THE SEVS WAY

**UNDERSTANDING THE COMPLEX CHALLENGES
OF THE TRANSPORT SECTOR**

Introduction

sevs

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SEVS

> " _Many of the tools and models are also useful for other types of complex systems that are integral parts of the society as a whole._ "

Foreword

Complexity cannot be reduced, it must be handled. To do that, we must understand the interplay between different stakeholders, technological development, resources and the society.

SEVS, Safe Efficient Vehicle Solutions, is a strategic explorative project addressing the need for new tools and capabilities to analyse complex societal and technological challenges – specifically regarding the future transport system.

SEVS focuses on urban areas where new solutions for the mobility of people and transportation of goods are key ingredients for achieving sustainable cities. The study has involved many experts from different organisations and sectors. It has resulted in insights and answers as well as tools for analysing complex problems using multidisciplinary teams.

The methodology was developed in parallel with the analysis and therefore this handbook consists of both the methodology steps as well as the exemplified process results.

Some of the tools and models will be useful also for analysing other types of complex systems that are integral parts of the society as a whole – not only the future challenges and conditions for the transport system. The purpose of the handbook "The SEVS Way" is to spread the knowledge and use of the methods among organisations and people both inside and outside the SEVS project. This is an excerpt of the handbook, in principle the first, summing-up chapter. For more information and to get the full version, visit www.sevs.se

SAFER is just one of many stakeholders with a strong engagement in forming the future sustainable transport system. We are proud that our collaborative platform could serve as an inspiration and a base camp for the SEVS project. We will continue to work with our new tools, insights and colleagues.

GÖTEBORG IN SEPTEMBER 2014
ANNA NILSSON-EHLE, DIRECTOR SAFER

About SEVS

The development of more energy efficient transport and mobility solutions – without compromising the vehicle- and traffic safety – is essential to future sustainable cities. It is also crucial for the success of the transport sector and automotive industry. Therefore, SAFER, the Vehicle and Traffic Safety centre and SHC, Swedish Hybrid and Vehicle Centre, (both national centres of excellence within Chalmers) initiated the SEVS phase 1 project in 2009.

The SEVS project is based on the understanding that no single organisation can by it self develop the solutions that meet all the requirements of a safe, efficient and green transport system.

The SEVS project was conducted by a wide set of partners from the industry, academy and public sector and resulted in several future scenarios and several virtual transport and mobility concepts. The second phase (SEVS2)was run between 2012 and 2014, and

one of the result (among many other), is this strategic analysis methodology handbook; "The SEVS Way".

Some 50 experts from different sectors have been working in the project, contributing to the results, acquiring valuable knowledge and insights for themselves and the organisations they represent. The project has been funded by the Vinnova FFI-program (Fordonsstrategisk Forskning och Innovation) and the participating organisations.

The SEVS Way

The question is not which solutions can be realised but which solutions will be realised – and why and with what consequences. The SEVS Way offers a set of tools to help organisations and entire sectors to analyse and address complex societal and technological challenges of the future.

The long-term development of complex systems – the transport of people and goods for example – cannot be understood unless it is studied as a part of society. Many of the strongest driving forces that influence the transport system originate from outside the sector, such as resource scarcity, changing values and new city planning paradigms. What makes the task even more complex is that important effects on the transport system may often be side-effects of other changes in society. If the analysis is narrowed down too much, we run the risk of missing what is really important.

As humans, we are quite bad at handling complex problems, especially on our own or together with like-minded colleagues. We tend to base conclusions on an undefined mix of data and on personal experience and feelings. What is possible and desirable is confused with what is likely to happen in reality. We need methods that reduce personal influence and help us identify the most relevant data and arguments for a particular case. The SEVS Way makes it possible to analyse questions and challenges in complex contexts in an effective, rational and structured fashion and in well-defined steps.

