowledge

- Serving a communicative function:

  - exchange of ideas between people with different perspectives

  - a public communication tool drawing attention to specific issues which diminish or improve resilience

- Aiding decision makers in formulating goals to improve resilience

- Providing a tool for examining how organizational strategies manage in their goal of improving resilience

1 Scoping the scenario field

2 Identification of the key factors

3 Analysing key factors and their dependencies

4 Scenario generation

5 Scenario transfer to paths
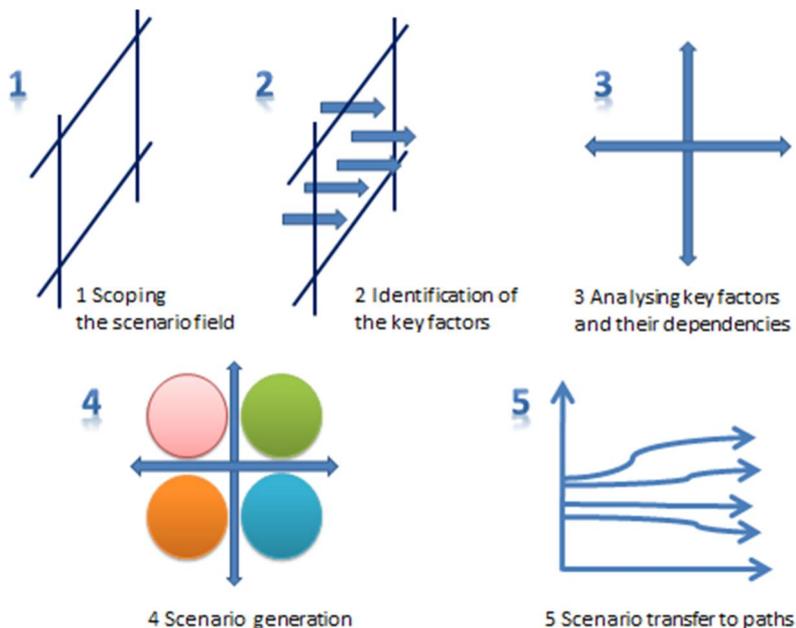
Figure 1 Steps of scenario-building process

The scenario technique includes anticipatory elements, such as subjective inter-pretations of facts, shifts in values, new regulations or inventions. The scenario-building process contains the following steps (see Figure 1):

- Step 1 Scoping: Defining the scenario field (questions addressed, scope, time horizon, etc.) **(Chapter 4.1)**

- Step 2 Identification of key factors that influence the future in focus (features / developments / events and related uncertainties) **(Chapter 4.2)**

- Step 3 Analysis of key factors, incl. their mutual interaction **(Chapter 4.3)**

- Step 4 Scenario generation, incl. resulting scenarios & their presentation **(Chapter 4.4)**

- Step 5 Scenario transfer (communicating, improving & using scenarios) **(Chapter 4.5)**

- Step 6 Evaluating the scenario-building process **(Chapter 4.6)**

The participatory scenario building process is a combination of participatory actions, such as workshops, and deskwork (see Figure 2).
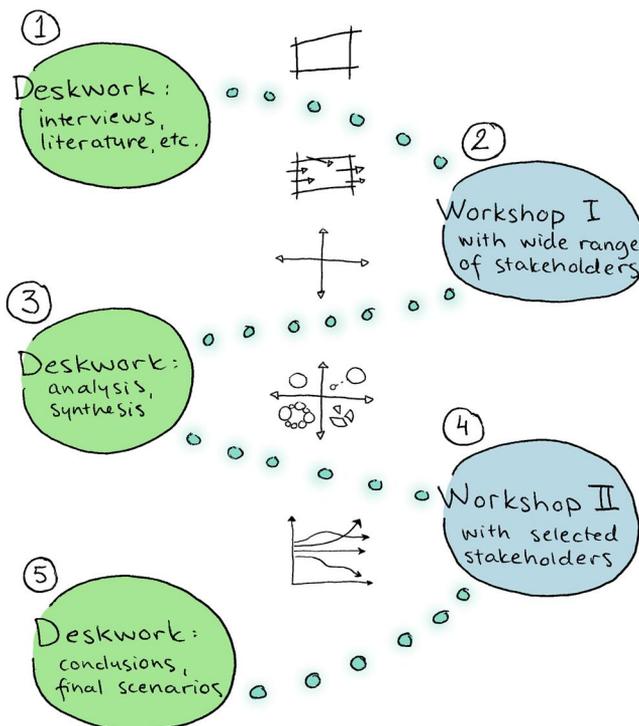
Figure 2 An example of a scenario-building process

Back to: About the content of the workbook (Chapter 3)

4.1 Step 1: Scoping

The first step when initiating scenario-building is to scope the current situation.

The core issues and problems to be addressed should be identified at this stage. These include which decisions are currently made in the focus areas and the time scale of the scenario, as well as the overall procedure of the work flow. The main purpose of the scenario work in relation to an urban city context should be stated. This could be, for example, to identify the emphasis of the results on the testing of existing ideas, generate new ideas, or integrate elements into a coherent strategy.

Often it is productive to arrange 'mini' workshops or interview a certain amount of stakeholders in order to define what the scenario work should be focused on. It is also possible to identify what the playing field or solution space is going to be. According to these decisions and solutions, the quality aims of the project should also be specified.

At the first stage it is also useful to agree on the overall assumptions that will be made for the basis of the scenarios. These assumptions are often either fastened political decisions dealing with issues such as land use planning of the city area, transport solutions, development plans, and so forth. They can also deal with global or regional trends such as aging, urbanization, climate change and the like. These assumptions will define the range of all possible scenarios.

In the scoping stage it is also important to discover the main decision factors to be covered, that is, the critical issues that should be known about the future in order to make best decisions. These can be identified by brain-storming or with the help of structured questions.

The main methods used for scoping the focus area are:

- interviews, e.g. 2–10 interviews, key interest groups
- literature review
- quantitative analysis and statistics

See example from Vantaa City (Chapter 6.1.1)
See methods for stakeholder mapping (Chapter 6.2.1)

4.2   Step 2: Identification of key factors that influence the future in focus

After deciding the focus of the scenario work and the overall assumptions the next step is to identify the key factors, drivers and barriers, which will shape the future of the focused area or topic at macro and micro-level. Micro-environmental key forces are those that have a direct influence on the dealt issue. For example, if the future of security in the urban area is considered, micro drivers can be related to specific regulations, new technology and its potential to ensure security, and support police and security guard work.

Macro-environmental key forces are broader and possibly global. They relate to social, technological, political, economic, and environmental forces that might have an impact on the issue considered. There are a number of tools available to support this activity. One often-used tool is PESTE (Chapter 6.2.2) which helps to identify Political, Economic, Social, Technological, and Environmental forces in a particular situation. Related to the security of the urban area, the macro-environmental key forces could be immigration, aging and fragmentation of social cohesion.

The aim of the identification of key factors is to start building a conceptual model of the relevant environment that includes critical trends and forces and maps out the cause-and-effect relationship among these forces. It will also be possible to identify the major trends and uncertainties in terms of which trends are the most important in determining key decision factors, and which represent underlying or 'driving' forces for significant change in the future.

The key factor identification process may also require some desk research in order to adequately define the driving forces. The aim is to spell out the main elements of the driving forces by also identifying major trends and break in trends. There are numerous national and international studies which can be used to broaden the understanding of the changing environment, for example [1],[2],[3], and [4].

It is apparent that not all the identified forces are equally important or equally uncertain. Therefore already at this stage it is possible to sort the identified key factors by clustering them according to their importance or likelihood.

Identifying the key factors creates the solid basis for the scenario work. There are tools which offer ready-made factors to analyse, such as PESTE and its variations.

