The S-E-A-T approach to Strategic Guidance for Planning towards Sustainable Transportation

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Abstract: Transportation is good for people, but it needs a social system shift in combination with sustainable technologies in order to move towards a sustainability vision. To explore how that can be done, the authors first found out about both national and municipal sustainability visions and identified a range of social and technological solutions for long and short term use. The exploration of how municipal planning of transportation can be improved lead to the conclusion that planning for transportation in Swedish municipalities can be made more sustainable when conducting the ABCD-method within the framework for strategic sustainable development. To enhance that, the authors merged the five subsystems developed for sustainable traffic solutions and the PESTEL-method. That resulted in the S-E-A-T model that informed the content of a prioritisation tool and also provides structure to the brainstorming sessions within the ABCD-method.

The combination of the ABCD method, the S-E-A-T model and the expanded guiding questions form a robust approach for strategic planning of sustainable transportation rooted in a bird´s eye and systems perspective and ultimately based on backcasting from the principles of sustainability. Further testing is though recommended to assess and refine its usefulness and applicability.

Keywords: Sustainable development, Sustainable transportation, Transportation planning, Strategic planning, S-E-A-T approach

Statement of Contribution

This thesis research was the result of the gathering effort of three team members, who found themselves having the same interest in how future sustainable transportation would look like, and how it would be possible to get there through the lens of sustainability.

Stefan is from Kalmar, Sweden. He spent three years studying Business Administration and International Tourism Management in Sydney, Australia, and went on to earn an Honours Bachelor's Degree of International Tourism Management at Bournemouth University, United Kingdom. Sven lives in Karlskrona, Sweden. He has 15 years working experiences within mechanical engineering and management from different private businesses. Qing from China has been working on the Jinghu expressway, which raised her concern regarding transportation.

One of the most interesting experiences was the co-creation with Transportstyrelsen and Jönköping Municipality. It gave the authors a great opportunity to apply some of the sustainability planning tools and skills learned throughout the studies at Blekinge Institute of Technology.

Qing focused her work on social aspect exploration and analyzing results gathered from the two collaborative sessions. Qing´s working experience, in combination with profound insights and unique angles were great contributions. Stefan focused on exploring the Swedish transportation planning processes. He did great contributions to the S-E-A-T model creation by using his expertise in business administration and the thesis overall by his structured way of thinking. Sven focused on technology exploration with his solid background as an engineer and did a great study of the technological sphere. His talents in designing pictures and graphs were truly beneficial.

This thesis not only reflects the authors' knowledge and learning but also presents the fruits of good collaboration and teamwork, enriched by differences in skills and backgrounds.

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- Ms Lena Wennberg, Luftfartsverket

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Executive Summary

Transportation is an important part of modern society and a central element in societal development by making goods and destinations more accessible. Today´s transportation is unsustainable due to severe socio-environmental impacts. For example, the infrastructure for transportation splits ecosystems by creating corridors across natural areas resulting in inhospitable areas for living creatures and organisms. Road accidents cost society 18.7 billion SEK in 2005 (MSB 2005). The sustainability challenge also includes the flow of chemicals and metals. Construction and maintenance of infrastructure contributes to a systematic increase in nature of substances both produced by society and extracted from the earth's crust.

Within the given background, a question then arises: how shall we plan travel and freight in order to sustain the amount of limited natural resources on earth, emit less harmful substances, and give prominence to the final users? This thesis will try to give guidance on how Swedish transportation can be supported in a transition towards sustainability. Such guidance will be developed by looking through the lens of sustainability as defined in a scientific consensus process by the NGO The Natural Step by sustainability system conditions (Holmberg and Robèrt 2000). These conditions can be reformulated to sustainability principles (SP´s) for transportation:

When transportation is truly sustainable it no longer contributes to… (1)...systematic increases in concentrations of substances from the Earth´s crust; (2)...systematic increases in concentrations of substances produced by society; (3)...systematic physical degradation of nature; (4)...conditions that systematically undermine people´s capacity to meet their needs.

Sweden is progressive on setting and fulfilling targets related to socio-environmental protection. Nonetheless, the public concerns about emissions and other serious socio-environmental impacts from transportation are growing as transportation is increasing. Ambitious goals at various levels (national, regional, municipal) try to respond to the need for a social system shift towards public transportation and more sustainable transportation of goods and humans. Municipalities are more often calling for new and/or improved transportation financed by the state. Municipalities set the stake for their local public transportation, sometimes in regional constellations with neighbouring municipalities. The authors believe that enhancing municipal planning towards sustainable transportation would have a positive impact on society and the citizens as they will see that local leaders are taking action towards sustainable transportation, which in turn could

increase awareness and motivation to take action in other areas. This thesis applies the Framework for Strategic Sustainable Development (FSSD) and the ABCD-method described below.

Rooted in science, the FSSD described by Robèrt (2000) can give powerful insights for how to plan towards a sustainable future. The FSSD is developed from a generic five-level framework used for planning in any complex system. The purpose of the framework is to bring clarity, rigour and insight to planning and decision-making towards sustainability. The FSSD is used as a unifying framework for systematic and strategic sustainable planning, for sustainability analyses of current practices and visions, and for the choice and information and design of tools.

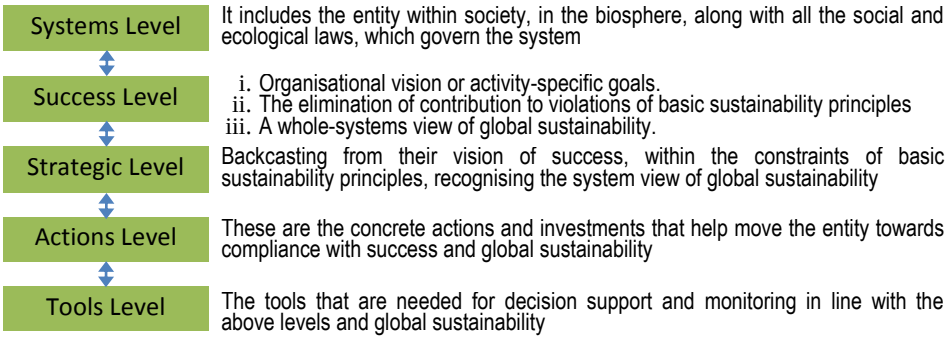


Figure: The Framework for Strategic Sustainable Development

The ABCD-method is a strategic tool within the FSSD and it uses backcasting to find the right prioritised actions derived from the vision that is framed by the SP's (Broman et al. 2000). It consists of four logical steps:

A - Awareness. The first step aims to involve and align organizations and projects around a shared mental model or a common understanding of sustainability.
B - Baseline Mapping (Current Reality Analysis). This stage consists of an analysis of the current reality to identify major flows and impacts of the organization/project.
C - Compelling Measures. In this stage a compelling long term vision for a sustainable organization is created and solutions to problems are identified. From the vision, organizations develop strategies and action plans for moving towards sustainability.
D - Prioritization. Suggestions from the C-list are prioritized according to their potential to serve as stepping stones to move the organization towards sustainability.

Scope of the Thesis

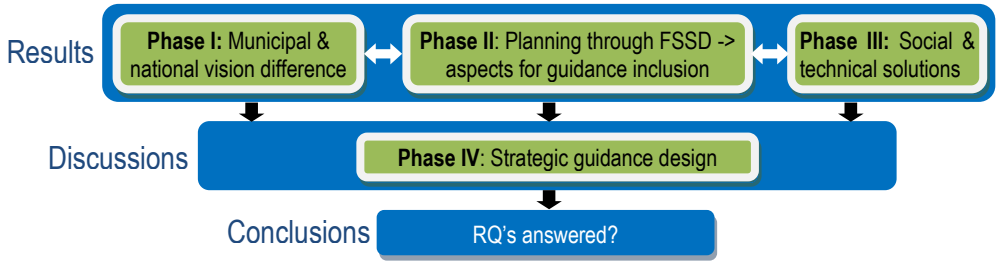
Derived from the given background, the research question is:

- *What will Swedish sustainable transportation look like and how can municipal strategic planning of transportation be supported?*

Sub-questions that will deepen the exploration of the above question:

1. *An exploration of national and municipal level visioning towards sustainable transportation: How would such visions ideally look like and is there a need for national and municipal differentiation?*
2. *What are the potential areas of improvements, actions and aspects within municipal planning that will support and enhance the chances of success of sustainable transportation?*
3. *What are the emerging innovations and possible solutions towards sustainable transportation?*
4. *How can flexible strategic guidance be provided to municipalities in order to prioritise compelling measures towards sustainable transportation?*

The research phases of the thesis are structured as follows:



Results: Phase I-III

The results chapter is divided into three phases (figure above) and each phase explores a research question (1, 2, and 3).

Phase I: Municipal and National Visioning. It was found that the system in which transportation planning occurs overall tends to be wrapped by the same boundaries regardless if it relates to national or municipal planning of transportation. The findings also reveals that some components of visions at national and municipal level are the same (core values), while other parts could be made the same (core purpose). Different vision building techniques across the country and societal levels are making it complicated to arrive at shared mental models.

Phase II: Planning Through the Lens of FSSD. This phase reviewed planning through the lens of FSSD after having outlined fieldwork findings

and then presented areas of improvement and potential challenges within the process. Areas of improvement and potential challenges in strategic planning towards sustainable transportation were identified to be visioning and responsibility, collaboration, stakeholder involvement, knowledge and capability, economic challenges, social barriers, and demand management. Success factors within planning of sustainable transportation highlighted a wide range of areas related to all stages of the process that if covered and considered could enhance the chances to arrive at success.

Phase III: Socially oriented and Technological Solutions. The study shows that emerging innovations would be the ones that are based on natural resources for propulsion, ones that requires very little land-use, have a low flow of metals and chemicals (which are handled in a closed loop), result in lower emissions, and are suited for different human needs. Current technological trends on the other hand were found to be solutions such as, green cars, tram, walking, biking, ship electric propulsion, fast trains replacing flights, and track guided personal vehicles. More socially oriented studies and solutions touched upon areas such as, social behaviour change, satisfier for public transportation, social injustice, capturing and analysing human transportation patterns.

Discussions: Phase IV

The first three phases of the thesis subsequently informed the fourth phase and the strategic guidance support covered within the discussions chapter. Using the ABCD-method (figure, page V) and arrive at the right prioritised actions in the D-step could be difficult, especially when analysing transportation with its complicated interaction with other areas. The authors therefore acknowledged a need to further expand the strategic guidance within the ABCD-method. Cars et al (2008) created an idea sketch for planning of sustainable traffic systems in which 5 interlinked sub-systems were suggested (Resource base, Energy carrier, Motoring, Infrastructure, Social system). The terminology of the 5 subsystems and the PESTEL model (used for macro-environmental analysis for business) were fused into one unified model for sustainable transportation with the purpose to categorise the most essential aspects in the strategic planning of sustainable transportation, and visualise a bird´s eye and systems perspective. The most essential aspects within planning were carved out from the findings of the results chapter and fed into the model in order to make it complete. It was concluded that strategic questions based on the subcategory content in the S-E-A-T model would serve as an ideal way of providing flexible guidance.

A strategic guidance tool was created, with guiding questions sorted as per the four spheres within the S-E-A-T model (figure below). After having analysed each measure one-by-one the user moves on to answer three correlation questions to determine interrelation opportunities to ensure a positive combination of the measures. The authors stress the importance of using the tool within a comprehensive workgroup of key stakeholders, experts and planners representing all involved areas that are touched upon in the questions. All the answers should then be deeply analysed and subsequently allow planners to more easily map-out a long-term strategy for sustainable transportation. The S-E-A-T model can be used to provide structure to the B-step and the C-step of the ABCD-method and the strategic guidance tool should be used within the D-step.

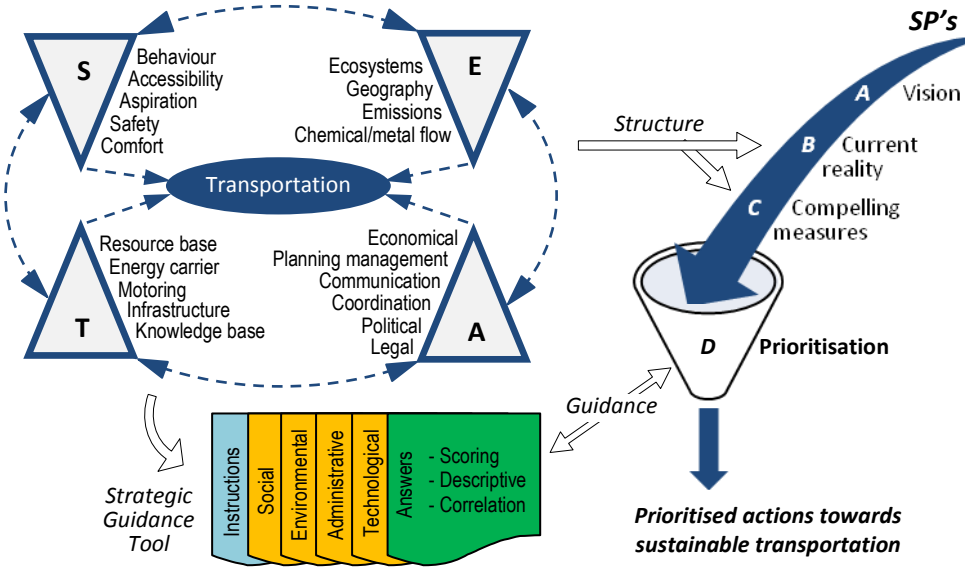


Figure: The S-E-A-T approach

Conclusions

The combination of the ABCD method, the S-E-A-T model and the expanded guiding questions form a robust approach (the S-E-A-T approach) for strategic planning of sustainable transportation rooted in a bird´s eye and systems perspective and ultimately based on planning informed by the principles of sustainability. It is recommended to follow this study up by further testing the tool at Swedish municipalities and other stakeholder groups to further refine the tool and enhance its usefulness and applicability. The S-E-A-T approach must be used within the ABCD-method in order to ensure backcasting from a principled definition of sustainability, and thereby requires knowledge of the involved methods.

Glossary

Agenda 21: A programme run by the United Nations (UN) related to sustainable development and was the planet's first summit to discuss global warming related issues. It is a comprehensive blueprint of action to be taken globally, nationally and locally by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment

Auxiliary systems (Vehicle): System(s) except from the propulsion to support the vehicle's other system(s) during its life cycle or for backup. Examples are electricity production, air condition, accommodation, food management, and emergency system(s).

Backcasting: A way of planning in which a successful outcome is imagined in the future, followed by the question: "what do we need to do today to reach that successful outcome?"

Banverket: The Swedish rail administration, from the 1st of April 2010 included in Trafikverket (the Swedish transport administration).

Biofuels: A wide range of fuels which are in some way derived from biomass. The term covers solid biomass, liquid fuels and various biogases.

Biogas: A gas produced by the biological breakdown of organic matter in the absence of oxygen. Originates from biogenic material and is a biofuel.

Biomimicry (or biomimetics): The examination of nature, its models, systems, processes, and elements to emulate or take inspiration from in order to solve human problems.

Biosphere: The part of the Earth, including air, land, surface rocks and water, within which life occurs, and which biotic processes in turn alter or transform. From the broadest bio physiological point of view, the biosphere is the global ecological system integrating all living beings and their relationships, including their interaction with the elements of the lithosphere, hydrosphere and atmosphere.

Carbon neutrality: Achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered or offset, or buying enough carbon credits to make up the difference.

Casual Loop Analysis: Analysis of the feedback loops in a system.

Cause-Effect Analysis: Generates and sorts hypotheses about possible causes of problems within a process by asking participants to list all of the possible causes and effects for the identified problem.

Combustion Engine (Internal): An engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber. The expansion of the high temperature and pressure gases, which are produced by the combustion, directly applies force to a movable component of the engine, such as the pistons or turbine blades and by moving it over a distance, generate useful mechanical energy. Examples are Otto-engines, Diesel-engines, Stirling-engines, aircraft turbines.

Demography: The statistical study of human populations. It can be a very general science that can be applied to any kind of dynamic human population, that is, one that changes over time or space. It encompasses the study of the size, structure and distribution of these populations, and spatial and/or temporal changes in them in response to birth, migration, aging and death.

E85: An alcohol fuel mixture that typically contains a mixture of up to 85% denatured fuel ethanol and gasoline or other hydrocarbon (HC) by volume.

Electromagnetic suspension (train): In current electromagnetic suspension (EMS) systems, the train levitates above a steel rail while electromagnets, attached to the train, are oriented toward the rail from below. The system is typically arranged on a series of C-shaped arms, with the upper portion of the arm attached to the vehicle, and the lower inside edge containing the magnets. The rail is situated between the upper and lower edges.

Electrodynamic Suspension (train): In EDS, both the rail and the train exert a magnetic field, and the train is levitated by the repulsive force between these magnetic fields. The magnetic field in the train is produced by either electromagnets or by an array of permanent magnets. The repulsive force in the track is created by an induced magnetic field in wires or other conducting strips in the track.

Exergy: In thermodynamics, the exergy of a system is the maximum useful work possible during a process that brings the system into equilibrium with a heat reservoir. When the surroundings are the reservoir, exergy is the

potential of a system to cause a change as it achieves equilibrium with its environment. Exergy is then the energy that is available to be used.

General Outline Plan (and Master Plan): Collective plan for infrastructure and Urban Planning. It is also called 'översiktsplan' in Swedish.

Geographic Information Systems (GIS): Any system that captures, stores, analyzes, manages, and presents data that are linked to location.

Global Warming: The man-made increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation.

Green House Gas (GHG) neutrality: Zero net emissions of greenhouse gases to the atmosphere. GHG gases (hydro fluorocarbons, methane, nitrous oxide, per fluorocarbons, sulphur hexafluoride, carbon dioxides) are measured as CO_2 equivalents in Sweden.

Halbach array configuration: An arrangement of permanent magnets that increases the magnetic field on one side of the array while cancelling the field close to zero on the other side.

Hybrid (vehicle): A vehicle that uses two or more distinct power sources to move the vehicle and refers here to hybrid electric vehicles (HEVs), which combine an internal combustion engine and one or more electric motors.

Life Cycle Assessment (LCA): Investigation and evaluation of the environmental impacts of a given product or service caused or necessitated by its existence.

Micro Grids: The decentralisation of power distribution system(s), also referred to as local (i.e. company or household) electrical grids.

Näringsdepartementet: Ministry of enterprise, energy and communications.

Naturvårdsverket: The Swedish Environmental Protection Agency (EPA)

POD-drives (also Azimuth thrusters): A configuration of ship propeller(s) that can be rotated in any horizontal direction and make rudder(s) unnecessary. Here the electric motor can be placed either directly at the propeller (direct drive) or inside the ship.