However, methods and models alone will not generate any answers. They are simply tools that can be used to address problems in a structured way. The actual analysis requires experts from all relevant areas to work together. What they need is a common language and models, which is something that the SEVS Way can provide. ●

The SEVS method is based on a number of key elements:

- A *multidisciplinary team* of experts

- A *driving force model* to handle the complexity of the many forces that will influence society in the future

- *Scenarios* that provide concrete pictures of different possible outcomes regarding the society of the future. The scenarios are also used in the transport analysis (below)

- Carefully chosen and well described *use cases* for the mobility of people and transport of goods

- *Transport analysis* to find actors' preferred transport solutions using the use-cases, the prerequisites from the different scenarios and the selection criteria of the studied user

- *A Multi-Criteria Sustainability Assessment* to evaluate the relative sustainability of different solutions

- *A GO concept for addressing actions, challenges or possibilities for stakeholders*

Examples of conclusions from the SEVS project

- The transport system and society have developed in symbiosis; if one changes, the other will be influenced.

- Electromobility is not driven primarily by customer demand, more by city planning. Focusing purely on the users and their needs will not provide the right answers.

- A plug-in hybrid is a strong candidate in all scenarios for the investigated family, since it does not require behavioural changes and only limited infrastructure support in the form of a charger at home.

- Transport of goods is a more cost-optimised system than the transport of people and therefore seems to be affected less by a change in external conditions than the transport of people.

- One should be very cautious about drawing conclusions when analysing a solution where the focus is on achieving just one objective. Solutions in the real world always result in compromises between a series of conflicting requirements.

Disclaimer: These are just examples of conclusions. They are not official standpoints of the project partners and they could contradict certain established facts. The goal of the project has not been to reach consensus on all questions being studied. This was an important aspect of the process that ensured an open discussion despite different interests.

DIFFICULT QUESTIONS

GO's

SUSTAINABILITY
ASSESSMENT

TRANSPORT ANALYSIS

SCENARIOS

USE CASES

DRIVING FORCE
MODEL

FORM TEAM

Multidisciplinary team
– the core of the process

Handling complex problems can only be done by having people with different skills and backgrounds working together. This will only be successful with effective tools for the analysis and well-structured methods for making cooperation work.

All projects involving complex societal challenges should be run by a multidisciplinary team, bringing together experts from all relevant areas. As they represent different organisations and professions they most likely use different models and scientific languages. The participants need a common language for communicating their knowledge and a willingness to use the knowledge of their fellow project members.

An unconventional, explorative project does not necessarily have well-defined deliverables. Instead, the process and the methodology need to be very structured and well defined and there must be very clear yet wide boundaries.

The key to success is the project management philosophy and the attitude of the participants. The management must enable cooperation over organisational boundaries and create an inclusive process with numerous opportunities for the participants to co-create, discuss and reflect on the results together. ●

> " No single organisation can by it self find the solutions that will meet the challenges of sustainable cities. "

The core of a socio-technological lab such as SEVS is a team of experts exploring questions and testing ideas together in an open and trustful climate.

Driving force model
– to understand what shapes the future

All changes have a cause and often more than one. By studying causes and how they influence different aspects of society we can analyse how both society and a system such as the transport of people and goods could develop.