See example from Vantaa City (Chapter 6.1.2)
See PESTE-method and other identification methods (Chapter 6.2.2)

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[1] http://www.eea.europa.eu/soer/europe-and-the-world/megatrends
[2] http://www.eea.europa.eu/highlights/global-megatrends-shaping-europe2019s-environment
[3] http://www.eea.europa.eu/themes/scenarios/global-megatends
[4] http://www.eea.europa.eu/publications/global-megatrend-6-update

4.3 Step 3: Analysis of key factors - Ranking by importance and uncertainties

The next step is to rank the driving forces on the basis of two criteria: the degree of significance of the focal issues identified in Step 2, and the degree of uncertainty surrounding those factors and trends.

One suggestion is to use an impact/uncertainty matrix with a simple 'High-Medium-Low' scoring system (Figure 3). The aim is to identify the two factors or trends that are the most important and the most uncertain in the scope of the discussed area.
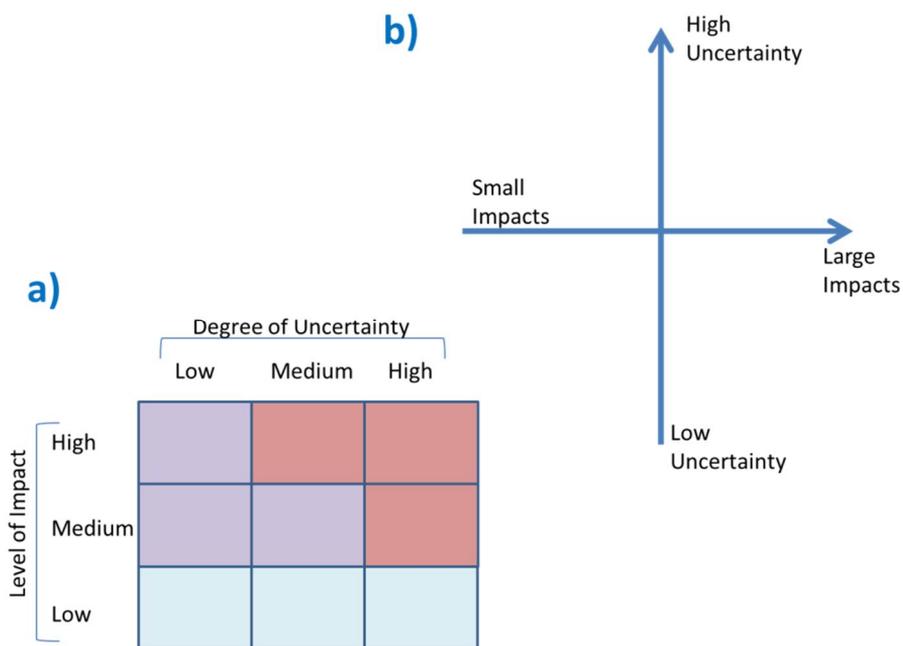
Figure 3 Two ways to visualize the degree of Uncertainty and the level of Impacts in scenario work

As an outcome of this kind of sorting, it is possible to focus attention on the relevant main factors of the future, and hence the process helps to select the factors for the next step. The focus of attention should be on the 'high impact/ low uncertainty' and on the 'high impact/ high uncertainty' quadrants of the matrix:

- High impact/ low-uncertainty forces. These are the relative certainties in the future for which current planning must be prepared.

- High impact/ high uncertainty driving forces. These are the potential shapers of different futures for which your longer-term planning should prepare.

See example from Vantaa City (Chapter 6.1.3)
See alternative methods (Chapter 6.2.2)
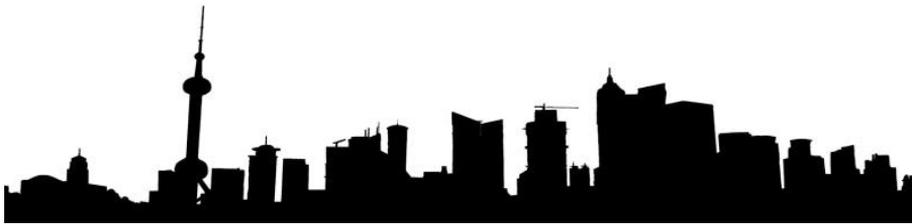
4.4   Step 4: Scenario generation
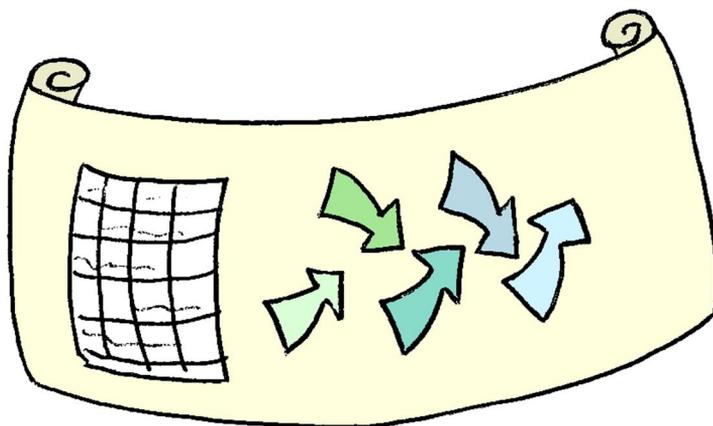
The literature on scenario-building suggests incorporating elements of both desirable and undesirable futures within the different scenarios.

When building the scenarios it is notable that some possibilities can be eliminated because their combinations of logics are implausible or inconsistent. Here, for instance, a FAR method (Chapter 6.2.3) can be used.

There are various ways to generate the scenarios. Key factors can for instance be structured into a future table, and scenarios will be then generated based on this table.

Another option is to select two or more of the most important key factors and put them into one or more xy-axes and then generate the scenarios based on the fourfold structure (see the Vantaa example).

The results of ranking made in Step 3 help in identifying the main carriers and barriers. Determining the axes of the scenarios is the crucial step in the entire scenario process and it requires a great amount of creativity, intuition and insight.

A third way is to decide, for instance, a so-called base-line story (linear development) and two stories that somehow make a difference to the development. Scenarios can be, for instance, three-fold as expressed in Figure 4: baseline scenario (linear development) and two different trend options (e.g. growth or decline).

Also e.g. Dator's (1981) four basic scenarios could be used, and generate scenarios by following these modes:

1.   Continued growth
2.   Societal collapse
3.   Conserve society
4.   Transformation society
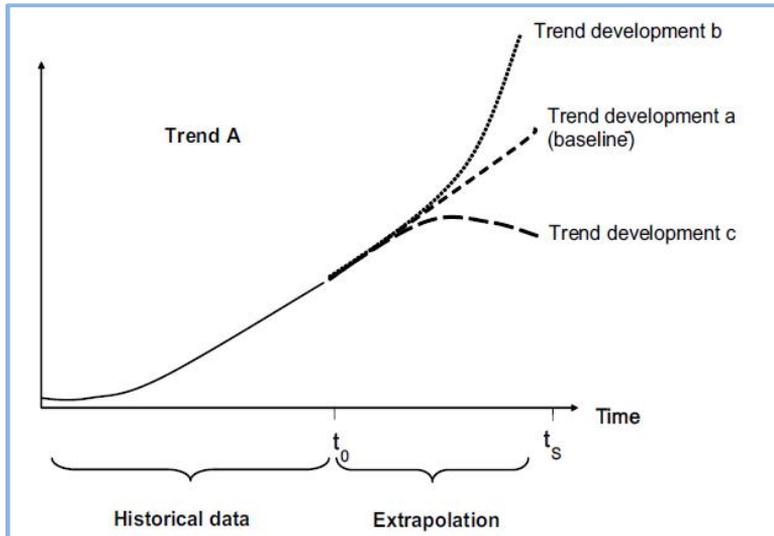
Figure 4 Three simple scenario options (Dator 1981)

The first basic scenario will tell a linear story of the development shaping its path based on current assumptions and ideas. This is a path-dependent story in our current world, without radical changes or expectations for future changes, but assuming growth and development in the society. It is the third story about a society which prefers to keep everything as it is without any development (trend development a). The second story is a collapse story where the growth and development has stopped for some reasons and the society must cope with issues such as poverty (trend development c). The last story is the most innovative story where the society is anxious to change and move forward with the help of technology and radical new innovations (trend development b).