Power Train: A group of components that generate power and deliver it to the road surface, water, or air. This includes the engine, transmission, drive shafts, differentials, and the final drive (drive wheels, continuous track like with tanks or Caterpillar tractors, propeller, etc.)

Precautionary principle: A response to uncertainty, in the face of risks to health or the environment. In general, it involves acting to avoid serious or irreversible potential harm, despite lack of scientific certainty as to the likelihood, magnitude, or causation of that harm.

PRT or Pod Car: Small automated vehicle within an on-demand public transportation system with an infrastructure of specially built guide ways. A key feature is that the start and stop is chosen only by the vehicle users.

Rudder Propellers: Propellers that are mounted either in front or after the rudder(s) of the ship.

System Boundaries: A range of information that together describes the limits of the chosen system within the biosphere.

Systems Thinking: An approach to problem-solving that assumes that the individual problem is part of a much larger system. The intent is to solve the problem in a way that does not create further problems down the road.

Svenska Kommunförbundet: A union of Swedish municipalities governed by political party representatives. It is incorporated in the SKL since 2005.

Trafikverket: The Swedish transport administration.

Urban Sprawl: Expansion of built land on the periphery of an urban area at a rate greater than that of the concurrent increase in population. They are characterised by low-density development, large single-use areas, discontinuous urbanisation, and a high rate of automobile dependency.

Vägverket: The Swedish road administration, from the 1st of April 2010 included in Trafikverket (the Swedish transport administration).

Acronyms

3GGQ	The three general guidance questions (D-step of the ABCD-method). See chapter 1.1.5
BTH	Blekinge Tekniska Högskola (Blekinge Institute of Technology)
BHAG	Big Hairy Audacious Goal (described in chapter 1.1.4)
EDS	Electro Dynamic Suspension (3.1.4)
EMS	Electro Magnetic Suspension (3.1.4)
EU	European Union
EPA	Environmental Protection Agency
FSSD	The Framework for Strategic Sustainable Development (1.1.2)
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilo watt hour
OECD	Organisation for Economic Co-operation and Development
PRT	Personal Rapid Transport
SEKom	Sveriges Ekokommuner
SIKA	Statens institut för kommunikationsanalys (Swedish Institute for Transport and Communications Analysis). From the 1st of April 2010 divided into Trafikverket and Trafikanalys
SKL	Sveriges Kommuner och Landsting (Swedish Association of Local Authorities and Regions)
SP's	The four sustainability principles. (1.1.1)
TNS	The Natural Step
US	United States (of America)

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1 Introduction

Transportation is about getting something or someone physically moving from A to B and thereby supports society in numerous ways. Distant societies can grow or sustain as necessary goods and people can be brought in and out. People also enrich their lives (in most cases) by travelling, while goods can be produced where it is most productive and then transported to the consumers. The possibility of getting aid quickly to people in isolated areas is a third example of how the society of today relies on transportation and will almost certainly continue to do so in the future.

Energy must be used in transportation, which is mainly conducted using fossil fuelled vehicles. 83 per cent of people transportation is conducted on the roads and the corresponding figure for goods is 41 per cent (SIKA 2009). 13.5 per cent of global carbon dioxide (CO_2) emissions are caused by transportation (Solomon et al. 2007), but the Swedish equivalent figure is 50 per cent, as the energy production share is much lower than the global.

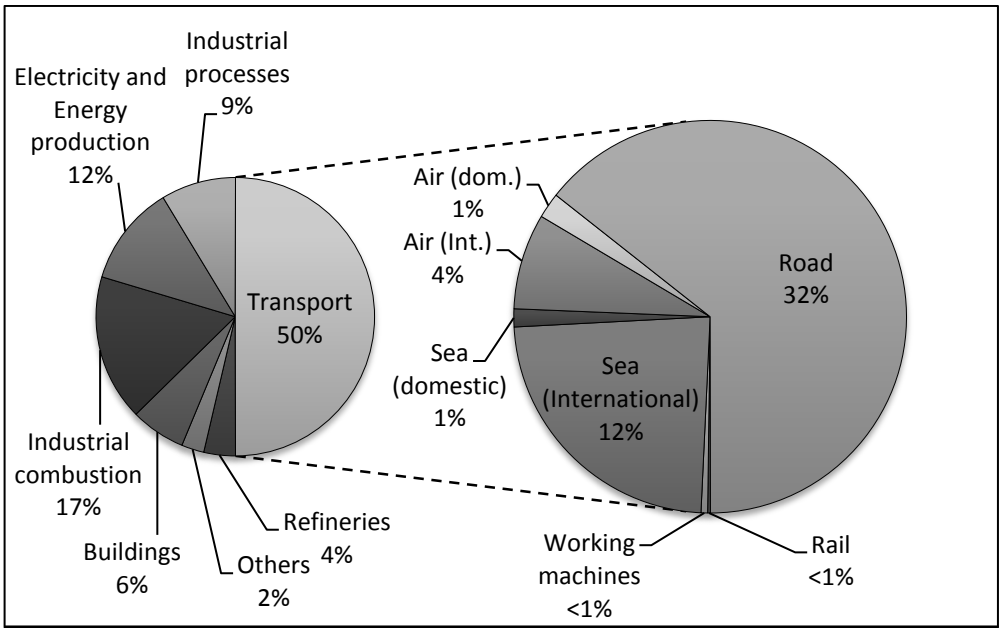


Figure 1.1: Swedish carbon dioxide emission shares in 2008. Data from Naturvårdsverket (2008)

Social and environmental impacts are not only about emissions. Land use for renewable energy sourcing, especially during and after use of fossil

fuels, is very area-demanding. Furthermore, land use for the infrastructure splits ecosystems by creating corridors across natural areas where it is dangerous for any creature to live and where most living organisms are not welcome. Road accidents cost society 18.7 billion SEK in 2005 (MSB 2005). Additionally, transportation today is unsustainable due to the flow of chemicals and metals accompanying the life-cycle of the fleet of vehicles used for transportation. The construction and maintenance of the infrastructure contributes to a systematic increase in nature of substances both extracted from the earth's crust and also produced by society.

A reason for hope is that Sweden has been concerned about environmental issues since the referendum regarding nuclear power in 1981, and even earlier with the scandal by the company BT-kemi in the late 1960's. The environmental code was established in 1999 with a purpose to promote sustainable development to ensure a healthy and sound environment for present and future generations (Naturvårdsverket 1998). The raised awareness in the 20th century of the climate crises as well as the need of societal development towards a sustainable future made the Swedish government set the goal for Sweden to be greenhouse gas neutral by 2050, mainly by cutting GHG emissions. Also, in comparison to the level in 1990, a reduction of 40 per cent will be made by 2020 and of 4 per cent on average between 2008 and 2012 (Naturvårdsverket 2009).

Regional objectives are sometimes more ambitious than national ones. Some of them are different because the conditions for transportation vary in each municipality. The organisation Sveriges Ekokommuner (SEKom) includes 77 municipalities (out of 290) who are committed to 12 green indicators that will help monitor the progress towards a sustainable society (SEKom 2010). Such awareness and the proactive attitude at the national and local levels can be seen as a fertile ground for planning strategically towards sustainable traffic solutions.

A sustainable and efficient transportation system is essential for societal development and economic growth, and thus to the creation of good welfare (SKL 2008). Another motivating factor to develop our transportation system and make it sustainable is that it has a key role in regional expansion by creating more and better-functioning labour market regions and bringing about joint planning of traffic (SKL 2008).

1.1 Planning Towards Sustainable Transportation

This sub-chapter introduces a principled definition of sustainability, and a framework for sustainable development. The authors briefly explain sustainability visioning and how backcasting from such vision through the ABCD-method can support the creation of strategic measures towards a sustainable society. Finally, a paper about Sustainable Traffic Solutions is briefly introduced.

1.1.1 Sustainability

The definitions of sustainability vary. The Brundtland Commission Report (1987) says that *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* The definition of sustainability in this thesis is facilitated in a consensus process by The Natural Step (TNS) and its founder Karl-Henrik Robèrt, and is defined within biosphere; it is a state where society does not systematically undermine natural or social systems. Achieving sustainability would happen when contributions to violations of basic four sustainability principles (SP's) are eliminated:

"In a sustainable society, nature is not subject to systematically increasing:

- *Concentrations of substances extracted from the earth's crust*
- *Concentrations of substances produced by society*
- *Degradation by physical means*
- *And people are not subject to conditions that systematically undermine their capacity to meet their needs"* (Holmberg and Robèrt 2000)

The human needs mentioned above and throughout this thesis refer to Max-Neef´s (1992) definition of nine basic human needs, which are: subsistence, protection, affection, understanding, participation, recreation (in the sense of leisure, time to reflect, or idleness), creation, identity and freedom.

The sustainability principles are preferably put into a framework for sustainable development in order to better structure our understanding of complex problems in the shift towards a sustainable society.

1.1.2 Framework for Strategic Sustainable Development (FSSD)

> *"To be successful in a system, we need to have a structured comprehension, or a conceptual framework, to allow systematic planning and decision-making*" (Holmberg and Robèrt 2000)

The Framework for Strategic Sustainable Development (FSSD) described by Robèrt (2000) constitutes the fundamental contextual framework utilised in this thesis. Scientifically rigorous, the FSSD is developed from a generic five-level framework used for planning in any complex system. The purpose of the framework is to bring clarity, rigour and insight to planning and decision-making towards sustainability. The FSSD is used as a unifying framework for systematic and strategic sustainable planning, for sustainability analyses of current practices and visions, and for the choice and information and design of tools. It can support long-lasting transformational change within an organisation/project. The framework also helps by "*avoiding the tendency in planning to focus only on a subset of issues or areas ignoring broader, connected issues leading to a need to expand the system boundaries*" (Holmberg and Robèrt 2000).

1. **System level**: It includes the entity within society, in the biosphere, along with all the social and ecological laws, which govern the system.
2. **Success level:**
   i. Organisational vision or activity-specific goals.
   ii. The elimination of contribution to violations of basic sustainability principles (SP's).
   iii. A whole-systems view of global sustainability.
3. **Strategic Level:** Backcasting from their vision of success, within the constraints of basic sustainability principles, recognising the system view of global sustainability.
4. **Action Level:** These are the concrete actions and investments that help move the entity towards compliance with success and global sustainability.
5. **Tools Level:** The tools that are needed for decision support and monitoring in line with the above levels and global sustainability.

To achieve a plan at the strategic level, which will lead to success, it is preferred to use guidance that keeps a bird's eye and system thinking perspective.

1.1.3 Backcasting

The concept of "backcasting" is central to a strategic approach for sustainable development. It is a way of planning in which a successful

outcome is imagined in the future, followed by the question: *"what do we need to do today to reach that successful outcome?"*

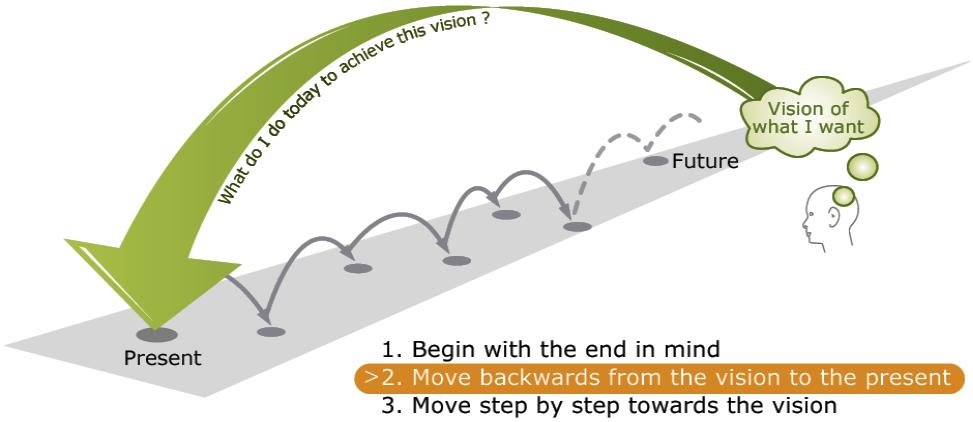


Figure 1.2: Backcasting from the future.
Source: The Natural Step n.d.

In this step, people are asked to brainstorm potential solutions to the issues highlighted in the baseline analysis. Armed with their vision of success and potential actions, organisations look backwards from the vision to develop strategies toward sustainability. It prevents people from developing strategies that only solve the problems of today. Instead, they begin with the end in mind, moving towards a shared vision of sustainability, with each action providing a platform for further improvement.

There are two major planning methodologies, forecasting and the above mentioned backcasting. In forecasting planning is done from the present time instead of backcasting from tomorrow (future). Instead of using forecasting only it is more effective to use backcasting or a combination of the two methodologies in order to avoid a too short sighted mindset that can limit creativity as well as flexibility.

1.1.4 Visioning

Backcasting can only be approached when an envisioned definition of success is in place. Using the ABCD-method described in chapter 1.1.5, a sustainable vision has to be created that includes the SP's in order to conduct backcasting and find solutions towards a sustainable society.

Robèrt et al (2007) describes the process of a sustainable vision and its components. First, it has to include the stable part (SP's and the core) that is

a stable platform on which all activities should be based on. The SP's then define the constraints within which an organisation should operate within (Robèrt et al 2007). The core consists of a purpose and a core value where the purpose is the organisation's reason for being and the values are a small set of guiding principles that are timeless and do not need any external justification (Collins and Porras 1996):

> *"The core ideology provides the glue that holds an organisation together through time. You discover core ideology by looking inside. It has to be authentic. You can't fake it."*

Secondly, the flexible part of the vision is the envisioned future which consists of strategic goals and the vivid description as described by Collins and Porras (1996). The strategic goals are made up by Big Hairy Audacious Goals (BHAG's) that with a 50 to 70 per cent probability of success can be reached in 10 to 30 years. They are described as ambitious goals, the success of which is not guaranteed (Collins and Porras 1996):

> *"What's needed is such a big commitment that when people see what the goal will take, there's an almost audible gulp."*

Robèrt et al (2007) further describes that the strategic goals have to point in the direction of success and can be made up in several focus areas. They should also be formulated on a principle level with a distinct timing and clear enough to be used in planning, but do not have to be quantified. The vivid description is then a futuristic story that translates words to pictures and describes what it will be like when the strategic goals are achieved (Collins and Porras 1996).

The vision has to be deeply rooted within the organisation to be solid enough for use in planning towards sustainability like the ABCD-method.

1.1.5 The ABCD Method

The ABCD-method is a specific tool to apply "backcasting" from basic principles of success" through four logical steps shown in figure 1.3.

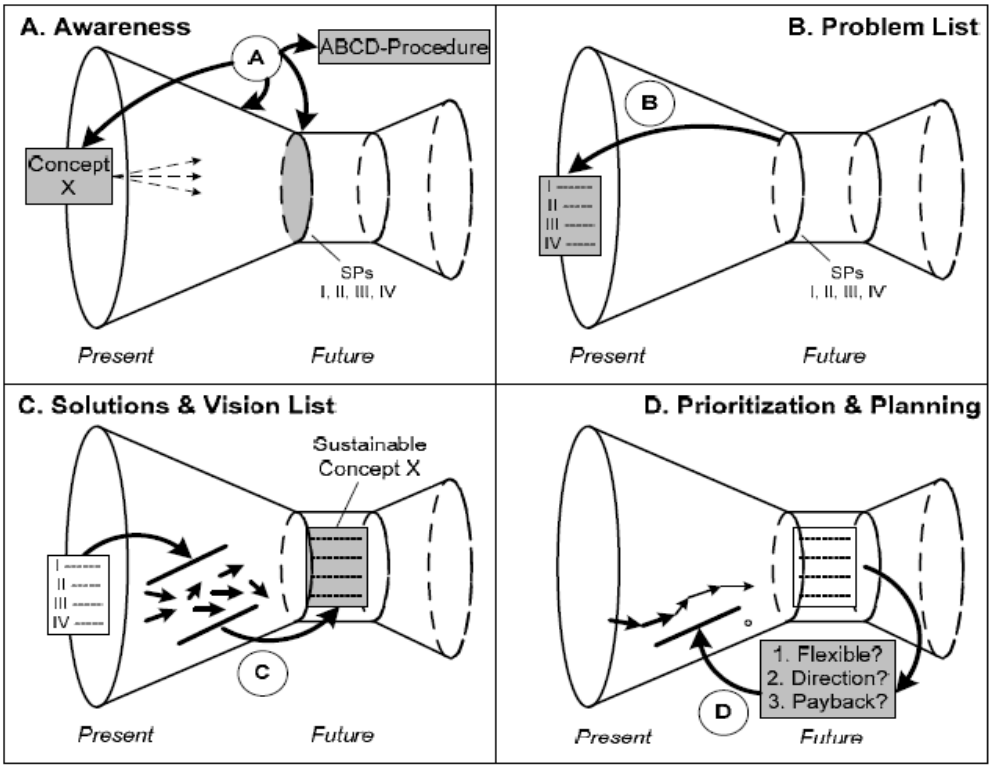


Figure 1.3: The ABCD procedure of backcasting from SP's.
Source: Ny 2009

A - Awareness. The first step aims to involve and align organizations and projects around a shared mental model or a common understanding of sustainability, demonstrating how society and organizations are part of the whole system, the biosphere and the main mechanisms by which societies are contributing to violations in our living system.

B - Baseline Mapping (Current Reality Analysis). How does society or our organization look like today? This stage consists of an analysis of the current reality to identify major flows and impacts of the organization/project. Sustainability principles are used to scrutinize process and activities and to allow identification of critical sustainability issues, their threats, and opportunities. This includes the impacts of the infrastructure, services, energy, and the social context, providing a basic platform to understand how changes can be introduced further on.

C - Compelling Measures. How does our organisation look like in a sustainable society? In this stage a compelling long term vision for a

sustainable organization is created and solutions to problems are identified. From the vision, organizations develop strategies and action plans for moving towards sustainability. Strategies are developed based on a principled vision of success. This approach prevents decision makers setting a direction based on addressing today's problem; instead they develop a shared vision and goal of sustainability with a series of actions to move the organization towards the eventual sustainability vision. At this stage opportunities and potential actions are identified.

D - Prioritization. Suggestions from the C-list are prioritized according to their potential to serve as stepping stones to move the organization towards sustainability.

> *"i. Does this measure proceed in the right direction with respect to all principle of sustainability?*
> *ii. Does this measure provide a stepping stone (i.e. 'flexible platform') for further improvements?*
> *iii. Is this measure likely to produce a sufficient return on investment to future catalyze the process?"* (Robèrt 2000)

Consisting of four simple steps, the ABCD analysis guides users to channel their specific knowledge and visions through the 'lenses' of the FSSD. It is a strategic tool that was developed to apply backcasting from the SP's (Robèrt 2000) and is often used as a method to guide workshops.