The driving force model is a visual representation of how different driving forces influence a system directly and indirectly and how the driving forces interact with each other. It enables us to see the real causes and effects and it bypasses personal preferences and intuition biased preconceptions and group-think.
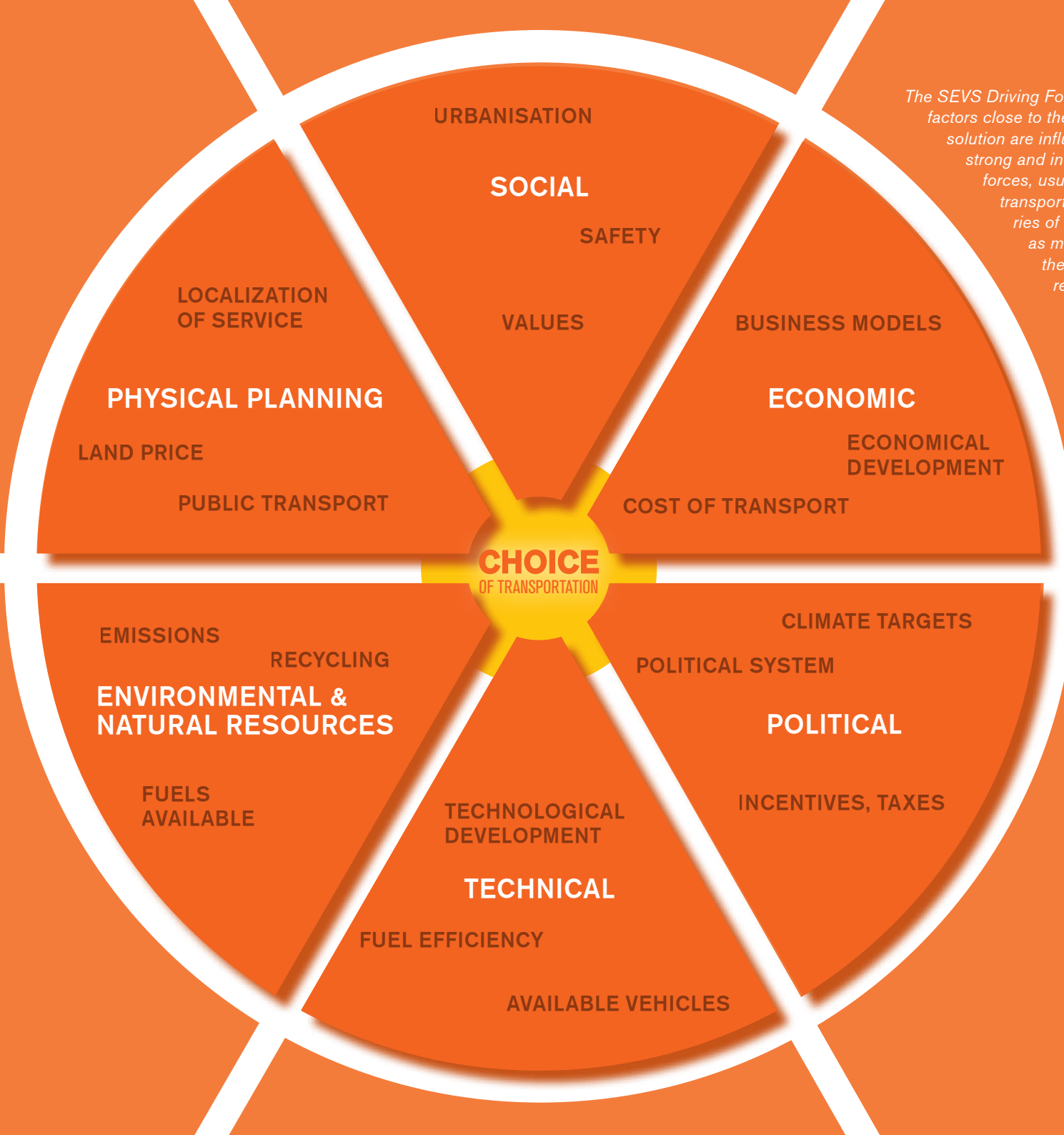
The driving force model allows us to first discuss each driving force individually and then integrate the results in a final analysis that will create holistic understanding. By breaking down the argumentation into smaller steps we prevent our brain from jumping to premature conclusions.

The driving force model will serve as a map for the group when deciding the route to be explored, pointing out what to focus on and what to ignore in each step. Initially, it will help to identify which competencies will be needed and which stakeholders should be invited to join the project, subject to there being a preliminary driving force model in place at the time the project is set up. ●

The SEVS driving forces

Initially, a large number of direct and indirect driving forces were identified in the SEVS project. They were organised into six groups to make them more manageable for the subsequent development of the dynamic model (described in Chapter 3).

The driving forces are placed closer or further away from the main focus of the project, i.e. the choice of transport solution made by a key actor – typically the user. Indirect factors, such as the characteristics of the overall energy market, will not directly influence the choice of mode for a commuter but it will – together with policies among many other things – influence the price and availability of different fuel options. This will in turn influence the household's choice and use of vehicle, or the decision to buy a car or not. These are all factors that set the conditions for the choice made that early Monday morning.