Sometimes it is useful to create success scenarios, e.g. stories about successful resilient cities. Success scenarios combine desirability and credibility (UNIDO 2005). The scenarios are based on a vision of what could be achieved in relation to the analysed key factors. The scenarios are validated by a group of experts or other stakeholders of the process.

A big challenge in scenario generation is to produce just a few scenarios which are different and reveal various viewpoints for the future.

See example from Vantaa City (Chapter 6.1.4)
See alternative methods (Chapter 6.2.3)

4.5   Step 5: Scenario transfer

Scenarios can be formed in different ways and it depends on the need of the scenario as to what is the best way:

- A highly descriptive title: short enough to be memorable; descriptive enough to transmit the essence of what is happening in the scenario.

- Compelling 'story-lines': scenarios are narratives of how events might unfold between now and the selected time-horizon, they should provide the dynamics (logics) assigned to this horizon. In simple terms, the scenario should tell a story that should be remarkable, convincing, logical, and plausible.

- A table of comparative descriptions: This provides planners and decision makers with somewhat of a 'line item' description that details what might happen to each key trend or factor in each scenario. This implies that the scenario developer should return to and include the list of key drivers developed in Step 2. Basically, the table provides the back-up material that gives the scenarios their nuances and texture.
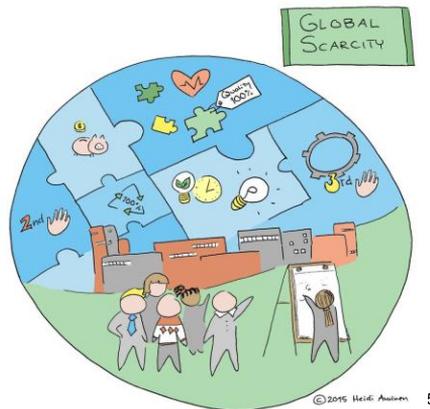
This fifth step includes communicating, improving, and implementing scenarios. In this stage, the developed scenarios are linked back to the decision focus of the first step, and the scenarios turn into strategy. In this process it is important to address the following questions:

- What are the strategic conclusions of the scenarios for the particular decisions selected at the beginning of this process?

- What options do the scenarios suggest?

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[5] Figure source: VTT For Industry http://www.vtt.fi/inf/pdf/visions/2015/V7.pdf

The built scenarios can be discussed from next points of views:

- Opportunities and threats assessment: what are the opportunities and threats that each scenario poses for the city?

- Which opportunities and threats are common to all (or nearly all) the scenarios? These are ones on which the strategic thinking should be particularly focused.

- How well prepared the city/society is to seize those opportunities and minimise threats?

If the scenarios are used to form strategy, the important questions are:

- What are the key elements of strategy stemming from the scenarios?

- What are the best options for each element in each strategy? For example what would be the technologies needed in Scenario A?

- Which options seem to be the most resilient / robust across the range of scenarios?

- Is it possible to integrate these resilient options into an overall coherent strategy?

Scenarios can be presented in many ways. Some of the ways are listed as follows:

- Narratives and story lines that describe the essential features of alternative scenarios.

- Graphs and tables describing the process, alternative future developments, underlying assumptions.

- Pictures that illustrate essential features of scenarios and their underlying assumptions.

- Video clips illustrating alternative scenarios and their underlying assumptions.

See example from Vantaa City (Chapter 6.1.5)

4.6   Step 6: Evaluating the scenario-building process

A general quality check for the foresight process is implemented at this stage. Important questions to be asked, and answered, are:

- Is the approach systematic?

- Is the process well-grounded (including selection of methods and participants)?

- Is the process transparent?

- How credible is the approach (including process, participants, and results)?

- Are the different viewpoints considered in a balanced way?

For the scenarios the evaluation should cover the following criteria:

- Plausibility: The selected scenarios must be plausible, this means that they must fall within the limits of what might conceivably happen.

- Differentiation: they should be structurally different, meaning that they should not be so close to one another that they become simply variations of a base case.

- Consistency: They must be internally consistent. The combination of logics in a scenario must not have any built-in inconsistency that would undermine the credibility of the scenario.

- Comprehensible and traceable detailed enough, not too complex, coverage.

- Transparent: scenario building process should be made visible.

- Decision making utility: Each scenario, and all scenarios as a set, should contribute specific insights into the future that will highlight the selected decision focus.

- Challenge: the scenarios should challenge the organisation's conventional wisdom about the future.

- Quality of reception/readability: including engagement, aesthetics, and enjoyment.

See example from Vantaa City (Chapter 6.1.6)

5. Resilient city and foresight

5.1 Resilience cycle in city context

In the HARMONISE project the resilience cycle (Figure 5), which is applied in the urbanising city context, is convergent with the general crises management cycle, but its focus is different. While the crisis management cycle proceeds step-by-step operationally, attempting to prevent disasters and crises, and facilitating recovery from them, the resilience cycle focuses separately on each step with the aim of improving the actions in each stage.

Each step of the resilience cycle is divided into the phases of mitigation, preparedness, response, and recovery. These phases are then applied to the planning, design and management processes involved in large scale urban built infrastructure.
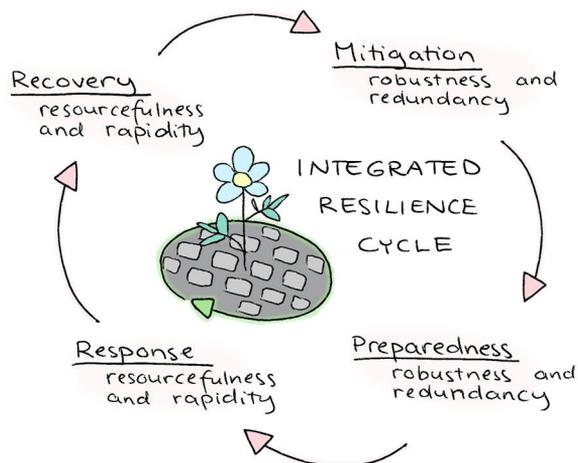
Figure 5 Resilience cycle in the HARMONISE project

The resilience cycle expresses the stages for which the planning, design and management processes are targeted. It is important to ensure that the operation's

mitigation and preparedness phases should be packed with robustness and re-
dundancy to achieve resilient effects. On the other hand, the actions meant for
response and recovery phases should involve sufficient resourcefulness and ra-
pidity.

"Resiliency is defined as the capability of a system to maintain its functions and
structure in the face of internal and external change and to degrade gracefully
when it must" (Allenby & Fink 2005). The resiliency of cities can be strengthened
by using the integrated resilience cycle as presented in the HARMONISE project.
This resilience cycle guides cities to ensure all their activities through four steps:
1) mitigate the harmful consequences, 2) be prepared for unexpected conse-
quences, 3) maintain sufficient response capacity, and 4) be prepared to imple-
ment recovery actions. However, there is a need to have a look to the future to
find out what new activities are needed to tackle forthcoming threats.