1.1.6 Sustainable Traffic Solutions

The core sustainability concepts mentioned above including the SP's, FSSD, backcasting, visioning and ABCD can be projected onto transportation and result in more specific guidelines that helps transportation move towards a sustainable society.

The idea sketch *Idéprommemoria kring framtidens transportlösningar* within the Real Change Research Program, prepared by The Natural Step (TNS) and Royal Institute of Technology (KTH) is based on a primary study of future traffic solutions. It is aimed at creating guidelines and a methodology for cooperative planning and the stepwise creation of sustainable traffic systems (Cars et al 2008). A version translated to English (Sustainable Traffic Solutions) by the co-author Karl-Henrik Robèrt is used throughout this thesis. The study helped the authors form research questions and functioned as a theory since the proposed five subsystems from the study were used to guide the research for potential solutions for Swedish municipalities.

Sub-systems for sustainable transportation. Transportation requires some sort of *Resource base* to produce the energy carriers we need for motoring. E.g. oilfields, coal mines, uranium mines. There are also units to be found in nature e.g. sea waves and sun light (Cars et al 2008). *Energy carriers* occupy the stages between the resource base and motoring, such as fuels that are produced from a forest, gasoline, electricity etc. Subsequently, energy carriers are used to power/fuel engines (*Motoring*) that are used to propel ships, trains, cars and other means of transport of which the Otto engine and the electric engine are typical examples (Cars et al 2008). Transportation is deeply dependent on *Infrastructure* and spatial planning, e.g. physical locations and physical links between them. The word can be interpreted in many ways and we often apply a simplistic definition of infrastructure including physical structures such as roads, rails etc. A more recent and wider view of infrastructure includes both built environment, and "non-built" structures such as educational systems, culture etc (Cars et al 2008). Transportation has a large influence on people´s life. At the same time, human needs, preferences and values largely influence the development of transport systems. Aspects in individual´s *Social system* could be e.g. values, traditions and cultural patterns (Cars et al 2008).

1.2 Planning of Transportation

In Sweden, the roads are either operated by the state, municipality or private sector. The railways are operated by the state, but public and private actors may own trains and use the network (with some exceptions). Airports can be either publicly owned or private and seaports are municipal, private or joint public/private. Public transportation is primarily tax-subsidized with municipalities and counties as principals, while most of the transport itself is handled by contractors. There are also a number of private companies who on fully commercial basis are operating on some routes. Sveriges Kommuner och Landsting (SKL) states that planning responsibilities are divided on national, regional or municipal level. Funding comes mainly from general state or municipal tax revenues (SKL 2009). As shown in table 1.1 the state and municipalities have the greatest responsibility in terms of planning funding and implementation. Municipalities logically plan for the local usage of transportation while the state, often through national agencies and administrations, is responsible for the national perspective and usage of transportation (table 1.1):

- The state (through Trafikverket) establishes national plans and allocates funds to regions through the so-called provincial plans.

- The state (through Trafikverket) forms a national plan for railways.
- Governmental bodies, cooperation agencies or county boards implements county plans.
- Municipalities are responsible for operating and investment in the municipal road network.
- Municipalities, counties and regions are also responsible for the regional and local public transport.

Table 1.1: Responsibility, planning and funding of transportation

Area of Responsibility		Users	Planning	Funding	Implementation
Civil Air Traffic investment, operation and maintenance	National airports	**National** **Regional** Local	Swedavia & Trafikverket	Swedavia	Swedavia
	Other airports	**National** **Regional** Local	n/a	n/a	n/a
Maritime investment		**National** **Regional** Local	Trafikverket	Fees/Charges	n/a
Maritime operation and maintenance		**National** **Regional** Local	Sjöfartsverket	Fees/Charges	Sjöfartsverket
Municipal maritime (civil traffic) investment, operation and maintenance		National Regional **Local**	Municipality	Municipality	Municipality
National railways investment, operation and maintenance		**National** Regional Local	Trafikverket	State	Trafikverket
National roads investment	Main roads	**National** Regional Local	Trafikverket	State	Trafikverket
	Other national roads	National **Regional** Local	Regional	State	Trafikverket
National roads operation and maintenance	Main roads	**National** **Regional** Local	Trafikverket	State	Trafikverket
	Other national roads	**National** **Regional** Local	Trafikverket	State	Trafikverket
Municipal roads investment, operation and maintenance		National Regional **Local**	Municipality	Municipality	Municipality

Sources: SKL (2008), *page 15; Trafikverket* (2010), *page 9 - 11*

1.2.1 National Level

Trafikverket is responsible for the planning of ordinary (main) roads as well as operation and maintenance of the entire state network. Their planning process consists of both long-term strategic planning and short-term operational planning. The Parliament decides on the annual economic boundaries for short-term planning. The long-term planning aims to show how the goals and objectives for transportation can be reached which results in plans with measures to prioritise for implementation, typically over a period of 10-12 years (SKL 2008).

Trafikverket also manages the infrastructure of the state railway which includes operation, maintenance, reconstruction and extension of the railway, as well as capacity allocation and traffic management (common rail, subway and tram). Trafikverket is also planning both long and short term for the railway system. The responsibility has been taken over for regional rail infrastructure which was formerly included in regional planning. The plan includes investment in the main line network and regional rail, contribution to regional public transport facilities and rail vehicles as well as operation and maintenance. Transportstyrelsen identifies the airports of national interest and what current and future activities should be protected. Municipal General Outline Plans must take into account the national interest. Swedavia has the responsibility of airports while Luftfartsverket is responsible for the air space. However, there is currently some internal uncertainty with regards to who currently holds the overall responsibility for the Swedish air space, Transportstyrelsen or Luftfartsverket (Wennberg 2010).

1.2.2 County Level

Counties develop action plans for the regional road network and create county plans in parallel with Trafikverket's preparation of a national plan for road transportation. While the counties are responsible for establishing plans, Trafikverket has responsibility for implementing the plans. There is a Head of transport in each county in Sweden who organizes the local and regional public transport. Several Heads of transport also interact and collaborate on traffic within and between counties.

1.2.3 Municipal Level

Municipalities are responsible for the municipal road network, including local road maintenance in terms of investment, operation and maintenance

(table 1.1). SKL has called for a government commission with a mandate to clarify funding options and responsibilities between national, county and municipal levels (SKL 2008).

1.2.4 Coordination between different levels of society

The Government and Parliament are taking the overall political decisions with regards to governmental investment in transport infrastructure. These are based on data from Trafikverket and regional and municipal authorities. Regions and cooperative bodies are making trade-offs and prioritisation on the regional level. Municipalities are responsible for the planning and implementation in the local transport infrastructure. Coordination across municipal boundaries is done, when needed, either bilaterally or with a support from regions, counties and/or cooperative bodies (SKL 2009).

1.3 Aim and scope of the thesis

With the given background, how do we break the current unsustainable path and create sustainable transportation for the future? This thesis will try to answer that by looking at it through the lens of Sustainability.

How can we place an attractive and functional transportation system within the sustainability constraints? In order to answer such question, this thesis will try to discover what sustainable transportation might look like without saying that it should be less available than today, and not undermining the needs for people to travel. Potential future solutions will be investigated without constrains (except from the SP's described in chapter 1.1.1), which might include changing the social structure and business model of transport.

This thesis will be looking at the existing transportation systems and how they might fit into a sustainable future, or if they will have to be replaced. The existing systems were invented in the past with the available technology at that time. Inventing the transportation system of tomorrow, planners and decision makers would most likely not choose combustion engines in vehicles that will pollute the air and contribute to the climate change and not design roads where vehicles without physical guidance or barriers are passing each other at a total speed of 180 km/h with only a few meters or less in between. The selection of measures towards sustainable transportation should be done in a strategic way and the need for modernised transportation is in Sweden mostly initiated from the regional or municipal level. Further guidance in the municipal prioritisation of compelling measures towards sustainable transportation could enhance the

chances for a successful outcome and ultimately achieve sustainable transportation.

1.3.1 Research Questions

The overall research question has then been formulated as follows:

- *What will Swedish sustainable transportation look like and how can municipal strategic planning of transportation be supported?*

The overall research question covers an area which is quite broad and the below stated sub-questions were developed to further narrow down and define the scope of the study. The ABCD method described in chapter 1.1.5 provides an approach to break down the overall research question. When thinking through that process, the following four sub-questions will enhance the exploration of the overall research question:

1. *An exploration of national and municipal level visioning towards sustainable transportation: How would such visions ideally look like and is there a need for national and municipal differentiation?*

2. *What are the potential areas of improvements, actions and aspects within municipal planning that will support and enhance the chances of success of sustainable transportation?*

3. *What are the emerging innovations and possible solutions towards sustainable transportation?*

4. *How can flexible strategic guidance be provided to municipalities in order to prioritise compelling measures towards sustainable transportation?*

2 Methods

This thesis contains three major research areas. The first is a background study of Swedish national and municipal visioning towards sustainable transportation, and challenges as well as areas of improvement in municipal planning of sustainable transportation. The second area is about discovering potential solutions for sustainable transportation and key aspects for social change in the transitional process. The third area of research is about how to support municipal planning of transportation with strategic guidance in their move towards sustainability. The research was conducted in four phases where each phase explores one research question, see figure 2.1.

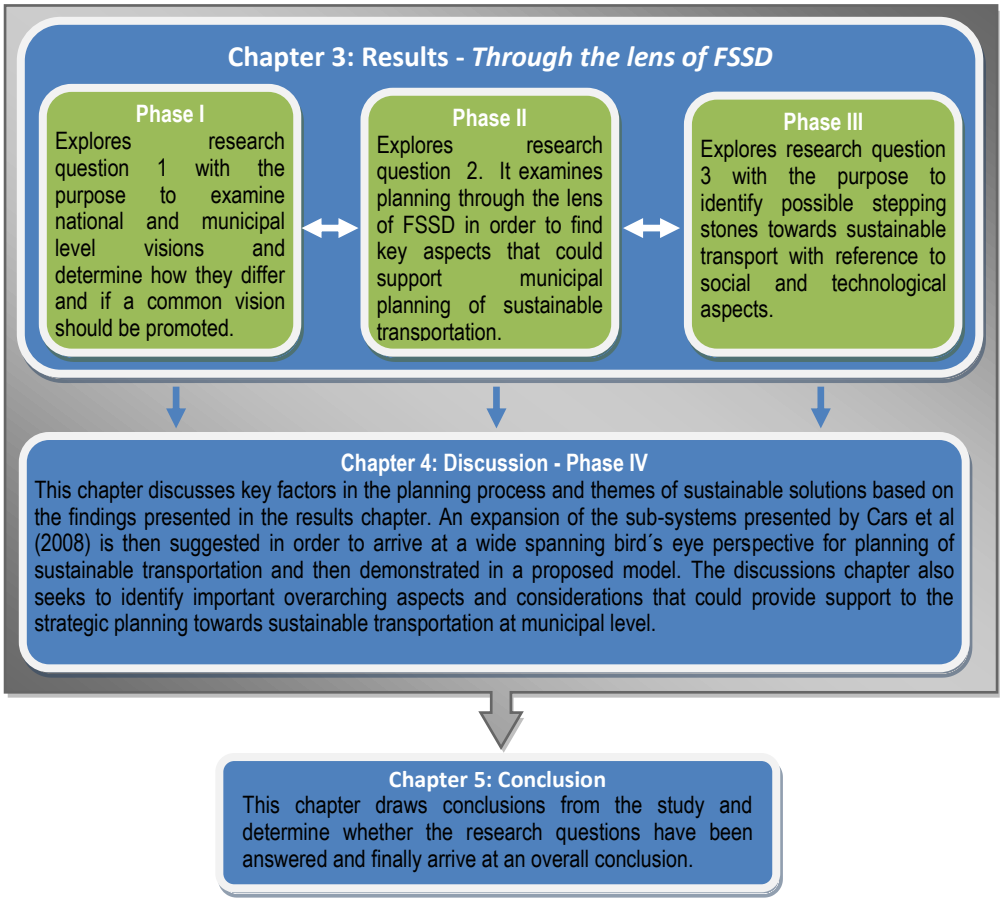


Figure 2.1: Structure of the Study

The research questions were inspired by the sequences within the ABCD methodology which were covered in section 1.1.5. The FSSD that was introduced in section 1.1.2 was used to frame the results chapter and to explore the gap between current and sustainable transportation. Furthermore, it was also used to better understand the setting in which municipal strategic decisions are made.

2.1 Secondary Research

The collection and analysis of secondary data was an important component of this study. Kotler et al (2007) defines secondary data as follows:

> *"Secondary data is information that already exists somewhere, having been collected for another purpose."*

Secondary research was the initial starting point wherein a vast array of published information was reviewed, analysed and matched against each research phase. The body of literature surrounding the subject area such as books, journals, reports, articles, magazines, websites and conference publications was explored to investigate the subject matter surrounding planning of transportation and the pathway towards sustainable transportation. One of the main purposes was to identify research gaps in existing publications. Such research gaps where the data was necessary for a successful outcome of this study were then explored and reduced through the primary research strategy presented in section 2.2. The secondary research was crafted in several phases over a period of four to five months and mainly concerned phase 1, 2 and 3.

Throughout the process a number of fields in need of further exploration were discovered and subsequently classified as research gaps. These gaps concerned the planning process of transportation in particular, such as coordination between different levels of society, allocation of responsibility, success factors towards sustainable transportation, areas of improvement and information regarding the tools level (level 5) of the FSSD. Below follows a brief introduction of the set of secondary research sources used throughout this study.

Reports – qualitative and quantitative data derived from reports relating to transportation planning as well as social and technological aspects in particular. Various reports have been published in recent years by governmental administrations and agencies as well as consultancy firms reviewing Swedish transportation, among others.

Journals – provided information for areas relating to social behaviour and change, possible stepping stones towards sustainability, and some areas within sustainable technological development.
Books – provided information regarding PESTEL analysis and other conceptual definitions. Data relating to tool creation and social constraints within transportation also originated from books.
Magazines – particularly helped to inform about current technological development within transportation to provide an accurate and up-to-date view on sustainable technological solutions.
Websites – some websites were found useful, especially regarding quantitative data relating to graphs and statistics within Swedish transportation. Various governmental databases were also accessed online to retrieve various publications.
Seminar and Conference Publications – transcripts and publications from various topical events helped inform sections relating to sustainable technological development.

2.2 Primary Research

2.2.1 ABCD Collaborative sessions

Two collaborative ABCD sessions were hosted. They were conducted in collaboration with Transportstyrelsen on February 2nd 2010 and with Jönköping Municipality on March 10th – 11th 2010. A national vision for sustainable transportation was created with Transportstyrelsen and a municipal vision was created with Jönköping Municipality. The session at Transportstyrelsen provided, apart from data regarding the ABCD method, introductory information and sources as well as stakeholder information for further exploration and surveying. The results from the session with Jönköping Municipality were intended for a case study creation and to provide information and insight about municipal planning of transportation.

2.2.2 Interviews

The interview method could typically be executed by three different techniques: structured, semi-structured and unstructured (Denscombe 2003). Both semi-structure and unstructured interviews were used for information gathering in this study. The semi-structured interview had a broad list of subjects to be addressed and questions to be answered. It was conducted by phone with Eva Göransson at Jönköping Municipality on March 3rd 2010 as an introductory information session prior to the ABCD collaborative session previously mentioned. On-going measures and future

plans regarding Jönköping´s current and future steps towards sustainable transportation were obtained from the interview. A number of unstructured interviews were conducted with various individuals, mainly from partnering organisations and experts, over a period of four to five months.

2.2.3 Survey

An online survey was sent out on April 9th 2010 in order to collect information from applicable experts representing each mode of transport (Air Traffic, Maritime, Road, and Rail) at Trafikverket. The results were intended and used as final complimentary information for Phase I and II.

2.3 Phase I: Research Question 1

- *An exploration of national and municipal level visioning towards sustainable transportation: How would such visions ideally look like and is there a need for national and municipal differentiation?*

2.3.1 Methods

Secondary research – was carried out prior to the ABCD collaborative sessions as a background study around contributing elements in visioning of sustainable transportation. Secondary research was also conducted after the session to further refine and complement the findings. Information, general and Jönköping specific, was gathered from governmental and municipal reports on transportation strategy, websites, seminar and conference publications as well as statistics on national and municipal transportation. This approach, in concert with studies of articles and books on how to create a sustainability vision, brought the authors to the results.

Primary research – was carried out through interviews and ABCD sessions with collaborators. The first introductory ABCD session was done with Transportstyrelsen on February 2nd 2010 at their head office in Norrköping. The session was focused on the first steps of the ABCD method. The system boundaries of transportation planning were defined and information about national visioning was gathered. The second ABCD session was done with Jönköping Municipality on March 10th – 11th 2010. This session was similar to the one with Transportstyrelsen, but instead focused on Municipal level. Interviews were conducted by phone with representatives from both Transportstyrelsen and Jönköping Municipality to guide research efforts towards relevant sources, such as reports and websites. These interviews gave aspects and ideas that would later contribute to the visions

and system boundaries. Unstructured interviews were also used to gather feedback in order to refine the final system boundaries and vision work.

2.3.2 Expectations

The author's expected to find ideas and aspects for the vision and system boundaries at both national and municipal level. They would then be refined in continued collaboration with partners for completion, where the differences between national and municipal visioning would be clarified.

2.4 Phase II: Research Question 2

- *What are the potential areas of improvements, actions and aspects within municipal planning that will support and enhance the chances of success of sustainable transportation?*

2.4.1 Methods

Secondary research – was carried out in the form of a literature review as an essential starting point of gathering relevant information to build a solid case of the current planning process of transportation in general and sustainable transportation in particular. Monitoring and follow-up reports published by all Swedish transportation administrations and agencies were found particularly important in terms of weaknesses and strengths within the planning process. Research and case studies conducted by various consultancy firms in close collaboration with Trafikverket and related journal articles also contributed greatly in terms of an overarching view on municipal planning of transportation. Even though the foundation was mainly formed by reports and journal articles, the secondary research also exposed research gaps that would be explored by primary research.

Primary research – was carried out through the before mentioned ABCD sessions, surveys and interviews. The first session was hosted on February 2nd 2010 at Transportstyrelsen and provided information for most phases of the study and gave an introduction to transportation planning from a national perspective. The second session was hosted on March 10th – 11th 2010 at Jönköping Municipality with the purpose to cover the A-B-C steps as a preparation for the creation of a case study. During this session, planning related tasks were also covered and predominantly gave a view on challenges, areas of improvement and opportunities related to planning of sustainable transportation from a municipal perspective. Online surveys with already established partners and experts at Transportstyrelsen were

conducted once the research gaps had been established from the secondary research. The surveys contained in total nine questions covering planning related questions, such as collaboration across different levels of society, allocation of responsibility, success factors towards sustainable transportation, areas of improvement, opportunities and information regarding the tools level (level 5) of the FSSD.