URBANISATION

SOCIAL

SAFETY

LOCALIZATION
OF SERVICE

VALUES

BUSINESS MODELS

PHYSICAL PLANNING

ECONOMIC

LAND PRICE

ECONOMICAL
DEVELOPMENT

PUBLIC TRANSPORT

COST OF TRANSPORT

CHOICE
OF TRANSPORTATION

EMISSIONS

RECYCLING

CLIMATE TARGETS

POLITICAL SYSTEM

ENVIRONMENTAL &
NATURAL RESOURCES

POLITICAL

FUELS
AVAILABLE

INCENTIVES, TAXES

TECHNOLOGICAL
DEVELOPMENT

TECHNICAL

FUEL EFFICIENCY

AVAILABLE VEHICLES

The SEVS Driving Force Model describes how factors close to the selection of a transport solution are influenced by many indirect, strong and interconnected driving forces, usually from outside the transport sector. The six categories of driving forces as well as many of the driving forces themselves can be considered to be general, making the SEVS driving force model applicable to the study of many other societal challenges. A dynamic and more detailed version of the Driving Force Model is presented in Chapter 3.

PROACTIVE
POLITICAL SYSTEM

ECO POLITICAL

RADICALISM
IN HARMONY

NO CHANGE IN
PATTERNS BY LIFESTYLE

RADICAL CHANGE IN
PATTERNS BY LIFESTYLE

INCREMENTAL
DEVELOPMENT

ECO INDIVIDUAL

*The scenarios are not predictions
but descriptions of different
possible futures.*

*They are created from an analysis
of driving forces and uncertainties
regarding how they will develop.*

REACTIVE
POLITICAL SYSTEM

Scenarios
– pictures of possible futures

The Driving force model illustrates which driving forces will shape the future, but not how they will play out. In order to analyse future needs and solutions, we need to have an idea of possible "values" of the driving forces and what future they points towards.

The driving forces are ranked according to how strongly they influence the complex system that is being studied – in the SEVS project it is the transport system – and the degree of certainty. The development of some of the critical factors will be very uncertain. This uncertainty can be used to define a number of scenarios that will help us to understand the consequences of different conceivable futures. What will society and the physical environment look like? What new rules or incentives have been introduced? How will people, companies and organisations behave?

The development of many other important driving forces is quite certain and will influence all scenarios

in the same way, while the uncertainties of the other driving forces will give rise to major differences in the scenarios.

It should be noted that the scenarios created are not predictions of what will happen, more tools for exploring possible outcomes. They are selected for being rather extreme, i.e. that the future is likely to fall within the wide area they cover. They should be described in a very concrete way (e.g. with fuel prices) and also told as stories to enable the project participants to step into the society of the future. The scenario method is thus a way of minimising the risk of basing the analysis on personal experience of today's world. ●

The SEVS Scenarios 2030+

The two main dimensions used to generate the SEVS scenarios are:

- Proactive political system vs Reactive political system

- Radical change in transport patterns by lifestyle vs No change in transport patterns by lifestyle

This led to four scenarios:

Incremental development, where neither people nor politicians lead the way – things happen, but at a much slower pace and on a smaller scale.

Eco-political, where politicians take initiatives and invest in infrastructure, research and incentives to change behaviour but with little support from people.

Eco-indivdual, where people and the market take many different and often uncoordinated initiatives, but with few major initiatives or large-scale investments or standardisations.

Radicalism in harmony, where change in lifestyle and political actions support one another.

No scenario should be favoured over the other during the analysis. They are all – or mixes of them – equally as likely to come true.

Transport analysis
– bringing actors, needs, solutions and conditions together

The transport analysis places the key actor in the middle of the decision process, equipped with selection criteria to evaluate possible solutions against the needs or activities of that actor – the use case. The result is a list of preferred solutions, or combinations of solutions, and, more importantly, an understanding of the mechanisms behind the answers and their consequences.

The Driving Force Model can be used to identify where and by whom key decisions are made and which mechanisms influence the process. In the SEVS transport analysis, the key actors are those who choose the means of transport, i.e. the people or households when it comes to mobility and the transport company or transport buyer when it comes to transporting goods.

The use cases are realistic and well-defined examples of households or companies and cover possible needs that influence long- and short-term transport decisions. The actor will have well-characterised existing or probable future transport solutions to choose from in order to fulfil the different needs or handle different activities. Some will be unsuitable, some will be manageable and others will do the job without any problems. To be workable, the analysis takes place in three steps.

Firstly examine all solutions versus needs separately.