5.2   Resilience in city planning and maintenance

Resilience in the context of city planning and maintenance means the ability to
adjust in the face of changing conditions. Figure 6 below suggests a resilience-
based city planning framework that takes into account vulnerability, uncertainty
oriented planning, urban governance and prevention actions (Jabareen 2013). The
figure presents some of the trends which need to be taken into account when
defining the resilience of a city. These trends are classified into six categories:

- Vulnerability
- Prevention
- Urban governance
- Recovery
- Societal behaviour and
- Uncertainty oriented planning.

The all-embracing background variable is technology change, as this will have
an effect on other trends. The changes in all these trends have to be taken into
account when creating the resilient future scenarios.
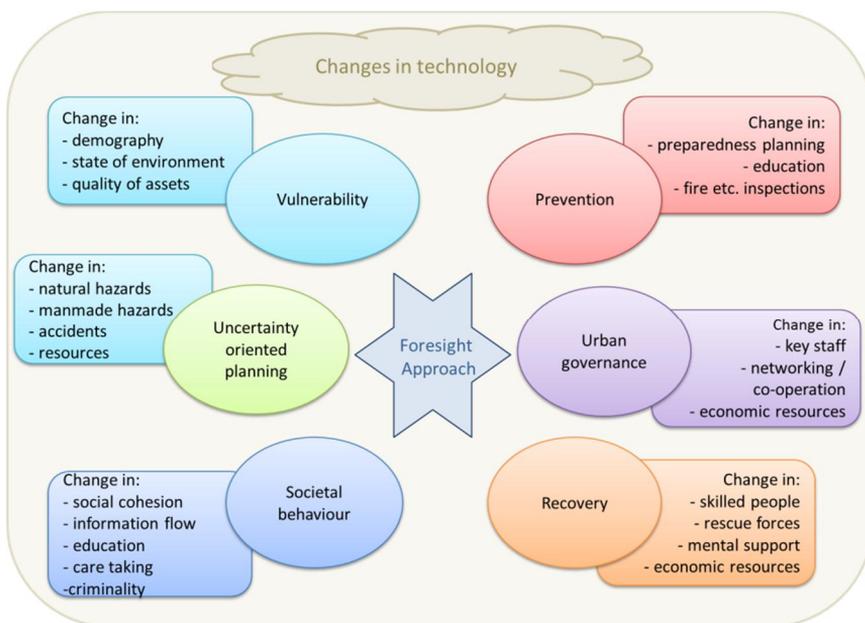
Figure 6 The Resilient City foresight approach: identifies potential changes which need to be considered (modified from Jabareen 2013).

Urban governance refers here to the governance of urban resilience. It includes the governance culture, processes and forum. The resilient city owns an inclusive decision making process in the realm of planning and open dialog. Hence, it is accountable and uses co-creative decision processes and acts in collaboration with other authorities and entities (Jabareen 2013). From this view it is important to follow the amount and expertise of key personnel, economic resources and the state of networking and co-operation.

In emergencies and disasters **societal behaviour** might either increase the speed of recovery, or it might prevent it. Societal behaviour depends on several different kinds of factors. Social cohesion describes how citizens feel about each other, whether they trust their neighbours, and whether they want to help or, take care of people in their neighbourhood. This also has an influence on the criminal behaviour; poor cohesiveness of society increases the amount of crimes. Information flow includes messages from-door-to-door, use of media as well as use of some for information change. In disasters the main channel is often from-door-to-door messages as technical equipment may stop working. The amount and relevance of the messages influences on the behaviour of people.

City planning is a key element to build resilient new areas. To manage in this challenge, the cities should adapt an uncertainty-oriented planning approach. Uncertainty in city planning is caused by the lack of knowledge or faulty knowledge when preparing for the future. Therefore it is important to create maps and scenarios of uncertainties that may affect cities (Jabareen 2013). For exam-

ple, changes in natural hazards such as floods and rainfall should be taken into account. Additionally, newly developed areas may increase traffic accidents, or new industrial areas may pose increased threats to the environment. Lister (2007) suggests that new innovations should be piloted using "safe-to-fail" design experiments, whereby a failure event poses no significant risk to society. The use of multidisciplinary stakeholders in the planning process is always recommended.

Vulnerability refers here to the capacity of the society to resist the harmful changes which take place in the environment. It can include, for example, changes in demographics (amount of people, aging, spatial distribution, immigration), changes in the state of environment (quality of the watershed, biodiversity, land-use, or pollution), changes in the quality of assets (water and wastewater, electricity, and transport networks, and critical infrastructure-related plants), or changes in the working environment (economic crisis, wars etc.).

Prevention is the first barrier to avert the disaster and hence it should be a continuous task to analyse the state of prevention. The good state of prevention presumes that all the preparedness plans are updated, there is enough education for all new aspects and all the regulatory inspections are made.

To analyse **the ability to recover** from a failure, the important things to assess are both internal and external of the organization of the city institution. The individuals with disaster management skills should take a main role in a recovery situation. They are important both inside the city organization, but also outside of it, and they are formed from the voluntary forces, other authority staff or public-private partnerships. The availability of mental support is also important, especially in cases where recovery may take a long time. Ahern (2011) states that, cities with a sufficient level of economic and social diversity have a complex variety of responses to adapt to changes in society. One main issue with recovery is the availability of economic resources including insurance contributions or claim payments.

In the background of all these sectorial changes is **technological change,** which is occurring at rapid pace. Changes in technology can be predictable, faster than expected, or perhaps they will not occur at all. Dolata (2009) pointed out that the speed of the progression of the technology depends on its adaptability to be a part of other technologies, routines or strategies. The regulations and norms of society may enhance or prevent this development. In addition new grand inventions which require new infrastructure will not progress without the support from the society (example wind power). However, technology development takes place parallel in the development of society (Geels 2002, Schot & Geels 2008, Geels & Schot 2007) and hence, it is important to take into account.

5.3   What is foresight

> "Foresight is a unique and highly valued human capacity that is widely recognized as a major source of wisdom, competitive advantage and cultural renewal within nations and corporations" (Chia 2004)

Foresight is a way to develop a range of views of possible paths describing how the future might develop, or, how we would like it to be developed. It also incorporates the understanding of these paths sufficiently well propose which decisions should be made today in order to create the best possible tomorrow (Horton 1999).
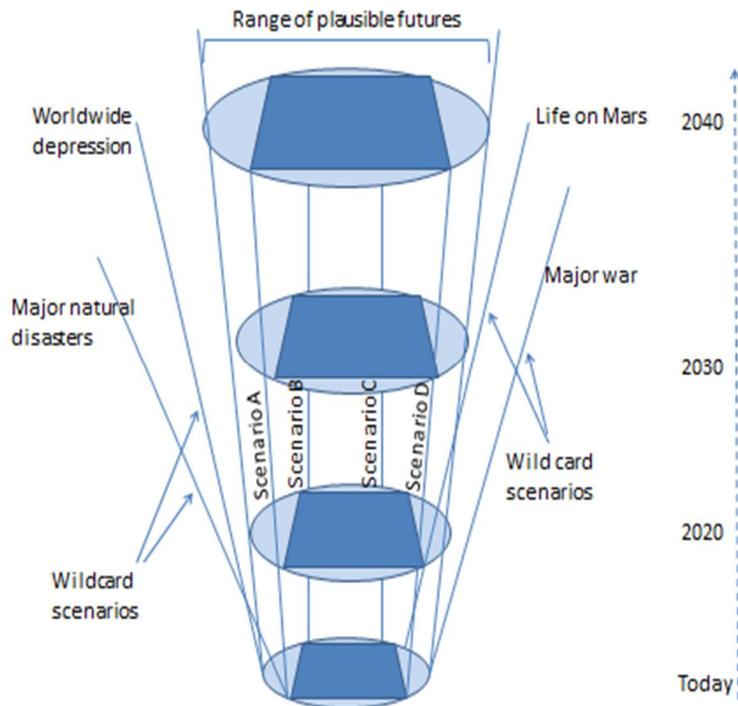

Figure 7 Plausible futures and wildcard scenarios.