2.4.2 Expected Results

As shown in table 2.1, it was expected to find complications in the funding system of measures towards sustainable transportation on Municipal level where the synchronisation and collaboration across geographical borders functions poorly. The authors also expected to find a mindset amongst decision makers where business as usual is a common attitude on sustainability and weak ambitions at municipal level making the transition towards sustainable transportation exceedingly weak. Lack of knowledge of sustainability was also expected to be found, especially on local level. Short-term thinking and lack of visionary leaders with courage to plan over a longer perspective were expected. A narrow view on transportation where the big picture often is lost was also anticipated.

Table 2.1: Phase II – Expectations

Area of Research	Expected Results
Municipal level planning of transportation	• Complicated funding system, making it hard to implement transformational change. • Often powerless and weak attempts towards sustainability.
Potential Challenges, Pitfalls and Areas of Improvement	• Ideological look-ups and lack of sustainability knowledge. • Lack of tools, methods and expertise as well as inconsistency in methods and procedures across the country. • Lack of ambitions, creativity and courage. • Poor stakeholder communication and anchoring of strategic plans. • A great need of strong visionary leaders at all levels of society and thereby short-term thinking in the forefront.
Opportunities	• A great chance to take lead and create competitive advantage. • Economic crisis fosters transformational opportunities. • Contributing towards national visions and thus gain recognition.
Success Factors	• Transparency and economic feasibility of actions and plans. • Long-term mindset in planning rooted in a systems perspective and a big overarching picture approach. • Consultation and communication that provides strength and legitimacy.

2.5 Phase III: Research Question 3

- *What are the emerging innovations and possible solutions towards sustainable transportation?*

2.5.1 Methods

Secondary research – was carried out as a preparation for the ABCD sessions. Journals, books, reports, magazines, websites, statistics, seminars and conference publications were reviewed to gather general information of suitable sustainable transportation solutions and also to justify and refine the final ideas/solutions in this thesis. Governmental reports, web pages and statistics were informative about the trends and emerging innovations.

Primary research – was conducted mainly in form a collaborative ABCD session and interviews. As mentioned earlier, the second session was hosted at Jönköping Municipality on March 10th – 11th 2010 and gave birth to and informed solutions/ideas that could take the municipality towards sustainable transportation. As in phase I, interviews were conducted by phone with representatives from both Transportstyrelsen and Jönköping Municipality with the purpose to guide authors towards useful sources. These interviews also gave aspects and ideas that would later contribute to the emerging innovations and possible solutions, but were also used to gather feedback on the refined findings from the ABCD session.

2.5.2 Expectations

The authors expected to find many short and long-term solutions/ideas within transportation that will contribute towards a sustainable future. These solutions/ideas would then be suitable for Swedish municipalities, but as they hold different ambitions, financial means and conditions for sustainable transportation the findings needed to vary from being "low-hanging fruit"-solutions with low initial costs, to ideas that through national and regional collaboration can be implemented in about 10 to 40 years. The many solutions in social behaviour and change were unexpected, but after having carried out a literature review and interviews the authors started searching in a more question oriented way that resulted in a social section.

Table 2.2: Phase III – Expectations

Area of Research	Expected Results
Technological trends	• Track guided solutions, cycling and walking, increased use of cars has to stop, public transportation, decrease of domestic flights
Emerging innovations	• Pod-cars, hydrogen fuel cells, solar powered vehicles, etc
Social behaviour and change	• Characteristics and stages to change social behaviours (habits, attitudes, lifestyles)

2.6 Phase IV: Research Question 4

- *How can flexible strategic guidance be provided to municipalities in order to prioritise compelling measures towards sustainable transportation?*

2.6.1 Methods

Secondary research – were carried out to give the authors inspiration on guidance design. The content/inclusions in the proposed strategic guidance were directly determined and informed by the results in phase one, two and three and then elaborated on in the discussions chapter. The actual structure and format of the guidance approach was determined by the review of commonly used tools and concepts within the business sphere and related corporate literature. The PESTEL-analysis (Lynch 2006) used for macro-environmental analysis for business was especially analysed. Previous journal articles and PhD-theses containing tool creation and modelling also gave birth to ideas. The idea sketch on sustainable traffic solutions (Cars et al 2008) was also inspirational and then further elaborated on.

Primary research – was carried out through interviews of established partners to gather feedback on the proposed guidance approach for further refinement (e.g. SEKom, Malmö and Jönköping Municipality).

2.6.2 Expected Results

Table 2.3: Phase IV – Expectations

Area of Research	Expected Results
Format of the Guidance	Questions for planning that rather guide than points out actions, and thereby enhance the prioritisation process of strategic actions.
Inclusions	Expansion of the guiding questions in the D-step that would increase encouragement concerning sustainable transportation

3 Results

The amount of transport in Sweden has steadily increased since 1960 as shown in figure 3.1 and 3.2. The road transport is increasing for both freight and people and has a very high influence on the travelling trend. This is forecasted to be valid until 2020 (SIKA 2005). The travel will reach 32 billion kilometres (27 per cent increase from 2005) where the growth in car travel will contribute most and air travel have the largest increase. Freight will increase to 125 billion tonne-kilometres (21 per cent increase from 2005) while the road transport increase (31 per cent increase from 2005) will be twice as much compared to rail transport. The trend line variables in figure 3.1 and 3.2 determine the curvature of the trend line and not the values by year 2020.

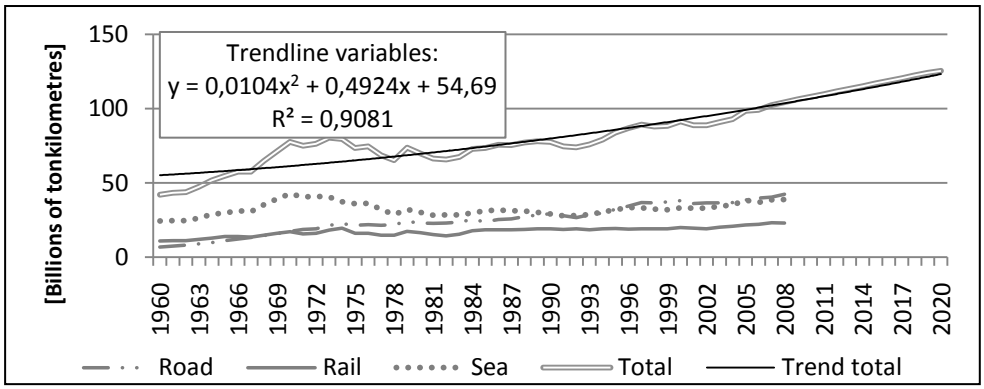


Figure 3.1: Freight - goods transport (excl air traffic – lack of data).

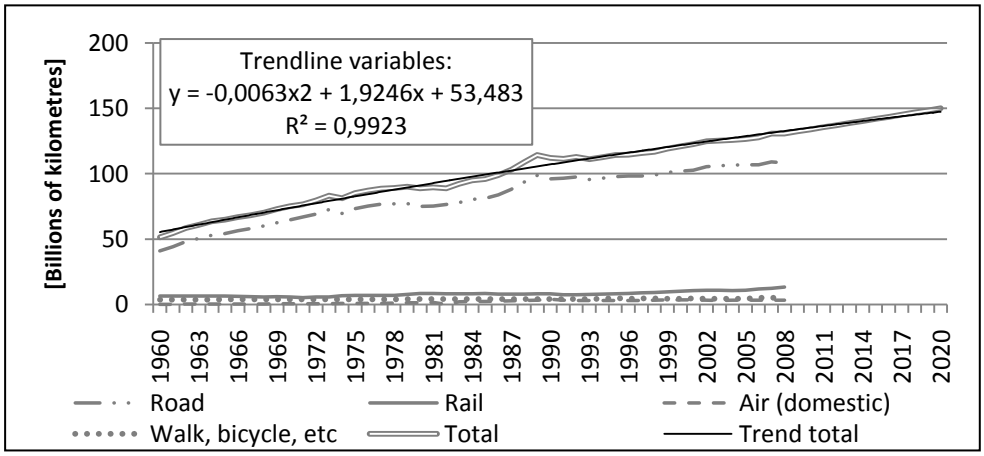


Figure 3.2: Travel - people transport (excl sea travel – low values). Data source: (SIKA 2009), *forecast 2008-2020* (SIKA 2005)

The research of this study is lead by the research questions (chapter 1.3.1) and the findings are structured by the Framework for Strategic Sustainable Development (FSSD) described in chapter 1.1.2 to obtain a sustainability perspective. Although, the findings concerning improvements and challenges are important to highlight as the need of change within those areas can be beneficial when moving towards sustainable transportation.

3.1 Planning of Transportation through the Lens of FSSD

The previously described development, trend and forecast of transportation are unsustainable. How can such a negative spiral be broken and reversed? Long-term strategic decisions will have to be made and municipalities will have significant transformational influence due to increased responsibility of their own transportation system. In order to evaluate transportation from a sustainability perspective and steer it towards sustainability it is of significant importance to fully understand the setting in which municipal level strategic decisions are made and that is why the FSSD has been applied. The FSSD which is outlined in chapter 1.1.2 has the purpose of bringing clarity, rigour and insight to planning and decision-making towards sustainability (Robèrt 2002). The authors will in the following pages explore transportation through the lens of the five levels of the FSSD.

3.1.1 Systems Level: Phase I

Municipal planning of transportation takes place within a municipality or city, within a county, within a region, within the state/nation and its governmental bodies, within the European Union, within the society in the Biosphere. Within such geographical constraints there are many aspects, components and considerations making up the boundaries of the system in which municipal level strategic planning of transportation occur.

The system boundaries ought to be identified by looking at transportation as a system through the lens of sustainability as described in chapter 1. In this study, the system boundaries were defined through collaborative ABCD sessions with Transportstyrelsen and Jönköping Municipality described in appendix B and C.

3.1.2 Success Level: Phase I

At the success level, the goals of a specific industry, or organization, are defined within the system, whose boundaries where outlined in chapter

3.1.1. The Swedish vision for transportation today has been defined by the government and is made up by a functional and impacts component.

> *"**Functional objective (accessibility):** The design, function and use of the transport system will contribute to provide everyone with basic accessibility of good quality and functionality and to development capacity throughout the country. The transport system will be gender equal, meeting the transport needs of both women and equality."* (Regeringskansliet 2009)
>
> *"**Impact objective (health, safety and environment):** The design, function and use of the transport system will be adapted to eliminate fatal and serious accidents. It will also contribute to the achievement of the environmental quality objectives and better health."* (Regeringskansliet 2009)

Lind et al (2002) examined regional visions and goals for transportation of which might well give a fairly accurate view even though the study now is a few years old. Four commonly covered key areas were identified:

- Growth, prosperity and attractiveness
- Equality, balance and integration
- Long-term financial strength and sustainability
- Clean environmental and safety

In a more recent study by Hyllenius et al (2007) Swedish municipalities´ future visions for transportation were reviewed it was concluded that visions often were connected to their transportation strategy and touched upon several national objectives, such as:

- Accessible transportation
- Equality within transportation
- Positive regional development
- High transport quality
- Environmentally friendly
- Safe transportation

Lichtenberg et al (2008) created a sustainable transportation vision for Karlskrona Municipality. It was generated through data acquired at meetings and interviews with a few of the municipalities´ senior department managers, and complemented with literature review.

> *"World class and integrated transport system that offers safe, efficient and sustainable travel for all, where public transport, walking and cycling provide real and desirable alternatives to car travel; moreover, making the municipality greener and more attractive."* (Lichtenberg et al 2008)

A collaborative ABCD session was hosted at Jönköping Municipality and following vision statement was produced for sustainable transportation in Jönköping:

> *"Transportation in Jönköping is bridging distances in a convenient, affordable, equal and safe way by regarding the sustainability principles".* (ABCD session, March 10th – 11th 2010)

Cars et al (2008) created, as further outlined in chapter 1.1.6, an idea sketch for sustainable transportation systems with the purpose to guide sustainable solutions by systems thinking in order to avoid mental and ideological lockups. The authors describe an overriding methodology with the purpose to avoid problems often associated with sustainable transportation planning. Cars et al (2008) suggests eight, also outlined in chapter 1.1.6, essential guiding component of which planning should derive from and include. Such suggested methodology would be applied to acquire a bird´s eye perspective in sustainable development of transportation, and thereby also enhance the chances for successful long-term planning.

3.1.3 Strategic Level: Phase II & III

An exploration is done at the strategic level of the strategic guidelines that are needed in order to accomplish our goals (defined in the Success level) within the System. Neergaard et al (2004) suggests that a strategic plan for sustainable transportation should cover the following areas to enhance the chances of a successful outcome:

- Cover the entire urban area
- Be linked to and coordinated with regional and national plans
- Contain locally formulated goals
- Reduce the negative effects of transportation
- Focus on limiting traffic growth and congestion
- Cover all modes of transport
- Emphasize intermodal solutions
- Examine the link with land use
- Be followed by an information campaign

It is important to note that some of the above points overlap with multiple levels of the FSSD, but on the whole mainly relates to the strategic level.

According to SIKA (2007), all municipalities should provide a general outline plan covering the entire municipal area. It is a comprehensive action plan which expresses the municipality's ambition related to the use of land

and water as well as land development in order to achieve the overall goal in creating a socially, environmentally, economically and culturally high living environment.

Neergaard et al (2004) reviewed eight of Sweden´s largest municipalities and their current strategic approach to transportation. A number of crucial elements within the development of sustainable transportation strategic plans were identified and explored. It was found that the implementation period of strategic plans often vary from as short time as 5 years to more long-term, 20 years. However, surprisingly many, four out of eight, of the reviewed municipalities do not specify a final deadline of the strategic plan (Neergaard et al 2004).

It was also found that municipal transportation strategies are often coordinated with Agenda-21, the environmental programme and the general outline plan. Other coordination approaches mentioned in the study relates to national goals and the local transport plan. Only one municipality does not coordinate the transportation strategy with other plans (Neergaard et al 2004). There is an overall active approach towards consultation with stakeholders through the development of transportation strategies (Neergaard et al 2004). However, the extent and methodology of such consultation processes remains unclear. Two municipalities conduct effortless or no consultation. Noteworthy is also that only one municipality have produced a proper information strategy for the plan (Neergaard et al 2004).

Success Factors. A systematic literature review and surveying of experts were conducted to identify key success factors within the planning process towards sustainable transportation. The exploration gave important clues of what aspects to put focus on and consider when forming strategic guidance. The below success factors represents key aspects of what needs to be covered and done now in order to optimise the chances to arrive at success (achieving the vision) and should be viewed from a planner´s perspective.

An important prerequisite for many transport infrastructure projects as a whole is involvement of actors at local and regional level - i.e. not only at national and European level (SKL 2009). Allowing time for strategic and visionary tasks even within committees is an important part of the efforts to generate political consensus on municipality development (Svenska Kommunförbundet 2004). It was interesting to find that visioning is recognised as a systematic process of importance but there were no

indication of any common use of specific planning procedures, such as backcasting.

According to SIKA (2008), it is important to consider the role of urban planning during the initiating and planning phase when making long-term and changes to a transportation system. Such collaboration between mobility and urban structure can in the longer perspective play a significant role. Joint studies of transportation and urban development could result in solutions and actions within the physical planning that maintain or restore values along the way or develop alternative measures, such as opening up opportunities to streamline transportation (Vägverket 2005). Some sort of coordination across geographical areas is required in order for transportation to function well, as transportation links various infrastructural segments and other sectors within society (SKL 2008). Successful projects have often had a well functioning and properly composed partnership with committed collaborators. Forming good partnership requires thought and time and cannot be done near the deadline. It is particularly important to get strategic actors from the local, regional and national level onboard (SKL 2009).

Political decisions regarding economic incentives will be required in order to address issues, such as congestion in urban areas (SIKA 2008). Specific regulations may also be required for certain groups, such as disabled people. SIKA claimed in another study from 2007 that economic instruments, regulation and planning tools ought to supplement infrastructure planning. Then there is good potential that these tools, often in correlation with each other, can contribute towards both a more economically viable and sustainable transport system.

Hyllenius et al (2007) reviewed five municipalities´ progress towards sustainable transportation and categorised success factors into four different phases of the planning process, as shown in table 3.1 below. The most important success factor associated with the initiation and start-up phase is that there is a strategy or equivalent for the municipality´s work. Strategy must also be anchored in a large amount of consultation mainly between officials in different committees and politicians, but also with the public and other groups.

The study also shows that the decision making process should have a clear strategy with clearly defined objectives that at the same time is easy to understand and absorb. The most important success factors related to the implementation phase is that there is a corresponding action plan that shows

what shall be done and that monitoring and evaluation becomes an integral part of the process. One of the most important success factors is related to the continued process phase, in other words when a project turns into a process and gets integrated with regular activities. This phase should be started as early as possible to make it stream through planning, implementation and evaluation.

Table 3.1: Success Factors in Planning for Sustainable Transportation

1. Initiating	2. Decision
• Anchor strategy by early consultation across political blocs to provide stability. • Allocate plenty of time for consultation. • Ensure that there are frequent meetings and reconciliations between officials and politicians so everyone feels involved. • Establish well-functioning dialogue with citizens. • Ensure timing when highlighting issues in order to match the political situation and the public debate. • Involve external partners in the initial work to provide greater authority.	• Ensure early consultation. • Create a transportation strategy or equivalent which clearly states the objectives, action areas, etc. • Create a transport strategy/action plan that is easy to absorb and not too excessive. • Ensure that senior officials and representatives from partners are included as active participants in the project. • Involve the organisation in decision making to avoid a sense of exclusion
3. Implementation	**4. Continued Process**
• Create a strategy or plan to follow. • Produce a single document that contains a vision, goals and strategy to work against. • Communicate the strategy / action plan to officials, politicians, organizations and citizens. • Secure that there are sufficient resources. • Allocate responsibility clearly in order to provide pressure for continuous work. • Ensure that there is an interest in the issues within the organization. • Make sure that staff holds previous experience in work towards sustainability.	• Make sure to have a good mix between project and process. • Ensure that the entire organization, as well as politicians, officials, is well prepared switching to the process phase. • Ensure prior knowledge / experience in going from project to process. • Allocate responsibility clearly. • Provide examples and benchmarks to get the entire organization to think of it the right way.

Source: Hyllenius et al (2007)

3.1.4 Actions Level: Phase III

Informed by the long-term vision of success, strategic guidelines will help decision makers to choose their specific actions.

It was found that some of the municipalities have developed an overarching and comprehensive action plan to cover each goal/objective. Others lack all-embracing plans and produce numerous action plans for each individual project (Neergaard et al 2004).

The remaining of this section provides a glance into some potential creative actions towards sustainable transportation. The solutions reviewed below can inspire municipalities towards the sustainable transportation vision. A municipality with small financial resources can "hook onto" a suitable current technological trend and thereby make a more safe investment while moving towards a more sustainable society. A large city with more financial means on the other hand can sense and capture the possibilities of investing money and workload into an emerging innovation that in a strategic way would suit their city in the future. The difference here between emerging innovation and trends is that the latter has existing solutions that already have been implemented and proven.