Secondly, find combinations that can fulfil all needs.

Thirdly, alter elements of the use case, such as moving the household, as means to find even more attractive transport combination.

Every use case will be 'played' in all different future scenarios, where the specific conditions will change the rules of the game. The list of preferred solutions indicates which types of products and services might be successful on the market and why. The solutions can also be compared using the sustainability assessment described in Chapter 7. ●

A transport analysis matrix consists of needs or activities from a well-described use case on the vertical axis and a list of well-defined possible solutions on the horizontal axis. A green cell means that a need is well fulfilled by a solution according to the selection criteria for the actor in the use case. Yellow means that a solution would work, but not as well, while a red cell means that the solution is impossible or very undesirable to use. The lines connecting green or yellow cells represent possible combinations that fulfil all needs, with or without behavioural changes.

It should be noted that although this illustration is just a limited example, a real matrix should also not be too big.

In the first step every need or activity are analysed separately, assuming that the user has access to any needed vehicle. In the next step the best combinations are identified. In the third step (not shown here), also behavioural changes are taken into account, such as moving to an other area or change hobbies, that alter the transport needs.

NEED 1

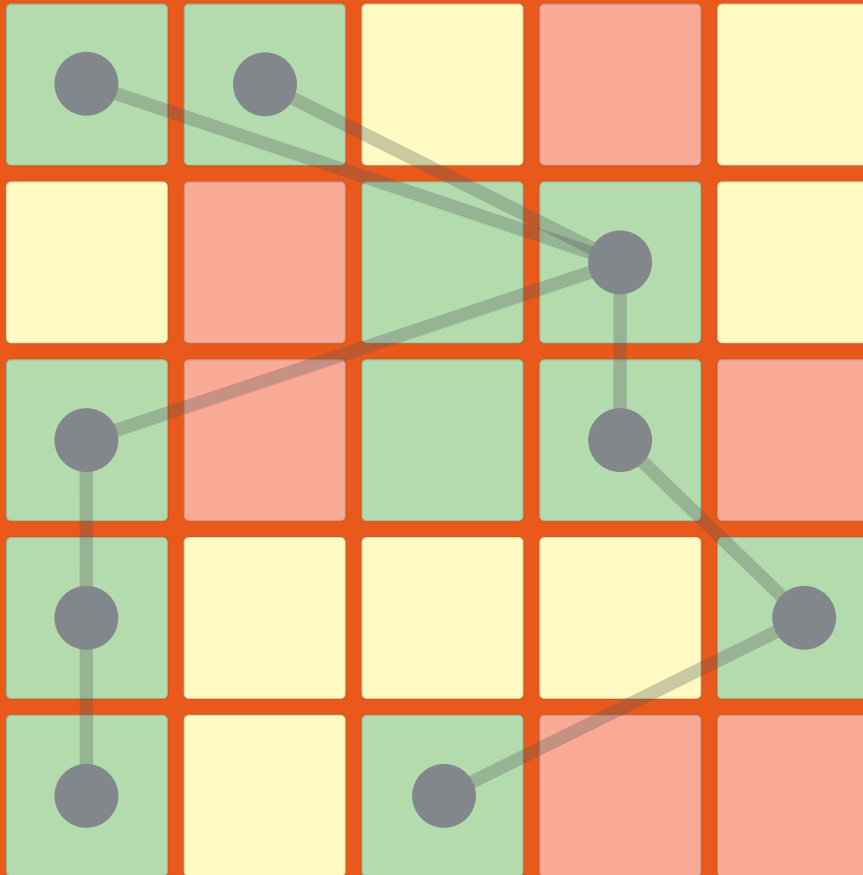To Work in city

NEED 2

Lunch

NEED 3

Pick-up daycare

NEED 4

Buy grocery

NEED 5

Play badminton

The SEVS transport analysis

A main task for SEVS has been to analyse the mobility of people and the transport of goods, with a focus on electromobility.

Use case, solutions and selection criteria

For the mobility of people, an activity-based use case model was used. The use case comprises every activity for a day or a week for an carefully defined actor. In this case a household is a suitable unit. It also covers more irregular transport needs since a family's annual ski trip could give rise to a need for a (larger) car.