In Figure 7 the range of foresight and scenarios are illustrated. In strategy work we try to focus on the range of plausible futures excluding so called wildcard scenarios that are consequences from unforeseen phenomena.

To support this method it is recommended to use statistical data (e.g. demographical, societal and environmental and economic trends) and, for example, technology forecasts as background information.

Back to Chapter 3: About the content of the work book

5.4   Participatory processes in city planning

The degree to which different stakeholders are involved in making the decision is the degree to which the decision will be accepted by the public (Glenn 2003)
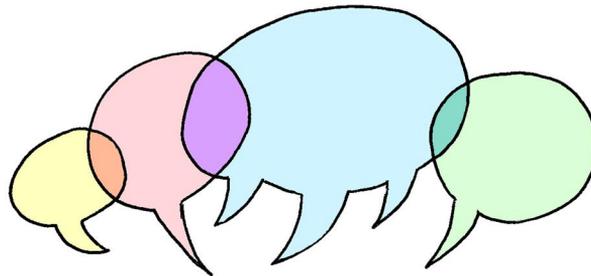
Participatory processes can be used as strategic tools for improving interaction between key actors and for anticipatory policy making. The participatory scenario-building work can, for example, support decision makers:

- in the mitigation stage by recognising new techniques that reduce vulnerability as new ways to follow up security and reduce uncertainty;

- in the preparedness stage by highlighting the role and know-how of citizens to strengthen the co-operation among different stakeholders;

- in the response stage by scanning the future needs for rescue centres, crew and equipment; and

- in the recovery stage by scanning the future need and availability of skilled human resources.

The benefits of participatory processes are numerous:

1.   Decision makers are more prepared to make long-term plans and difficult decisions.

2. Decisions create more successful and effective working processes because of the shared commitment.

3. The results that are achieved by using collaborative work are better compared to the results individuals and stakeholder groups achieve working separately and alone (Leathard 2003).

4. The participatory process accelerates the implementation of the strategy because decision makers are already embedded into the decisions during the foresight process. (Glenn 2003)

5. The participatory process utilises distributed cognition as well as explicit and tacit knowledge to improve results.

Participatory processes may also fail for many reasons:

- The participants may represent parallel opinions or scholarships where only one side of the topic is taken into account.

- The process lacks a facilitating agent whose role is to ensure that all participants are heard.

These weaknesses of the participatory process can be reduced by careful stakeholder mapping and selection. The stakeholder mapping is a useful tool to reduce overly superficial or unfair analysis due to the high spirits of participants, or to avoid aggressive and powerful persons who may create an imbalance of opinion.

5.5　Knowledge development in the foresight process

There are four ways to exploit the knowledge of individuals (Nonaka 1994): Socialization, Externalization, Internalization and Combination (see Figure 8). Tacit knowledge flows from one individual to another by socialization when people work together and listen to each other in an empathizing way. Externalization changes tacit knowledge into the explicit knowledge by articulating and discussing with other people, for example, in group work. Individuals' explicit knowledge can be communicated to other individuals in a combination process whereby people connect new knowledge with their existing knowledge, and hence widen their knowledge incrementally. Finally, knowledge internalization occurs when individuals make mental notes of new things, for example as a student does in a class at school.

Multidisciplinary group work is one of the best approaches to combine knowledge and create new valuable ideas by using distributed cognition as well as an individual's tacit and explicit knowledge. The participatory group processes encourage knowledge exchange and develop deeper understanding of central issues important to the future.

The foresight and participatory process requires a facilitator who understands not only the substance, but who can also perceive the foresight and the participatory process as a whole. The facilitator ensures that the process is planned organised appropriately, and that it produces what is expected. An important element is also the motivation and orientation to see the future. This is often the most difficult part in the foresight processes, that is, to be able to orient oneself to the future, instead of the current or past situation.
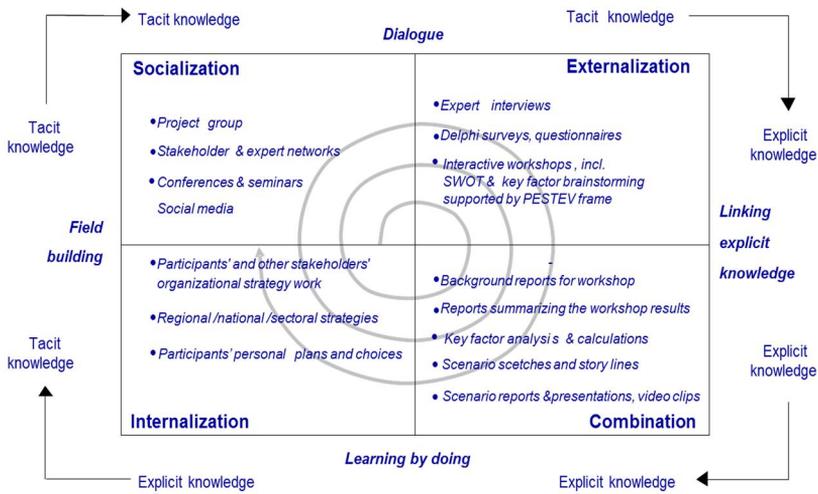
Figure 8 Different foresight elements in a dynamic process of shared knowledge creation, a SECI (Socialisation, Externalisation, Combination and Internalisation) perspective (Eerola and Jörgensen 2002).

Back to Chapter 3: About the content of the workbook
To Chapter 4: The scenario-building process.

6. Additional material

6.1 Scenario-building in the city of Vantaa

6.1.1 Step 1: Scoping in Vantaa

The city of Vantaa is a rapidly growing city alongside Helsinki, the capital of Finland. Vantaa is home to a growing railway station, and the Helsinki-Vantaa airport. The participatory scenario-building process was utilised to tackle the potential security and safety risks pertaining to the surroundings and area of the railway station.

The scoping process began with a meeting with the security manager and the project director of Vantaa city. In the meeting the main target of the scenario-building process was decided, and the participatory workshop preparation was outlined. The background information utilised in the scoping meeting consisted of:

- the results from a project completed two years earlier,

- statistical data by police and Vantaa City, and

- the safety and security plan of Vantaa city.

The earlier project was a result of cooperation between Vantaa City and researchers, and considered the security of the inhabitants of Vantaa. The statistical data used in the project consisted of the summaries and spatial data of police tasks in the area and the current population information, and the population fore-

cast for the near future. The safety and security plan included the main targets and actions of safety and security related issues for the near future.

In this project seven interviews were made consisting of individual representatives from public transport sector, police, city planning, youth services, local private services (accommodation and restaurants), and security business training. Interviews gathered information on:

- desirable future of the railway station and its immediate surroundings,

- readiness to face disturbances,

- potential success factors, barriers to achieve the desirable future,

- common trends in city planning and development, and

- possible stakeholders related to safety and security issues in city development work.

6.1.2   Step 2: Identification of key factors

According to the gathered background information, two main safety and security factors (key factors) emerged: disorder in behaviour, such as troublemaking, vandalism, crimes, and disruptive alcohol drinking of small groups at public sites, and citizens' fear due to this disorder.

These issues were the starting point for the scenario generation.

6.1.3   Step 3: Analysis of key factors

The identified key factors - disorder in behaviour and citizens' fear – were analysed to identify the main drivers and barriers for scenario work. As the result of the work two forces were highlighted:

- The extent of co-operation in society: The development of the society in terms of individual or community-centred development

- The quality of safety and security actions (S&S): The development of safety and security in terms of hard S&S (technology, police forces etc.) and soft S&S (guiding, built environment, etc.).