Current Technological Trends (green cars to track-guided personal vehicles) that are reviewed here are based on forecasting and are hard to predict more than 20 years ahead, in some cases only 10 years.

> *"A trend is a relatively smooth and unidirectional pattern in data that arises from the accumulation of information over time"* (International Encyclopaedia of the Social Sciences 2008).

Green cars. The emissions and energy consumption of vehicles are determined by total weight (and size), power consumption and efficiency through the power train (from fuel storage via the motor, including auxiliary systems, to the wheels) and how the motor is powered (Naturvårdsverket 2009). The sales of green cars in Sweden are increasing as the government has raised incentives concerning vehicle taxes and also on non-fossil fuels like ethanol (E85) and biogas. A green car emits less than 120 gram CO_2 per kilometre, or runs on other fuels than petrol or diesel, or is powered completely or partly by an electric motor (Transportstyrelsen 2009). It has been forecasted that 45 per cent of all registered cars during 2010 will be considered green (Gröna bilister 2010). The increased number is dependent on technological development and large scale sales of electric powered cars (Petersson 2007) and (Vägverket 2009), as the classification of a green car will be stricter. The potential reduction of climate impact is 65 per cent for ethanol fuelled cars and 85 per cent for biogas compared to petrol fuelled cars with equal fuel consumption (Naturvårdsverket 2009). If focusing on buying a green car that will contribute most in the early transition phase towards a sustainable society

by low climate impact, the priorities according to Naturvårdsverket (2009) should be:

1. Motoring: Renewable fuelled motor, preferably electric powered and secondly hybrid (electric and combustion engine) and thirdly (even when taken in account the next generation) bio fuelled combustion engine where biogas is the most preferable and secondly E85.
2. Vehicle: As light (small) vehicle as possible concerning the user needs and with moderate motor power. A small car is also less demanding regarding production, maintenance and scrapping. If the motoring is provided by a fossil fuelled engine, the priorities should be the other way around for low fuel consumption.

Tram. The largest cities have a lot of road traffic and are therefore planning to expand public transportation by reintroduction or expansion of the tram network. Some examples:

- Malmö will reintroduce tram and start up the new metro line (Citytunneln) (Environment Department the City of Malmö u.d.)
- The region of Västra Götaland is planning for an expansion of the tram network in Gothenburg and the railway system in the region (Västra Götalandsregionen 2010).
- Stockholm are expanding the tram and metro networks (Stockholms lokaltrafik 2010).
- Norrköping will expand the existing tram network (Norrköpings kommun n.d.)
- Lund, Linköping, Helsingborg, Jönköping, the region of Skåne, etc. are all investigating the viability of tram as a future solution (Trivector Traffic 2010).

Human-powered transportation. The governmental strategies towards a sustainable society in Sweden promote human-powered transportation modes like cycling or walking (Naturvårdsverket 2009). A general trend within Swedish municipal planning is to encourage people who are travelling short distances to choose the bicycle or to walk, especially instead of going by car. The major benefits are many, e.g. better personal health, almost zero emissions (except from bicycle production) as well as energy usage, less road maintenance and reduced societal accident costs (Vägverket 2009).

Ship electric propulsion. Being a conservative and cost sensitive transportation mode, the world's fleet of commercial and leisure ships are mostly propelled by combustion engines fuelled by low graded diesel that not only contributes to global warming, but also emits large amounts of

sulphur oxides that by acidification harms the environment (Helsinki Commission 2009/2010). Shipping is otherwise an energy efficient way of transporting distant goods and could be a future sustainable freight solution if the propulsion as well as the life-cycle is managed in a sustainable way. Propellers directly driven by electric motors like POD-drives or rudder propellers have been installed onboard ships since the previous century. The development from supporting ship manoeuvres at harbours or hovering at low sea states, to being the main source for propelling has taken place during the last decades. Luxury cruise liners and ice-going tonnage benefit from this solution as it provide improved manoeuvrability and reduces fuel consumption as well as emissions. Today, combustion engines are coupled up with generators to produce electricity, not only for the propulsion but also for the ship electricity (auxiliary) grid. The U.S. Navy have calculated that integrated electric-drive propulsions can reduce fuel consumption by 10 to 25 per cent (O'Rourke 2006), even though the ships have combustion engines that are fuelled by various fossil fuels, depending on the size of the ship. If using bio-fuelled engines and in the future fuel cells in conjunction with electric propulsion as well as solar cells for auxiliary power generation, the ships will significantly reduce their emissions and oil consumption (O'Rourke 2006). This would also be applicable to archipelago ferries in a coastal region.

Train to substitute air transport. The introduction of the train type X2000 between Stockholm and Gothenburg during the 1990s increased the share of trains by almost 20 per cent (Banverket 2008). The energy consumption is 0.1 kWh per person and kilometres, while domestic flights consume 0.66. The CO_2 emissions from trains are close to zero (people and goods), while air travel emits 171 gram CO_2 per person and kilometre, and freight 540.000 per kilometres and tonne (Banverket 2009). The investigation for high speed railways in Sweden (Malm 2009) stipulates that the establishment of infrastructure for trains faster than 250 kilometres per hour is feasible between the three largest cities with a junction point in Jönköping (Götalands/Europabanan). An upgrade of the existing railway network to train speeds more than 200 kilometres per hour would be feasible when the travel time with a high speed train would be two hours or less from Karlstad to Stockholm or Gothenburg to Oslo (Malm 2009). This would be equal or faster compared to air travelling to and from city centres.

Track guided personal vehicles. As demand for more transportation in urban areas increases, it is getting more difficult and expensive to expand the existing modes of transportation. Track guided personal vehicles like Pod Cars, PRT:s, etc. are transitional sustainable solutions, especially

concerning existing public transportation systems in cities with more than 40 000 inhabitants, where that system would be cheaper, more sustainable and increase public travelling in comparison to bus or tram systems (WSP Analys och Strategi 2009). The government proposes pioneer tracks to be laid out at 12 different locations in Sweden, for example to/from and within airports, tourist attractions, dense city areas, shopping centres (Näringsdepartementet 2009).

Integration of travel modes. It is rare to have door to door transportation with public transportation, especially if the carriage is extensive. Park-and-ride and the introduction of integrated and fast regional public transport networks are perhaps the two developments which may enable public transport to provide a genuine alternative to the majority of longer distance car travel, which is so difficult to win over to public transport (Feitelson, 2001). The purpose of such measures is to make those areas more accessible. For this case, based on the case study of Israel introduced by Eran Feitelson in his book *Transport and environment: in search of sustainable solutions*, it listed several actions. First, residents parking can be introduced at key locations to reduce the supply of private non-residential parking and long stay commuter parking can be changed to short stay. Second, parking standards for new developments area can be made more restrictive and in major urban areas parking standards can be linked to public transport. Third, if considerable parking stocks already exist such that supply exceeds demand, the only likely options available would be to redevelop regional authority controlled parking, like shift it to a closure of city centre. An integration of personal transport modes like bicycles on buses/trams or trains would increase the usage of public travelling (Banverket 2007).

There is a great possibility of increasing the human-powered transportation (bicycle/walk) as 39 per cent of the population in Sweden lives closer than 2 kilometres from a train/tram station (Banverket 2007) and the interest of carrying the bike on trams for further travelling is big (Brodén 2008). Bringing along the car on a train is not possible in Sweden anymore, but the method is working in Germany, Austria, France, Finland and Italy (Botzén Consulting 2008). Outlined in the Sustrans report *Transport and Social Justice* (2008), some European public transport services combine public transport with dedicated health, school and special needs services to create an on-demand door-to-door shared taxibus service by the following:

- Conventional timetabled bus (or train) services on key routes.
- Services that run in response to a phone call, generally offering the option to pick up and set down at people's homes.

- Full availability of services during off-peak periods, evenings and week-ends, becoming demand-responsive during periods of low demand.
- Reasonably priced fares.
- Integrated ticketing so passengers pay once even if they change vehicles.

Trends of technologies that may help reshape transportation systems were discussed in the previous part, however, after a field work on literature review and interviews, the thesis team decided to conduct some research in a more question oriented way by prioritizing "improvement aspects for regional planning" beyond "potential solutions searching" and expected to find out possible ideas and thoughts that could assist sustainable planning and accelerate sustainable technological trend and innovation application. In that light, social behaviour seemed to become more important than we thought before. The following part will present findings in social aspect for Sweden transport planning on municipal level. According to a paper by Noxon and Kassirer (2009), there are two important questions in the area of social change towards sustainability:

- How to increase the use of non-driving travel modes, like walking and cycling, public transport?
- How to make people use their cars in a more sustainable manner, including buying a more sustainable car, when and where to drive, and how to operate and maintain it?

Individual behaviour change. Jackson (2005) sheds light on this change:

> *"Individual behaviours are deeply embedded in social and institutional contexts. We are guided as much by what others around us say and do, and by the 'rules of the game' as we are by personal choice. We often find ourselves 'locked in' to unsustainable behaviours in spite of our own best Intentions"*

In the report of Communication and Behaviour Change, study result of COI (2009), the authors discussed factors that would influence individual's behaviour and how it can be changed.

Table 3.2: Factors of social behaviour

Levels	Examples of Factors
Personal	Knowledge and awareness; attitudes; habits and routine; self-efficiency; emotion; mental shortcuts; biases
Social	Social influence; social norms; social proof
Environmental	Infrastructure; technology; the economy; taxation and legislation; Regulations; the provision of services;

Source: (Central office of information of UK 2009)

The reason why people do not want to move into high density area which will reduce long distance travel can be explained by factors such as "routines" and "emotions" in table 3.2.

> "*The problems experienced in the post-war high density developments in inner city areas gives rise to the perception that this type of housing is the last resort rather than what most people would choose*." (Buchanan, et al. 1997)

Habits established at an early age tend to be maintained throughout the individual life span. The social habits people acquire when they were children tend to be remembered later on in life, for instance, young people in families without a car are often experts on public transport, young people in motorized families do not manage to get around without a car, and these experiences might influence travel behaviour later in life (Future Urban Transport 2009). There are also different stages of how to change individual behaviours that were studied and outlined in the late 1970s and early 1980s.The study was based on smokers' approaches to giving up cigarettes: "pre-contemplation, contemplation, preparation, action and termination" (Prochaska and Velicer 1997). Another theory on the topic is Roger´s Diffusion of Innovations in which the diffusion itself follows a five-stage process of Rogers' Diffusion of Innovations (1995), the diffusion itself also follows a five-stage process:

1. Knowledge: The individual is aware of the innovation but lacks information about it.
2. Persuasion: The individual becomes interested in the innovation and seeks information about it.
3. Decision: The individual weighs the pros and cons and decides whether or not to adopt the innovation.
4. Implementation: The individual adopts the innovation.
5. Confirmation: The individual decides to continue using the innovation.

Satisfiers for public transportation. A project called *Benchmarking in European Service of public Transport* (2007) was conducted in nine different European cities: Barcelona, Berlin, Copenhagen, Geneva, Helsinki, Manchester, Oslo, Stockholm, and Vienna. It rated the ten commonalities of satisfied citizens: traffic supply, reliability, information, staff behaviour, personal security and safety, comfort, social image, value for money and loyalty (BEST 2007). The result showed that public transport performance from the perspective of the travellers involves three prominent dimensions. Reliability and trust are important aspects in public transportation (trust in that the service offered would be provided as promised). The second dimension is safety which refers more specifically to safety at stations, bus stops and on board busses and trains. It also reflects the risk of getting into traffic accidents when using public transport. The last one is identified as comfort (Fellesson and Friman 2007). It relates to the physical environment in a broader way such as cleanness and design of vehicles.

Social injustice influences both the amount of travel related to work and the amount of travel during leisure time (Carlsson-Kanyama and Lindén 1999).

> *"The higher the income, the longer the distance travelled. Men with high incomes consume more energy than all the other groups for their travel"* (Future Urban Transport 2009)

Town-centre parking charges may decrease the competitiveness of retailer's downtown compared to decentralised shopping centres since suburb shopping centres often provide large free parking-lots for customers (Buchanan, et al. 1997). However, current transport plans regarding municipal parking-lots still have social inequity, such as passive driving, living with the consequences of other people's travel behaviour. People who live close to busy main roads are more likely to suffer chronic ill health, as evidenced by symptoms such as runny or blocked nose, sore eyes or sore throat, coughs, or lack of energy (Sustrans 2008). They are depending on the car, have no realistic public transport alternative, need to travel relatively long distances for work or shopping and seldom have leisure trips (Sustrans 2008).

Social behaviour change interventions can be defined as:

> *"Behaviour change interventions, such as education, training and information provision, and mass media persuasion (through advertising and the use of campaigns)"* (Avineri and Godwin 2009)

Educational activities and communication measures, with the purpose to raise awareness of sustainable transportation and environmental concerns, needs to be done on municipal level. Results from the ABCD-session (Jönköping Municipality, 10-11th March 2010) showed that when measures were taken to reduce parking lots in front of small shops, a lot of businesses that depend on the customers parking their cars in front of the shop did protests against such measures. Results showed that the municipality already hosted public meetings in attempts to engage everyone in the decision-making process. Other methods such as questionnaires and on-line surveys can also be used to help build a shared vision of the performance improvement goals and objectives for the local government. Mass-media persuasion, i.e. deliberate efforts to influence the way people think or behave, has big and significant effects (Avineri and Goodwin 2009). In a transportation context, advertising campaigns are commonly attached to specific initiatives such as public transport service improvements. The authors found that there will always be a need for the transmission of information about any new circumstances to the public, and various forms of advertising will normally be used (Thogersen 2004). It may be just as important from the citizen's point of view to feel that the influence was 'fairly' developed and approved by the public (Avineri and Goodwin 2009). That can provide a conceptual framework for understanding behaviour, and offers proven tools for practitioners to bring about new transportation decisions that would benefit individuals as well as their communities.

Capturing and analysing human transportation patterns is one of measures created based on the study of human behaviours. The ultimate goal is to develop predictive models of human travel and use these to design motivational interventions that serve to modify travel behaviour towards sustainability (Camara 1998). The measure is very important when understanding how human transportation patterns can be optimized in order to achieve a higher level of sustainability (Van Leeuwen et al. 2009). It will rely on data from Global Position System (GPS) equipped mobile phones, blue-tooth location tagging stations, and detailed bus ticketing data to capture individuals' mobility in an urban environment which can be used to create models of personal travel and public transportation systems (Girardin et al. 2008). Some of those models can be aggregated to express the general behaviour of passengers in personal and public transport (Ziebart et al. 2008).

Intelligent transport systems (ITS) can make a difference while striving towards sustainable transportation. According to estimates made for road transport in Europe, CO_2 emissions could be reduced by 10 to 20 per cent,

accidents and incidents by 5 to 15 per cent and congestion by 5 to 15 per cent by employing different ITS solutions (Vägverket 2009). Although, ITS is not only operational intelligent but also used in an intelligent way as to positively support society (PS 2008). There were four levels of intelligence for the unknown of the future that was mentioned in the article of "Change human behaviour to have more efficient transport" (2008):

> *"Intelligent design, minimizing the need to move, through urban design, efficient integration and management of public transport and local production; A system that can provide intelligence, with sensors and data mining providing information to support the decisions of individuals and service providers; Infrastructure that is intelligent, processing the mass of information we collect and adapting in real-time to provide the most effective services; Intelligent use of the system where people modify their behaviours to use infrastructure in a sustainable way."* (PS 2008)

Emerging innovations are being explored below and McKeown (2008) defines an innovation as follows:

> *"Innovation is a change in the thought process for doing something or "new things that are made useful". It may refer to an incremental emergent or radical and revolutionary change in thinking, products, processes, or organizations."*

An exploration of the emerging innovations can be a key component that should be addressed in order to inform the discourse about what is feasible today or in the near future. Some of these are briefly explored below.

Electric cars. Fossil fuels of today such as gasoline and high graded diesel are two examples of how exergy (available energy) can be stored and then released through a combustion engine to propel vessels. Transportation in a sustainable future does not rely on combustion engines as the electric motoring is more than three times more energy efficient and has almost zero emissions, not taken in account the electricity production (European Commission 2009). The Swedish Minister for the Environment is pointing out the electric car to dominate the car fleet in 2020 as the government will increase incentives for electric cars and penalize those who contribute to increased CO_2 emissions (Carlgren 2010). Research for improved battery life-span, energy storage, recharging time and weight optimisation is today conducted as the batteries of today is more or less limited to urban travels for about 150 kilometres. Although, the new distance record is set to 501 kilometres by the Tesla Roadster and recharging can be completed in 3.5 hours (Tesla Motors 2010).

Hydrogen fuel cells is another way of storing energy like in a battery, but the advantage is that it can be produced out of water and has no emissions when released (Fuel Cells 2000 n.d.). Research is being focused on gas storage in tanks as it has to be highly compressed without being dangerous, but also on ways of producing the hydrogen with low energy consumption like generation via bio mimicry (TEKNAT University of Uppsala 2008).

Smart grids can be used to level out peaks in electricity production via storage in the electricity grid and then released for consumption upon demand (European Commision 2005). Concerns have been raised about privacy and fair availability of electricity and the initial cost of regulating equipment like power system stabilizers. Pilot projects are conducted in Arvika and Djurgården (Fortum Media 2009) and a research overview shows a lot of activities around the world as micro grids (Hatziargyriou, et al. 2007), and EU (European Commision 2006) as well as US (U.S. Department of Energy 2006) have launched plans for research programs and developed strategies for the 22nd century.

Algae fuels. Future Biodiesel, Biogas, Jet fuel and others can be produced out of algae. Via photosynthesis, algae are made out of CO_2, waste water and sunlight, and then extracted and refined to fuels. They are almost carbon neutral as CO_2 is used during production and then released at combustion (AlgaeFuel 2008-2009). Big airline companies are interested in the development and flight trials with a mixture of algae fuel have been successful (Lane 2009). The U.S. government has plans for serving the military aviation fleet with algae fuels. The main challenges are identifying oil rich algae, find processes for economic extraction of algae oils, but also to find commercially viable "co-products" that can help to reduce the end user price (DARPA 2010).