The key to understanding a decision by an actor is to know the criteria the key actor uses when comparing alternatives. For the transport of people, it would typically be time, cost and convenience.

The analysis of goods transport was also based on use cases, but it is not activity-based as the transport of goods is a much more repetitive activity when it comes to city delivery, as in this case. Instead, the range of selection criteria was broadened, adding factors such as service level, customer relations and special requirements – cooling of cargo, security and policies for example.

The final ingredient of the transport analysis is the list of candidates, i.e. transport solutions. For practical reasons, it will be reduced to a manageable number of main alternatives. Substitutes for transport should also be included to capture behavioural changes that can alter the transport need.

The analysis

Decisions about transport modes are not made independently. The decision to buy or sell a bike or a car for example, will influence the forthcoming decisions. The right conclusions can only be drawn if a user's combined decisions are taken into account, although the starting point is an individual analysis of each trip and assuming access to any needed vehicle (bicycle, car etc).

In the second step, it will be possible to identify one or more combinations of transport solutions that more or less fulfil every functional requirement (or trip) of the use case. The attractiveness of specific transport solutions can only be compared as part of these packages. Furthermore, the analysis needs to include the transport needs of the whole family in order to see, for instance, if there is a need for one or two (or no) cars.

Finally, the analysis should also be open to a change of behaviour that alters the need for transport, making new, attractive combinations possible. This could be moving to another area, changing hobby or planning daily activities in a different way. In the end, patterns will emerge in the needs-solutions matrix that correspond to preferred combinations of solutions.

All steps in the analysis should be taken for each scenario with its specific conditions. At least as important as the list of 'winners' are the arguments that led to the conclusions. Which factors have the strongest influence? Which trips in the use case are most difficult to meet?

Sustainability assessment
– comparing solutions and understanding consequences

It is not certain that the most probable solutions are the most sustainable. By comparing the solutions using a manual multi-criteria analysis (MCA), we will not only assess the sustainability but also learn more about the consequences of different driving forces and decisions.

By comparing the 'winning' solutions in the different scenarios from the transport analysis, a great deal can be understood about the sustainability aspects, not only for the solutions themselves but also for society in different futures that would foster this solution.

The MCA starts with the team formulating the relevant sustainability criteria for the study, typically using three dimensions – environmental, social and economic – as a starting point. For example, one criterion used by SEVS was 'Number of killed or seriously injured persons by or during transportation'.

The assessment is performed as a qualitative multi-criteria analysis (MCA). An MCA is suitable when there are criteria with different dimensions that need to be evaluated in comparison with each other and when there are different stakeholders involved. During workshops the participants will need to agree on how well the transportation solutions in each scenario are performing for each sustainability aspect. 0 is equal to the present situation (index), -3 is the least favorable and +3 the most favorable. If no consensus is reached following discussion, the average from a vote will be used. In the same way, the degree of importance of the different aspects is weighted from 0 to 100.

The result will be a table with weighted sums for different solutions or entire scenarios. Understanding what led to the results will lead to – sometimes counterintuitive – insights, both in sustainability and the underlying mechanisms. ●

The MCA of SEVS

The process of formulating sustainability resulted in 18 criteria that were applied to the winning solutions from the transport analysis of "the Kungsbacka family" and "Kurt the baker"

The results from the multi-criteria analysis show that the transportation solutions in the scenarios are more favourable from a sustainability perspective compared with the present state, but also that the social and economic performances in the scenarios vary and are not always favourable compared with the present state.

Go!

The goal of SEVS2 has also been to induce actions and progress by directing different issues to sectors or organisations that are best suited to handling them or making use of them. These so-called GOs comprise challenges, risks and possibilities on the one hand and stakeholders who need or want to address them on the other, e.g. Go Research, Go Factory, Go Political.

Complexity cannot be reduced, it must be handled. To do that, we must understand the interplay between different stakeholders, technological development, resources and the society.

This is an introduction to the "SEVS Way", a handbook containing both the results from the strategic explorative project SEVS phase 2 (Safe Efficient Vehicle Solutions) as well as the methodology that was developed parallel with the analysis.

Some of the tools and models will be useful also for analysing other types of complex systems that are integral parts of the society as a whole – not only the future challenges for the transport system.