6.1.4   Step 4: Scenario generation

In Vantaa four scenarios on the bases of identified key factors was defined. The fourfold table to describe the scenarios was formulated. The content of the scenarios were created in participatory workshop with the stakeholders of Vantaa city and its safety and security partners.

The target of the participatory workshop was to brainstorm city planning in the railway station and its immediate surroundings 10 years ahead. "What kind of place the Tikkurila area will be in year 2025?" For the workshop, the participants were divided into four groups. Each group studied the possible future in different point of view as seen in fourfold table in figures below. The time frame for the analysis was given and the task for each group was to discover examples of positive urban culture and habitable, safety, and resiliency at the case area.

The following stakeholders were invited to the scenario-generating workshop:

- public transport sector actors
- police
- security services of railway station and shopping centre premises
- local private service producers

- city planning, including traffic planning and building design
- social services and youth services
- public cultural services, including library services
- security business training, including a number of students
- local church
- rescue services
- property management services.

The fourfold table utilized in workshop is seen below:

The quality of safety and security actions

	Soft	Hard
Co-operation	Community - Soft **1**	Community - Hard **3**
Individual	Individual - Soft **2**	Individual - Hard **4**

The degree of co-operation in society
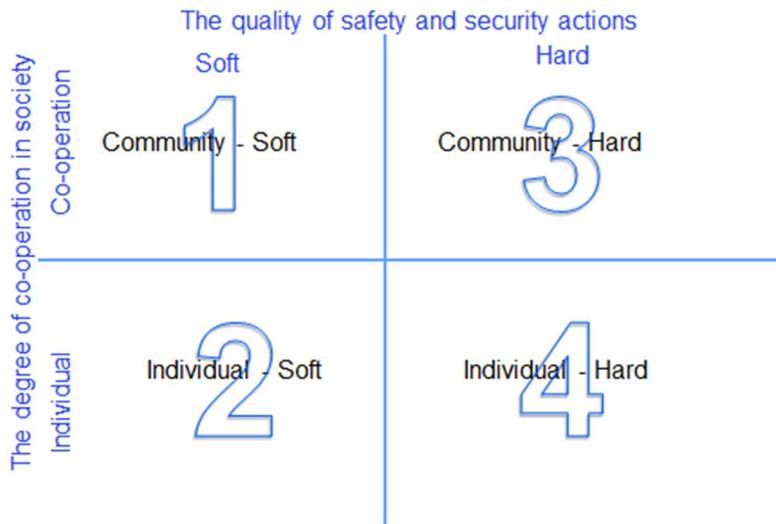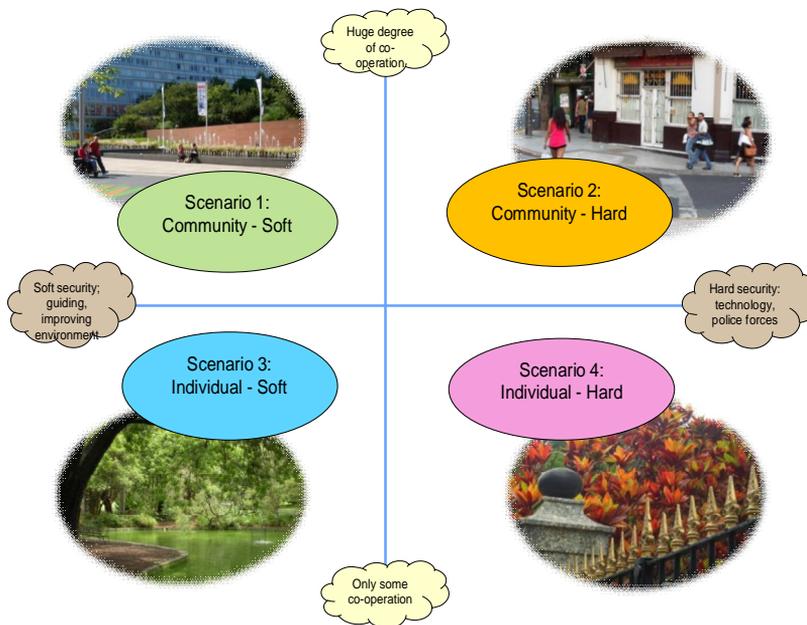
| Scenario	Focus in security	Citizens	Resilience	Motto
Community-Soft	Large amount of people (travellers, students) Movement (light traffic: pedestrians, cycles)	Multiculturalism, and different needs Families with children Government is interested of citizen's well-being.	Community culture and its strengthening by creating the assembly areas and common events People are interested in each other's well-being.	Enjoy being and working together
Community - Hard	Foresight, Preparedness; Industrial risks; Communication	More resources in well-being of young people.	Disturbance and accident contingency plans; Good cooperation between safety experts; Improving the physical safety of the environment	Hard security creates a reliable basis on which to build a comfortable being.
Individual - Soft	Individual responsibility and resources; Connection between well-being and security Municipal, public authorities and experts supporting individual people Outreaching security	Malign and self-reliant; Tolerance and encouragement; Support available for individuals needs	Individual abilities and skills to use; The smooth operation of small units; Decentralized responsibility for the safety	New way to be a citizen
Individua-Hard	Technical control of premises, rooms, areas and people The role of society in creating communality emphasizes	Individuality Physical solitude but also virtual community. Small groups resurgence.	Bases on a strong role in society, but also on responsibility of businesses providing personalized services.	Buying human relationships

6.1.5 Step 5 Scenario transfer
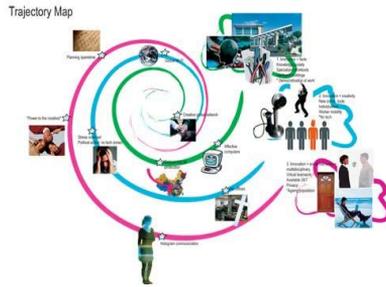
In the case of Vantaa city the research team was not involved in the scenario transfer process because it was not possible to do during the HARMONISE project. The scenario transfer will occur as an internal process within the city's government. For example, the developed scenarios are taken into account in areas such as land-use planning and security planning of the city, as well as in rescue services and police services activities.

6.1.6 Step 6 Evaluating the scenario-building process

In the Vantaa example, scenarios were evaluated by those who produced them. Researchers sent an evaluation template to all workshop participants, who then provided feedback in the following areas:

- What does the future look like in light of these scenarios?
- What are the main actions required to direct current safety and security circumstances towards the desired vision?
- What should be done to avoid worsening the situation?
- How would you like to complete or change the developed scenarios?

In addition to these questions, feedback was also requested in order to improve the participatory scenario-development process.

6.2   Other guidelines

6.2.1   Stakeholder mapping

Newcombe (2003) states that stakeholders interact with the project in two primary arenas: the cultural arena and the political arena. When working in the cultural arena, the stakeholders represent their ideology and shared values. It is in this arena where co-operation between stakeholders will be formed. In the political arena, conflicts exist due to the involvement of powerful individuals and different interest groups.

Stakeholder mapping is a process where the importance and interest of stakeholders are analysed by making the following judgements (Newcombe 2003):

- How likely is each stakeholder group to enforce its expectations on the project?

- Do these groups have the means or power to do so?

- What is the likely impact of stakeholder expectations on future project strategies?