Solar sails (ships). Sailing is probably one of the oldest propulsion of vessels and was concerning commercial purposes replaced by the combination of combustion engines and propellers in the early 19th century. The leisure yacht business has refined the sailing technology and the latest battle of the Americas Cup was won by a fixed winged trimaran (BMW Oracle Racing 2010). The sailing around the world record was recently completed at an average speed of 18 knots (WSSR 2010), which is more than the service speed of modern super tankers like TI Europe (Ships and Yacht Information 2008). The Solar Sail concept consists of fixed rotatable wing sails covered by solar panels. The sails will help to propel the ship for suitable winds and the solar panels will support the onboard

energy/electricity production and also assist propulsion. Development has to be made in terms of making the big sails more flexible, lighter and easier to fold up/down, and how to install them onto existing ships. An Australian company has delivered solutions onboard ships in Hong Kong and China that reduces emissions (Say 2009) and the design of 190 feet long leisure yacht primarily propelled by solar sails (Pfeiffer 2009). Such development points out the direction for the future of ships/yachts with solar sails.

Magnetic Levitated Vehicles (MagLev) has often been referred to as the future of track based high speed transportation as power consumption and emissions (and noise) are low in comparison to traditional "wheel on rail" systems (International maglev board u.d.). Also, passenger convenience and safety is higher as it has no physical contact with the track and no crossroads with road traffic since the track can be elevated and fitted into the existing environment and trains are well suited for fast rural transport, e.g. airport transfers, and can also be an alternative to airborne transports (International maglev board u.d.).

In Japan, MagLev's are developed with an Electrodynamic Suspension (EDS) and has today the world record at 581 kilometres per hours (International maglev board u.d.). The Transrapid concept with Electromagnetic suspension (EMS) as propulsion has 5 times lower energy consumption than passenger aircrafts and 3 times lower than a car (Transrapid n.d.). The operating cost is lower than "wheels on rail" high speed trains while the infrastructure cost is similar (Transrapid n.d.). The Transrapid MagLev line in Shanghai has been a success concerning the city's vision to be less oil dependent and to handle the fast growth. Furthermore, Shanghai is planning to build more MagLev lines (Coates 2005).

The drawbacks with EMS and EDS includes high initial and maintenance cost, technological difficulties and operational instability as well as magnetic fields (EMS less than EDS) which have to be isolated from passengers as well as sensitive electronics (Heller 1998). The authors found that the Inductrack solution (Heller 1998) can solve the issues with EMS and EDS, as the Inductrack is a passive system using the Halbach array permanent magnet configuration. The magnetic field that levitates the vessel is neutralised and there are no demands for electrical or mechanical guidance, but only a propelling external force and auxiliary wheels are needed for stop/start purposes (Heller 1998). The system allows curve radius like traditional train systems and can easier be implemented in urban areas than the active MagLev (Heller 1998). Pilot projects for urban (and

rural) transport in small trains have been conducted in the US and products have been developed to fit onto cars, trucks and trains to lower power consumption (General Atomics n.d.). The PRT concept SkyTran is designed for Inductrack propulsion which could be a future replacement of personal cars as it has benefits in all areas compared to cars, except from the high initial investment costs (Malewicki 2009).

3.1.5 Tools Level: Phase II

Tools that are supporting efforts to achieve success and ultimately sustainability, in this case sustainable transportation, can be divided into three categories (Robèrt, et al. 2007).

- **Strategic Tools** to evaluate how progress towards success and compliance with the strategic plan, e.g. Life Cycle Assessment, Environmental Management Systems or ABCD analysis.
- **Systems Tools** to monitor actual impacts in the system of which needs to be protected, e.g. Toxicity level measurements or Total Material Flow.
- **Capacity Tool** to build capacity to understand the system itself, e.g. FSSD, Causal Loop Diagrams or Systems Thinking.

One commonly used strategic tool when planning towards sustainable transportation in Sweden is the so called Four Step Principles method (Fyrstegprincipen). It is an approach that supports the selection of actions that aims at limiting the use of resources and reducing the negative environmental impact of transportation (SKL 2005). The steps can briefly be described as follows:

1. Measures that can impact transport demand and modal choice. Examples would be the planning, operation control, marketing management, and pricing.

2. Measures to provide more efficient use of existing transportation systems. It can apply to work in operation control, marketing, pricing and information targeted towards different parts of the transport systems in order to streamline the existing transport network. Increased traffic for better utilization of existing infrastructure is an example.

3. Limited reconstruction measures. Can include improvements and alterations to the existing stretch of roads e.g. safety measures. Meeting-free roads with wire racks are examples of actions in this step.

4. Initial investment and major reconstruction measures. Including improvements and alterations to the existing route, e.g. traffic safety or carrying capacity measures, and more extensive reconstruction and construction measures.

A wide array of tools from all three categories are being utilised in various stages of the planning process of transportation, such as Life Cycle Assessment, Geographic Information Systems (GIS), Cause-Effect Analysis and Causal Loop Analysis (Naturvårdsverket 2009).

An overview table on the topic of supporting tools and concepts can be found in Appendix D for further reading. The table provides examples of methods and tools that can be used for transportation planning to identify, describe and assess environmental impacts, effects and consequences of various measures and alternatives developed in strategic plans (Naturvårdsverket 2009). They can also be used to develop measures and options to remedy negative environmental impact and to reinforce positive environmental impact. The table is based on a review by Naturvårdsverket and outlines suitable usage areas, cost, strengths, weaknesses etc. However, it is important to point out that all tools are not necessarily utilised by all municipalities due to different conditions.

3.2 Areas of Improvement and potential Challenges: Phase II

The exploration of various potential challenges and areas of improvements facing transportation planning today aims at contributing towards a solid base for effective strategic planning where current shortcomings in the process (at the higher strategic level) can be avoided and learned from. The purpose is also to provide a balanced reflection of the FSSD coverage above. A literature review and surveying of planning experts has been conducted to determine the results of this section.

3.2.1 Visioning and Responsibility

It was expected to find visioning to occur at a high political level and prioritisation of actions to occur at a lower level by transportation experts and planners, within certain given financial parameters. However, SIKA (2008) claims that both visioning and action selection often takes place at a high political level. Such high-level selection then instead turns into conditions for planning at the lower level and as a result planners and experts tend to become more restricted. There is a need to lift planning and

work of transportation and sustainability to a higher and more strategic level, such as to the Municipal executive committee, in order to give the question matter its rightful attention and legitimacy. This would, according to Neergaard et al (2004), provide an opportunity to create a more collective view on problems and vision, both between departments and between politicians and officers.

Organisational control in terms of responsibility allocation within the planning process sets a certain condition for change as it could have an impact on outcome and efficiency. Both responsibility and implementation are carried out either centrally or by a department, and its advantages and disadvantages are illustrated in table 3.3 below. Usually, the responsibility is borne by a committee or a Municipal executive committee, while the implementation takes place in one or more departments (Hyllenius et al 2007).

Table 3.3: Central control vs. Department control

	Central control	Department control
Advantages	• Central control can provide support to employees and ensure that contact with politicians and senior officials are maintained during the process and the allocation of responsibility at the same time becomes clear. • Central control gives the work a certain authority and status. This is beneficial when municipalities have multiple strong departments that want to pull in different directions.	• Department control makes integration of sustainability into regular activities less complicated and can foster a more natural mix of physical and behavioural change measures. • Department control prepares the organization better for the phase in which sustainability will be integrated into regular activities. • Department control fosters a wider allocation of responsibility to various departments and staff.
Disadvantages	• Central control makes the integration of sustainability planning into regular activities more complicated.	• Department control tends to give sustainability less legitimacy and authority compared to central control.

Source: Hyllenius et al (2007)

3.2.2 Collaboration

Collaboration is an area that has been relatively widely discussed in various studies and reports. The infrastructure of transportation as a whole, with its components, are interconnected which subsequently leads to shifting challenges of different magnitudes regarding coordination at borders. Such coordination issues could arise between, for example, urban planning and transportation (SIKA 2008). Development of transportation also requires

extensive and fairly complicated coordination between different levels of society and shared priorities. There is according to a study conducted by SKL (2009) a significant need to strengthen the undeveloped and weak dialogue between state, region and municipality in order to enhance the efficiency of actions.

The outlined plan is limited to a municipality´s authority area and a limited regional planning puts limits to collaborative traffic and development strategies. Voluntary cooperation between municipalities easily reaches an ambiguous status as responsibility and decision-making often becomes unclear (SIKA 2007).

3.2.3 Stakeholder involvement

Development of transportation infrastructure is aimed at increasing the efficiency of transportation and support sustainable growth in which the business environment is a stakeholder of considerable importance. Business involvement in projects is therefore important in order to secure a business perspective in action plans and coordination of resources (SKL 2009). Dissatisfaction and pressure from citizens or enterprises could make timeframes longer, costs higher and implementation harder in transportation projects (Flyvbjerg 2007). It is therefore crucial to involve stakeholders throughout the planning process.

3.2.4 Knowledge and Capability

Along with increased attention to sustainable transportation the demands for knowledge and enhancement of capability increases. The political sphere´s capacity and resources to evaluate various action alternatives, including innovation within the transportation sector needs to be developed and strengthened (SIKA 2008). Certain issue and aspects requires specific expertise which can often only be expected to be found at the national level (SKL 2008).

There is according to Naturvårdsverket (2005) a need for greater knowledge about the existence and character of functional urban regions and their building, dwelling and commuting structures. Densification of the Swedish sparsely populated urban regions is necessary to give more people realistic possibilities to walk, cycle and use public transport. In many situations, densification means a difficult balance between the protection of existing qualities and the need for building on low density areas, land used

for streets and parking, low quality green areas etc (Naturvårdsverket 2005). Also in this field new knowledge ought to be created.

3.2.5 Economic Challenges

Not surprisingly, the current process of funding and resource allocation encompasses some severe obstacles, especially through the interaction phase between state, region and municipality. The state investment plan which is decided by the parliament, central authorities, county administrative boards or regional governments, is not connected to municipal land use planning (SIKA 2007). There is on the other hand a clear link in terms of planning and review of specific traffic installations and objects (SIKA 2007). Such links create challenges both at state and regional/municipal level. For the state because it must be tempting for regions to inflate their needs to ensure a large financial frame and for regions and municipalities as there is no certain promise by the government to actually follow regional plans (SKL 2008).

Current transportation often tends to be based on "yesterday's" solutions with actions intended to solve problems. It was expected to discover challenges related to large projects with the purpose to make grand transformational changes to or within a transportation system. This view is supported in a study by SIKA (2008) where the authors argue that costs can be high when customized systems are to be built, particularly if they are to be fully borne by an individual municipality. Municipalities, counties and regions are forced to pay in advance state investment in order to prevent local and regional plans to be deferred or capsized even though main responsibility for investing in transportation is borne by the state (read more table 1.1). They are also expected to meet the requirements of municipal and regional co-funding of public infrastructure (SKL 2008). Transportation projects therefore often end up being delayed due to an unsustainable funding system, but also as a result of limited manoeuvring space to find good solutions for a well functioning and attractive urban environment (SKL 2008).

3.2.6 Social Barriers

Transportation needs to be developed to facilitate everyday life for people and businesses (Näringsdepartementet 2008). The same paper also points out the importance of putting human needs in the forefront when planning towards sustainable transportation, but that there are many potential barriers

in this regard. Furthermore, findings with respect to human needs often point towards fields such as inequality, mobility and safety.

The large increase in the distance that the average person travels in a day obscures a large and growing inequality. For example, those with cars and sufficient money tends to fly freely and travel much more than average, and those dependent on deteriorating public transport thereby travel much less (OECD 2000). Car ownership is strongly correlated with household income, and mobility is strongly correlated with household car ownership (OECD 2000). Income seems to be a significant factor as it is well documented that people in the poorest households are more likely to be injured or killed in traffic, and this is especially true with regards to children (Sustrans 2008). As traffic increases, traffic danger increases, especially for pedestrians and cyclists. Furthermore, the increasing fees and taxes are likely to increase the burden on low income people who live in rural areas as they are depending on the car and often lack realistic public transport alternatives (OECD 2000).

3.2.7 Demand Management

People tend to rely on the established players and many may feel reluctant towards innovations in general which is then reflected in their roles as administrators, investigators and policy makers (SIKA 2008). Innovations can be opposed and refused by already established actors and stakeholders based on self-interest. SIKA (2008) describes planners of sustainable transportation as being tied up and locked into a corner with limited tools to influence demand:

> *"Demand for transportation, which is under the transport political premises decentralized and determined by market forces do not adapt easily to supply. Planners do not have access to any instruments to influence the demand level and distribution towards specific traffic solutions or to affect the characteristics of the vehicle fleet, aviation, road, etc. The ability for the planners to focus on a greater role for cycling, public transport and possibly new modes of transport are severely restricted by various organizational and legal reasons. Planners must also balance the alternative use of resources in an economic perspective."* (SIKA 2008)

Comprehensive information and marketing strategies from municipalities seem to be rare and their absence could potentially hinder public awareness and acceptance of sustainable measures/strategies (Hyllenius et al 2007).

3.2.8 Supervision, Documentation and Monitoring

Sometimes timing can create complications e.g. when one plan is adopted and produced much earlier than the other (Neergaard et al 2004). There are only a few municipalities having an overall transportation strategy that weaves land use, traffic, environment and urban visions (Neergaard et al 2004). Furthermore, regional plans should be more transparent and clear to the attendees to determine whether the choice of action is the most effective and socially, economically and environmentally sustainable (SIKA 2010).

There are generally vague and inconsistent evaluation procedures at municipalities and they often lack a comprehensive plan or strategy for follow-up activities. Furthermore, there are generally none or very little documented effects of strategies. This could probably be linked to and parallel to the overall unsatisfactory monitoring and evaluation procedures (Neergaard et al 2004).

SIKA (2010) concluded that the strategic planning tool, the Four Step Principles (covered in 3.1.5), had not been widely used and thereby left very small traces in the planning process. It had often been used to give the public an impression that the planning had been conducted openly and comprehensively which in fact never happened. SIKA (2010) also identified a great need for new flexible analytical tools and guidelines to compare different measures.

4 Discussion

To provide a description of what sustainable transportation should look like in the future, this chapter begins with discussing the vision findings. Using this vision as a long range perspective, the discussion then outlines how the planning of today and tomorrow can be enhanced and shift towards the created vision. The discussion concludes with an exploration of what a guidance tool in the D-step of the ABCD-method (described in chapter 1.1.5) might look like.

4.1 Visioning Sustainable Transportation

The authors, in the results chapter 3.1.1, have discovered that there is a lack of a unified understanding of sustainability (as defined in chapter 1.1.1), and that success is not currently based on a principled definition of sustainability, neither at a municipal nor national level of transportation planning. Creating a vision as described in chapter 1.1.4 based on the SP's according to Robèrt et al (2007) would allow a movement towards a sustainable society, positively unify multiple efforts, and ease the collaboration between national, regional and municipal levels.

4.1.1 System Boundaries Analysis

Visioning begins with defining the system boundaries in order to locate transportation within the society and in the biosphere. The system boundaries were (as reviewed in chapter 3.1.1) identified in the two ABCD-sessions with Transportstyrelsen and Jönköping Municipality. They can be considered the same for both national and municipal level, since the only difference between them was due to alternate phrasing of the same content.

4.1.2 Core Component Analysis

The core analysis examined what timeless elements guide organisations through complex and difficult situations. The core concept was also created in collaboration with Transportstyrelsen and Jönköping Municipality. It took into consideration the core values of safety (security, environmental, trust), convenience, affordability (value for money and/or limit), and equality among humans. The core values were found to be the same for both Jönköping and national level and can therefore be considered the same. However, the core purposes were different. The national purpose to *"facilitate and support our wishes, needs and demands (Socializing,*

curiosity, exploring, economical)" did not appeal to Jönköping Municipal representatives as it was considered to be too general and applicable to other sectors, rather than just to transportation within a municipality. The core purpose created for Jönköping involved *"bridging distances to enable people to meet their basic human needs and to support the societal development"*. This purpose is general enough that it is considered to be applicable to all municipalities.

When comparing the core concept to the governmental vision in chapter 3.1.2, it was found that the difference was about safety. While the national vision focused on reducing accidents, the core concept additionally covered the human need of feeling safe during transportation. Moreover, sustainability is only touched upon with regard to some human needs and environmental quality, while the core concept is framed by the SP's.

Lind et al (2002) identified attractiveness (described in chapter 3.1.2), which is not directly included in the core purposes, but touched upon in some of Max-Neef's basic human needs (1992). Prosperity is slightly different from "supporting societal development" within the core concept, but more closely related to the national's vision to*"...support our wishes, needs and demands."* The content can anyhow be considered to be the same as the core concept.

Sustainability is highly regarded in the core concept as it is framed by the SP's (chapter 1.1.4). Even though Hyllenius et al (2007) have identified high quality as a key component within current municipal transportation visions, it is not being mentioned that sustainability should be included in such visions. The authors believe that planning from a principled definition of sustainability will enhance the prospect of providing high quality as the probability of moving towards a sustainable future is high.

The vision created for Karlskrona Municipality by Lichtenberg et al (2008) covers most of the core concept, but does not include goods and mainly focuses on attractive substitutes to car travelling.

4.1.3 Strategic goals Analysis

In order to render the vision more tangible, the core concepts and visions are often translated into concrete audacious/strategic goals as described in chapter 1.1.4. A specific Big Hairy Audacious Goal (BHAG), for transportation has not been created by the government, but there is a "vision" that Sweden will be green house gas neutral by 2050, which could

be considered a BHAG for Sweden. The transportation sector is the largest contributor of CO_2 emissions as shown in chapter 1 and there is a need to focus on reducing this. During ABCD-sessions with Transportstyrelsen and Jönköping Municipality, the authors have set the BHAG for transportation to achieve carbon neutrality (described in the Glossary) and be "*carbon neutral by 2050*", both on a National and Municipal level.

Comparing the governmental goals (chapter 3.1.3) and the national collaborated strategic goals that should be reached by 2030 (fossil free fuelled vehicles, possibility of driverless track guided vehicles on demand, possibility of shopping transportation on demand) has demonstrated that the governmental goals only include fossil free vehicles, and are more focused on safety. There will probably be different strategic goals for the National and Municipal levels, as the authors found much diversity during the ABCD-sessions and there is a need to tailor the goals to the unique conditions of transportation for each municipality.

The vivid description (a story of sustainable transportation in the future), as described in chapter 1.1.4, ought to be tailored to each municipality as it should include applicable strategic goals. This could be useful when creating a vision because communicating the vision as a story could enhance the understanding amongst the general public more than a pure theoretical exploration of the vision components.

The results from the ABCD-sessions with Transportstyrelsen and Jönköping Municipality can be found respectively in the appendix B and C.

4.2 The S-E-A-T Approach

This section illustrates the S-E-A-T approach which has been proposed in order to support municipal strategic planning of sustainable transportation. The word approach is used as a collective expression for both a proposed core model (S-E-A-T model) and strategic guidance tool (figure 4.1). S-E-A-T stands for *Social, Environmental, Administrative and Technological*. It has been designed as an expansion of the ABCD method and should therefore be used in conjunction with the ABCD methodology in order to ensure that the key focus areas specific for transportation are covered while backcasting from a principled definition of sustainability.