To assess these three contingencies two methods of stakeholder mapping can be used: the power/predictability matrix and the power/interest matrix (Figure 9).
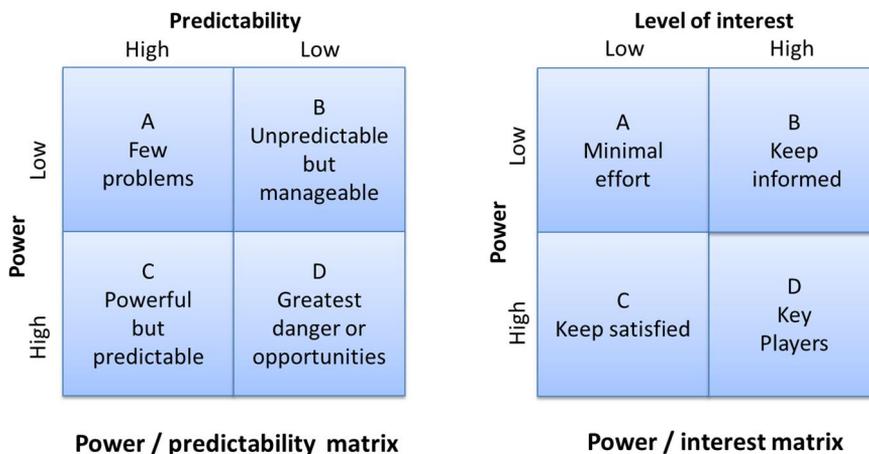

Figure 9 Power/predictability and power/interest matrixes (Newcombe 2003).

Stakeholders can be individuals, groups, or even organizations. When asking a person to attend a scenario group the following aspects should also be taken into account:
- the individuals power within the organization

- their capacity to take action and to implement (i.e. where they fit within the organisation)

- their goals, both organisational and personal

- how approachable they are and what their team work abilities are

- who are their opponents or supporters

- how well the stakeholder believes the organisation is performing

Tools and help for stakeholder mapping and creating participatory plans can be accessed through the following links:

- http://www.mindtools.com/pages/article/newPPM_07.htm

- http://www.stakeholdermap.com/

- http://www.bsr.org/reports/BSR_Five-tep_Guide_to_Stakeholder_Engagement.pdf

- http://gsvc.org/wp-content/uploads/2014/11/Stakeholders-Identification-and-Mapping.pdf

- http://www.som.cranfield.ac.uk/som/dinamic-content/media/CR%20Stakeholder.pdf

- http://creativecities.britishcouncil.org/urban_co-design_tools/future_city_game

6.2.2   Methods to identify key factors

The PESTE approach is known by a number of different acronyms including PEST, PESTLE, PESTEC, STEP, SEPTED, STEEPLE and STEEPLED. The letters in PESTE stand for Politics, Economy, Social issues, Technology, and Ecology (or Environment). Additionally, other versions of the acronym noted above may include Education, Demographics, Culture, and Legal issues.

The important questions in PESTE are:

- Political: What are the key political drivers? European and Government directives, funding policies, national and local organisations' requirements, institutional policy

- Economic: What are the important economic factors? Funding mechanisms, business and enterprise directives, internal funding models, budgetary restrictions, taxes

- Social: What are the main societal and cultural aspects? Societal attitudes to education, general lifestyle changes, changes in populations, distributions and demographics and the impact of different mixes of cultures

- Technological: What are current technology changes and innovations? Major current and emerging technologies of relevance for teaching, research or administration

- Environmental: What are the environmental considerations, locally and further afield? Local, national and international environmental impacts, outcomes of political and social factor.

With the PESTE tool it is possible to collect the factors which have an effect on the topic you want to discuss.

City administration: Work with young people in 2020				
	Staff	**Premises**	**Education**	**Voluntaries**
P			State reduces training	
E	Less money - less staff		Young staff need training	
S	Staff gets older, gap			Role of church strengthens
T		ICT equipment	More training for ICT	
E		Located in the European NATU-RA area		

The use of these factors alone might lead to too broad a view, and thus no advantage is gained when studying local urban-area resilience. A more productive approach could be to use the key indicator lists of city resilience and combine them with the PESTE factors to focus the scope to local or regional aspects. The Rockefeller Foundation has defined 12 indicators for city resilience, which fall into four categories: the health and wellbeing of individuals (people); infra-structure & environment (place); economy and society (organisation); and, finally, leadership and strategy (knowledge).

The 12 indicators for city resilience are:

1.   Minimal human vulnerability
2.   Diverse livelihoods and employment
3.   Adequate safeguards to human life and health
4.   Collective identity and mutual support
5.   Social stability and security
6.   Availability of financial resources and contingency funds
7.   Reduced physical exposure and vulnerability
8.   Continuity of critical services
9.   Reliable communications and mobility
10.   Effective leadership and management
11.   Empowered stakeholders and
12.   Integrated development planning.

More methods to identify the key factors can include:

- Futures wheel and applications: e.g.
  http://www.mindtools.com/pages/article/futures-wheel.htm

- Environmental scanning: e.g. internet search, experts selecting topics

- Expert panels

- Literature review

- PESTEVL http://pestleanalysis.com/

6.2.3 Alternative methods for scenario generation

Scenario-building by using the FAR-method

For building the scenarios using the FAR method, the quantitative and qualitative information is collected into a future table according to the themes, variables and their possible future states. Each variable has either quantified, or qualitative, alternative future states. The number of qualitative future states depends on the variable, and they may differ from each other. (Varho & Tapio 2013)

The future table is based on the field anomaly relaxation (FAR) method (Rhyne 1995, Seppälä 1984). The FAR method involves multidisciplinary teams who will qualitatively describe alternative future states. The qualitative scenarios and the FAR method, together with policy analyses, seem to be a fruitful combination to tackle problems of the future. According to Mäkitalo (2011), the benefit of the futures table is that it sets limitations to the issue at hand and hence it helps with focusing the subject of research.

It is evident that there are development trends which exclude some other trends, for example if voluntary rescue associations reduce their training activities; it is of little use to count on a future which involves an improved rescue capability. The use of the future table checks that the implemented factors are not contradictory and hence it ensures the quality of the scenario process. Therefore the scenarios are constructed by first eliminating mutually exclusive pairs of situations in different sectors, and then eliminating mutually exclusive collections of situations regarding all sectors (Varho & Tapio 2013).

When the contradictory and impossible collections have been eliminated, the scenario working group can start developing the scenarios by discussing, analysing and arranging the residual combinations of factors. The future table can be regarded as a study result as such, because it describes the most important variables related to the research subject. On the bases of the future table it is possible to produce utopias, preferred futures, non-desired futures or even dystopias.

The main difference between the FAR method and predefined scenarios is that the FAR method can take into consideration far more different factors than predefined scenarios do. While pre-defined scenarios are based on two variables, FAR can be based ten or more different variables – in fact there is no limitation to the number of possible variables except for time. Naturally, the more variables included, the more time the formulation of a future table takes.

An example

In a scenario workshop the multidisciplinary group has decided that the next five factors (1-5) should be taken into account when developing up the scenarios (Table 1). They have also given the four possible development trends to each factor (A-D).

Table 1 An example of the future table of the impacts of land use and population growth.

		A	B	C	D
1	Coherence of the urban land use	One mega centre and few side centres	No mega centre, several side ones	One mega centre, no others	Fragmented structure
2	Immigration	No immigration	Immigration 1-2 %	Immigration 2-5 %	Immigration over 5 %
3	The need of public transport	The need declines	No change	The need increases 1- 2 %	The need increases over 5 %
4	The need of apartments	The need declines	No change	The need increases 1- 2 %	The need increases over 5 %
5	The funds for critical infrastructure building and maintenance	No change	Amount decreases 5 %	Amount increases 0-5 %	Amount increases over 5 %

To ensure that there are no contradictory issues in the table, the following table should be created (see Table 2). It shows that factor 1A must not be described together with 2A-4A (marked X) because they represent different development trends to the same factor. Also 1B (No mega centre, several side centres) must not be described together with 3B (No change in the need of public transport), as they represent conflicting development trends.