The S-E-A-T model consists of four spheres and subcategories and was created to mirror and frame the most essential aspects in strategic planning towards sustainable transportation. The strategic guidance tool was derived from the model and should be plugged into the D-step of the ABCD process in order to help prioritise among a list of compelling measures. The approach was inspired by an idea sketch called Sustainable Traffic Solutions (Cars et al 2008) which is illustrated in the sub-chapter below.

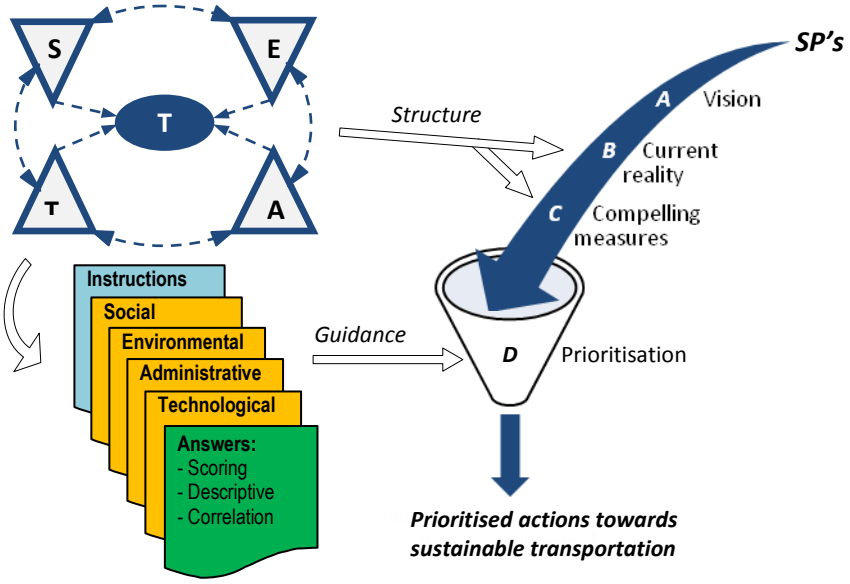


Figure 4.1: The S-E-A-T approach

4.2.1 Sustainable Traffic Solutions (Cars et al 2008)

The above section gave a brief introduction to the proposed S-E-A-T approach and this section briefly clarifies the link between the approach and an idea sketch on sustainable traffic solutions authored by Cars et al (2008), as described in chapter 1.1.6.

Cars et al (2008) produced the idea sketch for sustainable traffic solutions with the purpose to guide sustainable solutions through systems thinking in order to avoid mental and ideological lockups. The authors suggested that there is a need for an overriding methodology with the purpose to avoid problems often associated with sustainable transportation planning. They proposed 5 interlinked subsystems that the transportation sector is dependent on. Each subsystem should be analysed from a life-cycle perspective and co-developed in parallel to each other. Planning should also

be conducted to determine interlinked, development steps that move towards future solutions which consider the theoretical resource potential within each subsystem. Planning within each subsystem should aim to find actions that support other subsystems. Cars et al (2008) suggests eight essential guiding components that planning should include and be derived from. This suggested methodology would be applied to acquire an overarching perspective in sustainable development of transportation, and enhance the chances for success in long-term planning.

The S-E-A-T approach has been influenced and inspired by the same bird´s eye and systems perspective as well as collaborative mindset rooted in the idea sketch for sustainable traffic solutions described above. Apart from the overarching perspective, some elements and terminology from the idea sketch have been incorporated into the S-E-A-T approach, such as the 5 subsystems (chapter 1.1.6). However, it is important to point out that the proposed S-E-A-T approach should not be viewed as an elaboration on the idea of backcasting within each subsystem (and in parallel with other subsystems) as this thesis instead puts its focus on ultimately providing support to the prioritisation step (D) of the ABCD method by forming guiding questions. Both the idea sketch by Cars et al (2008) and the S-E-A-T approach are rooted in the concept of backcasting from a principled definition of sustainability, and use the ABCD-method to develop action plans towards sustainable transportation.

4.3 The S-E-A-T Model

Transportation is a highly complex system with multiple interactions, considerations, aspects and forces to encompass in the planning process. The authors identified a need to discover essential overarching elements within transportation planning and create a model to help visualise and understand the complexity involved. The model helps to disentangle crucial overarching elements in the planning process towards sustainable transportation.

The ultimate purpose and justification for creating the model was to provide a visual representation of the most important elements derived from the results chapter. This model would then subsequently inform the guiding questions in the strategic guidance tool. Some terminology and elements were used from the idea sketch by Cars et al (2008) and helped to inform about the inclusions. The S-E-A-T model forms one part of the full S-E-A-T approach and it was the first step towards creating the strategic guidance

tool and should therefore not be considered a planning tool of its own. It rather visualises the bird´s eye and systems perspective of transportation planning and at the same time highlights the most essential aspects in the strategic planning process. Having described the purpose of the S-E-A-T model, the next section illustrates how it was created.

4.3.1 Fusion of the 5 subsystems and PESTEL

The core of the S-E-A-T model was created through a fusion of two methods, 5 subsystems (Cars et al 2008) and PESTEL, and this section illustrates how they were combined.

The study about sustainable traffic solutions by Cars et al (2008) that was outlined in chapter 1.1.6 and 4.2.1 suggested five interlinked subsystems of which transportation depend on:

- *Resource base* = e.g. sugar cane, sea, oilfields, uranium mines.
- *Energy carrier* = e.g. gasoline, diesel, methanol, ethanol, biogas.
- *Motoring* = engines used to propel modes of transportation.
- *Infrastructure* = e.g. roads, rail, airports, harbors, communications.
- *Social system* = e.g. values, traditions, cultural patterns

The suggested five subsystems appear to be sufficient and relevant when prioritising measures and technological solutions within the subsystems, which should always support all five subsystems. The five subsystems provide good coverage of technological aspects when planning towards sustainable transportation, yet they do not fully address some essential aspects beyond technological and social constraints.

Therefore, there is a need for an even broader perspective that considers a planner´s viewpoint and also takes into account constraints that often set the conditions for planning. Incorporating the suggested five subsystems into a unified and overarching model could provide a better balance between subsystems and significant planning considerations. It is important from a strategic point of view to not lock the process up with too much detail at an early stage. Instead, there should be a greater focus put on the sweeping bird´s eye perspective and the identification of smart, long-term and strategic pathways towards sustainable transportation.

The system boundary identification process for transportation suggested a vast array of essential aspects for successful planning. ABCD-sessions with national and local strategists and transport planners, along with secondary research, it was implied that there is a wide array of non-technological

aspects to consider. These aspects hold much importance during the planning process of transportation. Strategic planning of transport may not always be significantly different from strategic planning of business. One tool that is used globally for planning of corporate strategy is a PESTEL analysis, which is the study of *Political, Economical, Social, Technological, Environmental and Legal* factors concerning future corporate action (Lynch 2006). The PESTEL analysis has been reviewed and tested throughout time by thousands and thousands of experts, decision makers, strategists and others, making it solid and robust. It provides a useful starting point for any analysis of the general setting which surrounds decision making within an organisation (Lynch 2006).

Combining these two methods in a balanced way provides a solid overall and overarching categorization of transport planning. Figure 4.2 demonstrates a suggested merger between the five subsystems and the PESTEL, with the aim to provide a sensible balance between administrative, environmental, social-cultural and technological aspects. The social sphere is given its own category in order to provide a better balance and all the other subsystems naturally feed into the technological sphere. It is important to note that it is the terminology of the 5 subsystems that has been transferred into the S-E-A-T model, not the idea of backcasting within each subsystem (and in parallel with other subsystems) due to the above described purpose of the model.

To ensure that there is no overlap with other spheres and their sub-categories, the content of the technological and administrative spheres has to be viewed from an availability perspective. For example, a question based on the content in a sphere should provide an answer that states how much of the long or short term solutions will most likely be achieved. Overlapping from the author's point of view is acceptable to a minor extent in the S-E-A-T model. Although, the overlap between the technological and environmental spheres will be overwhelming concerning the SP's if the content in the technological sphere is not seen from an availability perspective. Concerning the overlap between the administrative and the social sphere, the S-E-A-T model user must keep in mind that the administrative sphere exists partly to make sure that actions from other spheres are conducted in a way that leads towards sustainable transportation. This is further exemplified in chapter 4.4.2 regarding tool questions.

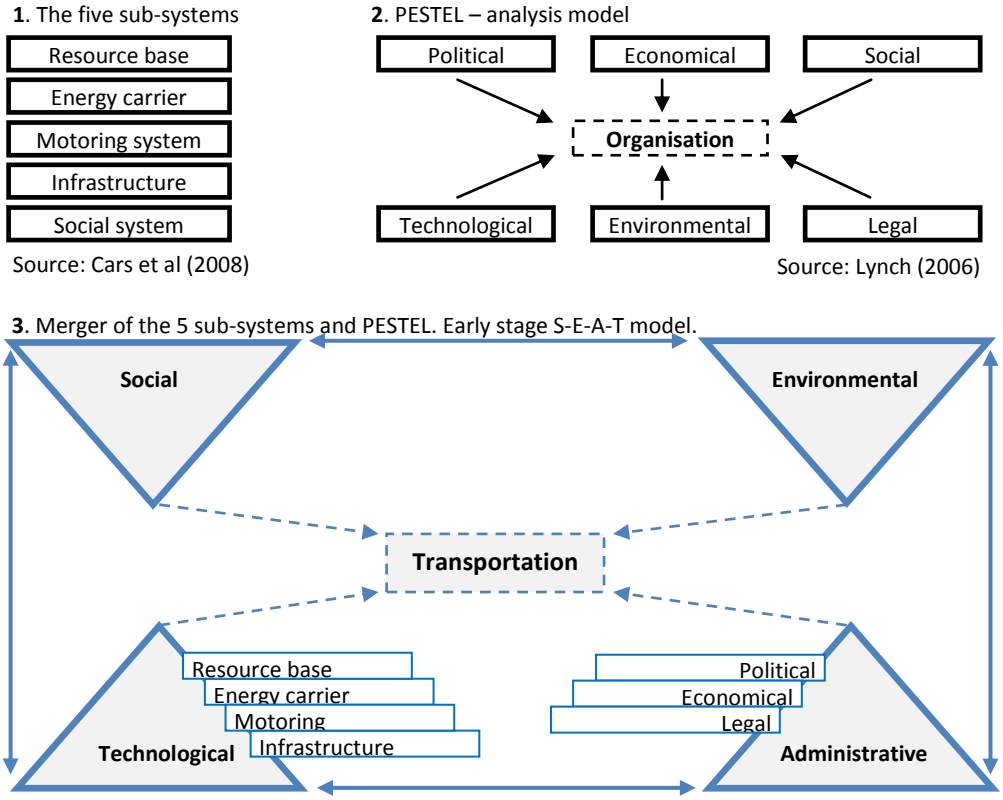


Figure 4.2: Development process of the S-E-A-T model.

This model will be referred to as the S-E-A-T model for the remaining portion of this study. The above figure shows the first initial steps towards an overarching model from which a strategic planning tool towards sustainable transportation will be based upon.

The remainder of this sub-chapter forms a discussion framed by the S-E-A-T model, based on the results chapter, with the aim to identify overarching key aspects and themes in the planning process towards sustainable transportation that would populate each sphere of the model.

4.3.2 Social Sphere

The social sphere is mainly related to the fourth sustainability principle (chapter 1.1.1). The context of this sphere refers to important aspects from an individual's perspective within transportation that are of utmost importance for planners to address when planning towards sustainable transportation.

Human beings are the main actors of traffic behaviour. They are the participants of transportation and have direct impact on the evolutionary tendency of the transport system. When city planners want to make a strategic plan for a sustainable transportation system in an urban or rural area, they must not neglect the most active and dominant factor within the complex system, the human beings.

It was shown in the results (chapter 3.1.4) that the factors of social behaviour such as awareness, attitude and habit influence people's choice of where to live and when to use transportation. Those personal choices influence the efficiency of governmental decisions. When planners within municipalities begin to think in a strategic way of planning, it is suggested that they make long term plans accompanied with short-term trade-offs that guide the municipality towards the sustainability vision.

As shown in the results chapter 3.1.4, the theory of Rogers Diffusion of Innovations (1995) was briefly introduced and it was found that there are different stages of social behaviour change. Interventions that provide information and education are preferably introduced in the beginning of the diffusion when individuals become aware of the innovation but lack information about it. Considering the time frame, information and education interventions are suggested to be part of the long term plan and should be considered at an early stage of planning. As shown in the results in chapter 3.1.4, mental shortcuts and biases cannot be erased and so sustainable solutions can often only be suggested as alternative choices since citizens may resist accepting them if the benefits are not totally understood. In public transport, for example, a possible source of unwanted established mental models might come from a loss of trust due to accessibility and reliability problems. Interventions described in chapter 3.1.4 (i.e. mass-media publicity) could be used to change those factors that influence human behaviour. These encourage citizens' participation and make plans more effective when executing actions towards sustainable transportation.

Municipalities want their new plans to be popular and adopted in the future, which means that changes among local populations, such as new policies, have to take place. A demographic study of local populations should be considered, for example, immigration and/or future proportion of population. Safety as the fundamental goal should always been considered too. A choice of travel mode can be easily connected with a person's lifestyle and physical differences, whereas lifestyle is often determined by

the individual's disposable income. The demands for a more equal society continue to increase and this should be reflected in the equal rights for mobility. Comfort and convenience for senior citizens, children, and disabled people are very important criteria to consider when conducting sustainable transport planning.

The above discussion has illustrated some key characteristics of the social sphere within the S-E-A-T model during strategic planning towards sustainable transportation. Figure 4.3 illustrates the sub-categories based on the content in this chapter.

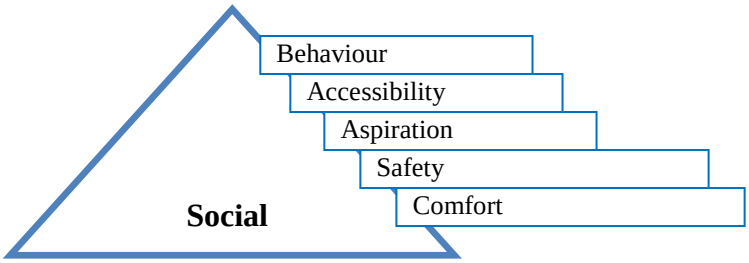


Figure 4.3: The S-E-A-T model: Social.

4.3.3 Environmental Sphere

The environmental sphere looks at the impacts that transportation typically has on the environment. The first three SP's explained in chapter 1.1.1 cover what is usually referred to as general environmental issues. An applicable tool for sustainable transportation planning needs to be specific enough to enhance the understanding of which strategic actions are preferable, without losing focus on the SP's. The themes for the environmental sphere within the S-E-A-T model were derived by looking at the large impacts that transportation today (and the future) has on the environment we (will) live within. Addressing these factors will also ensure a transition towards a sustainable future.

Thinking about energy and eco-efficiency will reduce many problems related to the content described in this sphere but it is also important to be aware of other planning concerns (spatial, energy, economy, etc), and to make strategic choices of transportation solutions in accordance to the technological subchapter 4.3.5. For example, a municipality that is planning for urban sprawl should consider choosing a location with as little impact from transportation on the ecosystems as possible. The municipality should also involve minimal flows of chemicals and metals and monitor energy

consumption during construction and usage of transportation. Hypothetically, a strategic choice for the location of urban sprawl which takes into account sustainable transportation concerns would be beside an existing railway/tram (back and forth job/city/shopping) where expansion could take place with minimal environmental impacts. Also, that sprawl should be located where human-powered motoring is the preferable mode of transportation for the majority of the inhabitants regardless of weather conditions.

Emissions that are primarily within the surroundings of the infrastructure pollute the soil, water and air. First of all, there are harmful chemicals used to prevent slippery roads or the growth of vegetation. Other pollutants may result from spillage from accidents, leakage from production of infrastructures, and particles/chemicals from tires and road wear. While air pollution includes particles, the green house gases are the main concern and especially the CO_2 as mentioned in chapter 1. The noise caused by transportation is also a great concern, especially urban areas, but also has effects on the wild-life in rural areas. It is important to remember the whole picture since emissions are not only caused by transportation vehicles, but are also a result of maintenance procedures (like ice-breaking ships, flight cargo vehicles, road and rail maintenance, etc) and the production of vehicles, fuels and infrastructure.

Geographical concerns that arise involve the topography of the landscape, ground composition, watercourses, snowdrifts, protected areas (historical, cultural, and natural), etc. These affect the cost and space needed to build infrastructure, but must be taken into account because they are interlinked with other environmental themes. The space used for creating transportation corridors and for biofuel production has to consider the concerns mentioned as above, while at the same time be cautious of natural oxygen production or CO_2 sinks. Also, the value of existing structures and the amount of energy required to break them down has to be included.

The flow of chemicals and metals resulting from the production, usage, and scrapping of vehicles, fuels, and infrastructure, is highly related to the leakage of harmful substances into the biosphere. This must be taken care of by using the precautionary principle and reduction programs, such as recycling and closed loops.

Ecosystems are affected by transportation. Transportation creates corridors and infrastructures that divides/moves/extinguishes existing ecosystems. Measures have to be taken to protect wildlife on the ground, shallow sea

bottoms and reefs, spawning areas, flights of birds, but also where people are living close to each other.

Figure 4.4 outlines the sub-categories based on the content of sub-chapters.

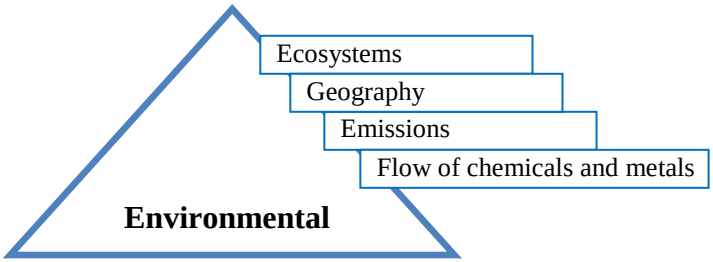


Figure 4.4: The S-E-A-T model: Environmental.

4.3.4 Administrative Sphere

The transition and planning towards sustainable transportation requires administrative activities and considerations which occur in a setting influenced by political and economic forces. Such influences often pose significant complications in the progress. Departure planning from a too narrow perspective where powerful forces are neglected could make the transition frail and vulnerable. However, such powerful forces can also be turned into opportunities if recognised and considered at an early stage in a balanced, systematic and diplomatic way. The context within the administrative sphere highlights areas that, if addressed when planning towards sustainable transportation, such as political support, transparency, communication, follow-up etc, will enhance the chances of scoring well on actions/measures included in the strategic plan. A number of essential key factors applicable to the administrative sphere were identified in the results chapter which can be allocated into six subcategories: political, economical, legal, planning management, coordination and communication. Table 4.1 demonstrates the correlation between key factors and sub-categories.