Scenario 1: From the residual factors it is possible to decide on the possible scenarios, for example: 1D-2C-3B-4D-5D: The city will develop on the bases of fragmented structure. However, it will be developed so that the need of public transport will be at today's requirements. At the same time the amount of immigration is 2-5 % of the population, which increases the need of new apartments by over 5 %. Due to the fragmented city structure the required funds for maintenance and building critical infrastructure increases by more than 5 %.

Table 2 Checking the possible contradictories of the previous table 1 (Table 1). X = alternative choice (e.g.1A is alternative to 1B or 1C), No = not possible (e.g. 1A – mega centre shall not come true if there is no change in public transport).

	1A	1B	1C	1D	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C	4D	5A	5B	5C	5D
1A		X	X	X						No										
1B	X		X	X					No											
1C	X	X		X																
1D	X	X	X						No								No			
2A						X	X	X												
2B					X		X	X												
2C					X	X		X	No					No						
2D					X	X	X		No	No			No	No						
3A		No		No			No	No		X	X	X								
3B	No							No	X		X	X								

Other methods to scenario creation can be found for example in:
Hands-On Knowledge Co-Creation and Sharing: Practical Methods & Techniques. 2007. Kazi, A. S., Wohlfart, L. and Wolf, P. (eds.) Knowledge Board, Stuttgart.
http://www.central2013.eu/fileadmin/user_upload/Downloads/Tools_Resources/General/Knowledge_Management_Handbook.pdf

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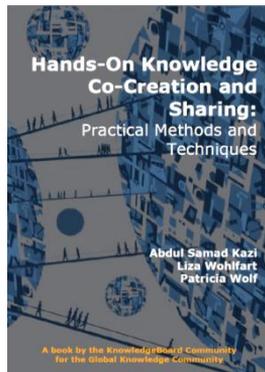
Back to Step 4 (Chapter 4.4)
To Step 5 (Chapter 4.5)

Acknowledgements

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Title	**Participatory scenario building** A tool for city planners
Author(s)	Riitta Molarius, Nina Wessberg & Jaana Keränen
Abstract	Today's cities are smart cities in many ways, resilience being one of their most important features. A resilient city is one that has the ability to overcome failures, unexpected changes in demographic changes, natural hazards, the operating business environment, and terrorism amongst other things. Such a city is strong and dedicated to tackling various kinds of risks, but also innovative and open to new opportunities and challenges. The object of this participatory scenario-building tool is to support decision makers in illustrating the future city and its constraints. This tool is formulated as a form of interactive workbook with internal and external links. Internal links help users to move quickly from one step of scenario-building to another. The book includes an example of how the method was used in the case of Vantaa city in Finland, which includes links in the guideline texts, and can also be found as an attachment. The external links to other guidelines found on the Internet are also available in each step of the scenario-building. Scenarios help city planners to concretely outline the potential challenges, changes, new actors, risks and opportunities to create the resilient city while the participatory approach enables multidisciplinary cooperation and hence, creates commonly acceptable results The tool is a part of the HARMONISE – A Holistic Approach to Resilience and Systematic Actions to Make Large-Scale Built Infrastructure Secure – project. The aim of the project is to develop a comprehensive concept for the enhanced security, resilience and sustainability of urban infrastructure and development.
ISBN, ISSN, URN	
Date	April 2016
Language	English, Finnish abstract
Pages	46 p.
Name of the project	HARMONISE A Holistic Approach to Resilience and Systematic Actions to Make Large-Scale Built Infrastructure Secure
Commissioned by	EU 7th Framework, VTT
Keywords	Scenarios, Resilient city, Participatory work, Foresight
Publisher	

Nimeke	**Osallistava skenaarioiden luominen** Työkalu kaupunkien kehittäjille
Tekijä(t)	Riitta Molarius, Nina Wessberg & Jaana Keränen
Tiivistelmä	Nykypäivän kaupungit ovat monin tavoin älykkäitä ja joustavia, resilienttejä, kohtaamaan tulevaisuuden uhkia ja mahdollisuuksia. Joustava ja resilientti kaupunki sietää epäonnistumisia, odottamattomia väestörakenteen muutoksia, luonnonuhkia sekä muita toimintaympäristössä tapahtuvia muutoksia ja muuttaa ne voitokseen. Resilientti kaupunki on vahva ja osaa puuttua erilaisiin riskeihin etukäteen, mutta se on myös innovatiivinen ja etsii avoimesti uusia mahdollisuuksia ja haasteita. Tämä työkirja tarjoaa menettelyn yhteiseen, osallistavaan skenaarioiden laatimiseen kaupunkien päätöksentekijöiden tueksi. Se avulla päättäjät voivat saada havainnollisen kuvan tulevaisuuden kaupungista; sen mahdollisuuksista ja rajoituksista. Tämä työkalu on laadittu vuorovaikutteiseksi: työkirja sisältää sisäisiä ja ulkoisia linkkejä, joiden avulla sähköisessä versiossa on mahdollista siirtyä nopeasti syvemmälle käsiteltyyn aihepiiriin. Sisäiset linkit auttavat käyttäjiä siirtymään nopeasti skenaarioiden rakentamisessa vaiheesta toiseen. Lisäksi mukana on esimerkki siitä, miten menetelmää käytettiin Vantaan kaupungissa tehdyssä skenaariotyössä. Ulkopuoliset linkit ohjaavat muun muassa internetistä löytyviin eri vaiheita tukeviin skenaariotyökaluihin. Skenaariot auttavat kaupunkisuunnittelijoita ja -päättäjiä hahmottamaan konkreettisesti tulevaisuuden haasteita, muutoksia, toimijoita, riskejä ja mahdollisuuksia resilientin kaupugin luomiseksi. Esitetty menettelytapa kuvaa osallistavaa menettelyä, joka puolestaan mahdollistaa monialaisen yhteistyön eri tahojen välillä ja siten puolestaan luo yhteisesti hyväksyttäviä tuloksia. Työkalu on osa EU:n 7. puiteohjelman HARMONISE-hanketta (A Holistic Approach to Resilience and Systematic Actions to Make Large-Scale Built Infrastructure Secure). Hankkeen tavoitteena on kehittää kattava konsepti kaupunkien turvallisuuden parantamiseen sekä niiden sietokyvyn ja kestävyyden kehittämiseen.
ISBN, ISSN, URN	ISBN 978-951-38-8420-8 (URL: http://www.vtt.fi/julkaisut) ISSN-L 2242-1211 ISSN 2242-122X (Verkkojulkaisu) http://urn.fi/URN:ISBN:978-951-38-8420-8
Julkaisuaika	Huhtikuu 2016
Kieli	Englanti, suomenkielinen tiivistelmä
Sivumäärä	46 s.
Projektin nimi	HARMONISE A Holistic Approach to Resilience and Systematic Actions to Make Large-Scale Built Infrastructure Secure
Rahoittajat	EU:n 7. Puiteohjelma & VTT
Avainsanat	skenaariot, resilienssi kaupunki, osallistava menettely, ennakointi
Julkaisija	Teknologian tutkimuskeskus VTT Oy PL 1000, 02044 VTT, puh. 020 722 111

Participatory scenario building
A tool for city planners

Today there exist big trends towards urbanization and the mega cities. This phenomena creates a need for consciousness and understanding what kind of chances do these mega trends involve city administration, construct and the maintenance of the buildings and infrastructure as well as land use. The strong immigration inside the countries from country side into the cities together with the immigration inside Europe as whole increase the population in cities and diversifies culture.

This workbook supports city decision makers to understand and foresight the forthcoming changes including opportunities and threats. In addition, the tool creates opportunities to influence the favourable city development and to build a vivid, vital and secure environment to all citizens.

This workbook is prepared as a part of the EU_HARMONISE project (A Holistic Approach to Resilience and Systematic Actions to Make Large-Scale Built Infrastructure Secure).