Table 4.1: Key Factor mapping in the S-E-A-T model.

Key Factors	Political	Economical	Legal	Planning Mgmt	Coordination	Communication
Time for strategic and visionary tasks	●			●	●	●
Clear goals and objectives	●			●	●	●
Political support and economic factors	●	●			●	
Clear responsibility and decision making	●			●		
Transparency and clarity						●
Methodology for consultation						●
Stakeholder involvement					●	●
Coordination across geographical areas		●			●	
State-Regional-Municipal collaboration		●			●	
Synchronisation with urban planning				●	●	
Overarching action plan				●		
Regulation and economic incentives	●	●	●			
Development of an information strategy				●		●
Follow-up procedures and knowledge				●		

It was found that strategies have to be rooted in political support and public opinion to enable a solid foundation for long-term development. Political support is also important in order to ensure monitoring and financing of the measures envisaged in the annual budget (Langeland 2003). For example, in Bergen (Norway) a major investment in improved public transportation was stranded due to lack of political commitment to the congestion charge as a measure (Langeland 2003). Studies indicate that selection of measures often takes place at a political level and thereby turns into a condition for planning. It is important to disentangle visionary tasks and action selection at the political level in order to avoid locking up transportation planners and experts. It is suggested to lift visionary tasks to a higher level and at the

same time give experts and planners more responsibility and influence on the path to get there. One of the major political weaknesses today is the significant focus on problem solving rather than on setting clear goals which could be a result of both ideological influences and the absence of a clear vision. Allowing enough time for visionary and strategic tasks is significantly important not only to establish an envisioned future as a reference point to plan from, but also as a way to build a long-term strategy that is rooted in political support and consensus with a shared mental model. A vision for sustainable transportation would be more robust if formulated in consultation with the public, the business environment, and across political blocks.

Constructive collaboration across geographical borders amongst neighbouring cities and municipalities could offer great opportunities to formulate shared mental models based on mutual interest. Such collaboration could be powerful when executed effectively, with competition left aside for the benefit of increased capability, enlargement of labour markets and increased accessibility. Sharing costs and opportunities could enhance the capability for innovative, creative and pioneering strategies to be adopted. Forming strategic alliances as such is particularly important as cross societal-level (municipal-regional-state) coordination does not function at its best. Establishing high-quality partnership requires effort, as well as time and it is particularly important to get strategic actors from local, regional and state level onboard. It is surprising that many municipalities administer land use and transportation through two separate committees and environmental issues by a third (Naturvårdsverket 2005). There is lack of coordination between administrative units involved in planning of transportation and between different sectors. Conflicting interests and objectives amongst stakeholders often make coordination complicated. Lack of knowledge about the vital link between sectors and between societal-levels and lack of effective planning tools is another problem. This may indicate a need for municipalities to merge committees and employ qualified coordinators to enhance synchronisation.

As transportation connects various parts of society it is significantly important to construct overarching plans that constitute all measures and goals towards sustainable transportation. Furthermore, it is crucial to synchronise transportation and urban planning in order to enhance the chances of forming a sustainable society that functions in symbiosis, is guided by systems thinking, and has an overarching perspective as the fundamental backbone. Close collaboration between applicable committees,

formulating plans in parallel, and synchronised timing are all important factors for planners to consider towards success.

Coordinated land and transportation planning can be constituted by physical and attitudinal, legal, organizational and financial measures. The greatest effect is obtained by combining restrictive and positive action (Naturvårdsverket 2005). The difficulty to introduce new innovative solutions and technologies towards sustainable transportation can often be linked to demand. Economic and legal measures (stick and carrot) could be useful instruments to influence demand, however such measures do not necessarily address the root of the problem.

One of the major obstacles towards sustainable transportation is the reluctance to change, which is often caused by lack of awareness and knowledge concerning various sustainable alternatives. It was surprising to find that most municipalities do not have a proper information sharing strategy in place. A strong correlation can be seen in business activities when new products are introduced. In marketing, the selling concept refers to the idea that consumers will not buy enough products unless the organisation undertakes large-scale promotional effort (Lynch 2006). This is naturally necessary when new products are introduced onto the market and the product awareness is low. It is argued that creating awareness of new technology within transportation compared to new products in business would not be excessively dissimilar. It seems that marketing and awareness building is an area that has been undermined and somewhat neglected. Constructing a comprehensive informational strategy in line with the overall strategy towards sustainable transportation and enhanced expertise would consequently be an area worthy of significant attention. Furthermore, the general public´s involvement in the creation of strategic plans is an important factor that can be used to prevent projects from being delayed or stranded due to lack of knowledge and resistance within the community. Another crucial factor that will enhance both public awareness and trust is that the entire planning process needs to be transparent and clearly communicated throughout.

A way to provide better conditions for change, sustainable growth and increased completion is coordination and consultation with businesses within the municipality who are vital stakeholders for the whole community. Such collaboration would introduce new opportunities regarding funding, but they would also be an important player towards societal development and wellbeing. A wide-ranging monitoring and follow-up is critical in order to measure the success and efficiency of

actions. It is also important to legitimize the strategies toward the general public by making it possible to document the effects and progress (Langeland 2003). The above discussion has elaborated on a number of key factors that require particular attention within the administrative sphere (figure 4.5) of the S-E-A-T model when conducting strategic planning towards sustainable transportation from a bird´s eye perspective.

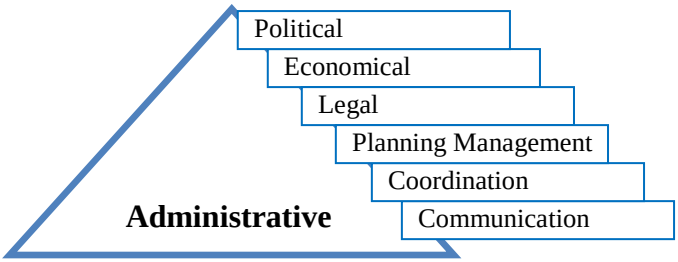


Figure 4.5: The S-E-A-T model: Administrative.

4.3.5 Technological Sphere

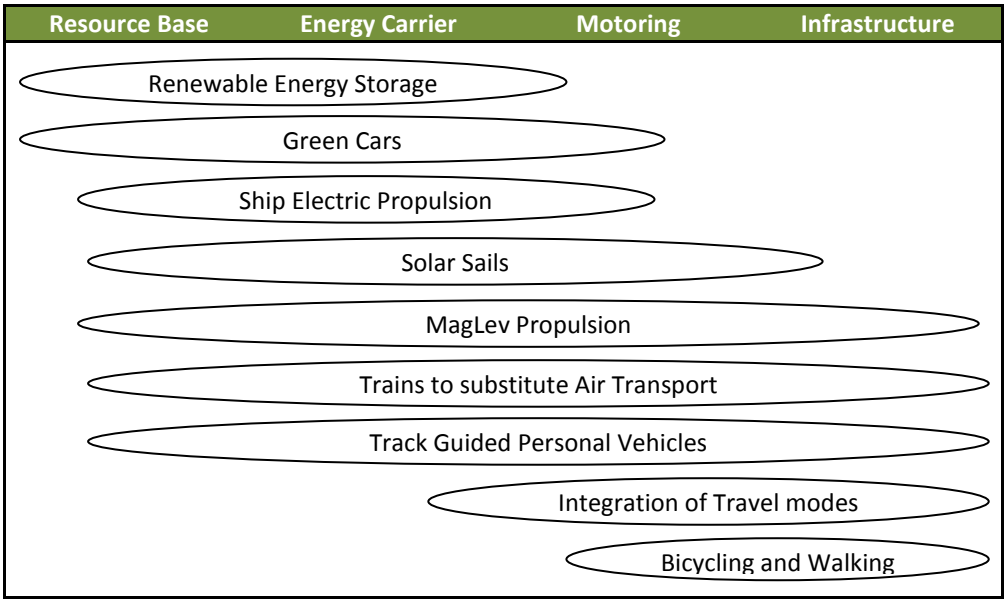
The technological sphere looks at the availability of technological solutions that could potentially help minimize negative impacts or foster positive implications within the social and environmental sphere. It is therefore important that the technological subcategories and context highlighted in this section are seen from an availability perspective in order to understand overlaps and interactions within the S-E-A-T model (chapter 4.3.1).

While planning for sustainable transportation, the question arises of how feasible each suggested solution in chapter 3.1.4 will be for all municipalities. Such a question is not easy to answer as each of Sweden's 290 municipalities has some unique conditions, even if most of them are similar. To conduct such a feasibility study, the solutions have to be divided into themes in order to be strategic and stand the test of time, at least in a perspective of some decades upfront.

The five subsystems described in chapter 1.1.6 are in this thesis representing the technological subcategories in the S-E-A-T model except for the "social systems", which forms the "Social" sphere. Instead, "knowledge base" is inserted to display the need of knowledge to execute projects derived from the strategic actions or to be part of the development of emerging innovations as shown in Table 4.2.

The overlap between the four other subcategories and several of the trends and innovations from chapter 3.1.4, displayed in Table 4.2, and each solution demands development or projects in several subcategories to be able to progress or be implemented.

Table 4.2: Overlap between technological themes and solutions.



The five subsystems reviewed in chapter 1.1.6 demonstrate the solutions in each subsystem that would most likely exist in a sustainable future. Adding these to the solutions from chapter 3.1.4 will give a range of sustainable transportation solutions that can be applicable both in a short-term perspective to start up new transportation projects, and also for visioning when creating long-term strategic goals. Creating long and short-term themes out of those solutions will provide the technological theme matrix displayed in Table 4.3.

Table 4.3: Long and short-term technological themes.

Term	Resource Base	Energy Carrier	Motoring	Infrastructure
Long	Solar, Sea, Geothermal, Wind	Electricity grid, Hydrogen fuel cells	Electric, Human-powered, Sailing	Track guided vehicles, public transportation, Human-powered transportation, Traffic mode integration
Short	Solar, Wind, Waste and rest products, Biomass	Electricity grid, Rechargeable battery, Bio-fuels	Human-powered, Sterling engines, Electric-hybrids	Long terms + Green cars and busses

The short-term solutions that move transportation to depend on electricity and/or hydrogen fuel cells are preferable choices, as they will act as stepping stones towards the sustainable vision for transportation. The others will help society move towards sustainability, but it is important to not plan strategically for those. The themes displayed above are a result of what we can predict today, and will probably need to be updated for future usage.

Figure 4.6 outlines the identified sub-categories based on the content of this sub-chapter.

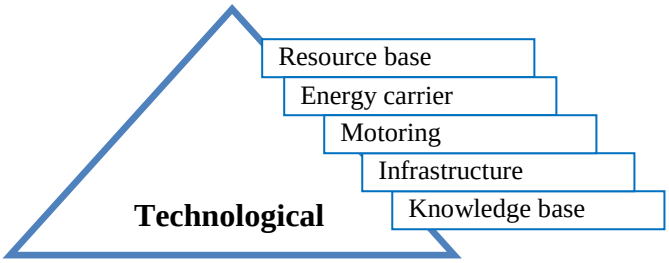


Figure 4.6: The S-E-A-T model: Technological.

4.3.6 Bird's eye and Systems Perspective

The purpose of the S-E-A-T model is not to be all-embracing where each single individual aspect and procedure of transportation planning are included and elaborated on. The intention is instead to carve out important overall elements from the full-perspective which is of utmost importance for strategic decision-making. It will provide planners and decision-makers with an overall view of the early stage essentials from each of the four interconnected spheres in the strategic planning process. Such interconnectivity supports the view of transportation being a highly complex system.

According to Ny (2009) some systems contain so many components and relationships that it is impossible to get a robust overview of their behaviour without scientific approaches and sophisticated tools. The S-E-A-T model (figure 4.7) is therefore deeply rooted in systems thinking and aims to highlight the importance of a systems perspective in the planning towards sustainable transportation. For example, a decision made in the technological sphere will have an impact, either positive or negative, within the social and environmental sphere, and at the same time have administrative requirements and implications. Administrative instruments,

procedures, and resources can be utilised to guide transportation towards a more sustainable path. This path is one in which humans in the social sphere live in harmony and wellbeing, while at the same have a minimum impact on the environmental sphere based on suitable and sustainable components from the technological sphere. Constraints, requirements and needs from the social and environmental sphere will ultimately inform what methods and considerations are needed in the administrative sphere when prioritising measures derived from all categories of the S-E-A-T model.

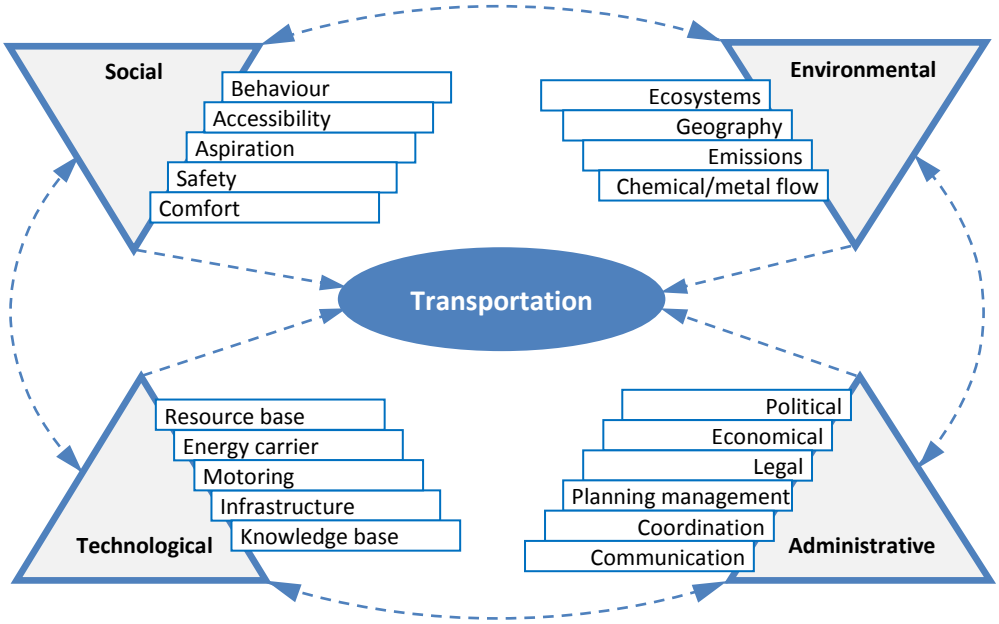


Figure 4.7: The S-E-A-T model.

It is therefore important to have a full understanding of how all four spheres are fully interrelated in order to set out in a long-term direction towards sustainable transportation. The various parts of the S-E-A-T model interact with each other without particular order or constraints depending on conditions. The discussion of the S-E-A-T model´s four spheres both justified their fundamental relevance and identified sub-categories of core elements within each sphere. It is believed that none of the spheres and its sub-categories can be ignored when planning towards sustainable transportation. The S-E-A-T model´s bird´s eye and systems perspective, with its sub-categories, is considered to be particularly relevant for the strategic planning stage and will therefore form the basis of the suggested strategic guidance tool emphasised below.

4.4 The Strategic Guidance Tool

The authors' vision is to provide strategic guidance of municipal planning of transportation that contributes towards a sustainable society. Guiding a municipality's transportation planning towards a sustainable society will be achieved most effectively by providing support to the ABCD-method described in chapter 1.1.5. This ensures that the bird's eye and systems perspective is kept in mind while strongly anchored (within the organisation) long and short term flexible strategic measures (that provide good return on investment) are undertaken in a comprehensive plan towards sustainable transportation.

Enhanced guidance through an expansion of the prioritisation questions in the D-step of the ABCD-method accentuate the importance of the prioritisation to be made in collaborative and cross-sector cooperation with business involvement, stakeholder consultation and expertise from various fields. This is already recommended in the D-step of the ABCD-method, but it is argued that it would be more important with the expansion of guiding questions based on the S-E-A-T model (described in chapter 4.3) as they go into more depth regarding areas affected by transportation. The prioritisation process would also require democratic settings to make prioritisation neutral and potentially also more planned time, as the questions could require and lead to further discussion and analyses. Altogether, this would ensure the quality of both the decision-making process and the scrutinised content of each prioritised measure, along with the positive combination of them. It would also lead to increasing knowledge about sustainability concerns among decision-makers.

4.4.1 The ABCD Method Inclusion

The sessions of brainstorming in both the B (contributions/violations regarding the SP's) and the C-step (creating compelling measures) of the ABCD-method would be easier and more thorough if there was guidance given. Further on, in the D-step, experience has shown that without guidance, it is not easy to prioritise among measures in order to find the best balance regarding cost and sustainability performance for short and long timeframes and also a stepwise approach towards success. An expansion of the three general guiding questions (3GGQ) outlined in chapter 1.1.5 would be a useful guide for municipalities that want to be successful while striving towards sustainable transportation.

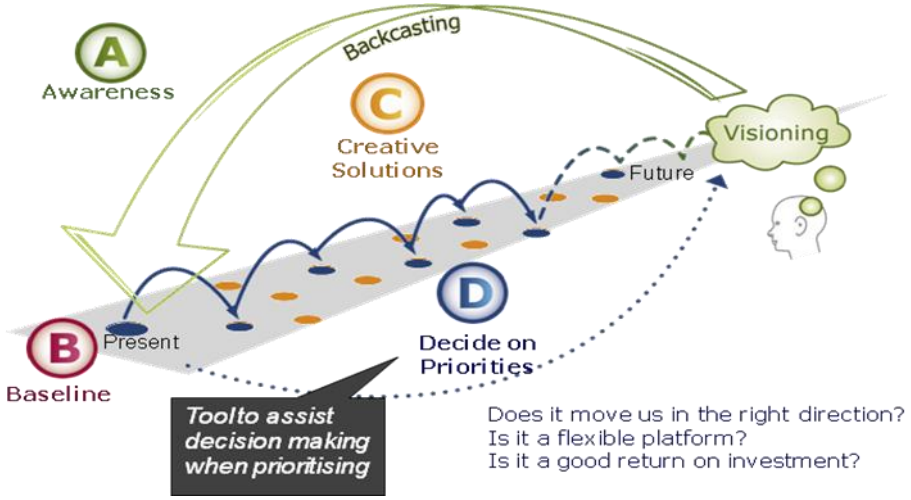


Figure 4.8: Strategic planning guidance within the ABCD-method. Graphics source: The Natural Step (2010)

Further on, flexibility is needed in order to be applicable for all municipalities in Sweden with their different conditions and needs regarding sustainable transportation. The guidance should also be user-friendly in order to enhance and simplify, rather than complicate the prioritisation process.

4.4.2 Guiding Questions

The design of positive, open questions can be formulated and inspired by ideas presented in *Appreciative Inquiry* (Cooperrider et al 2005). These questions will anchor the actions that are later included in the action plan, and then also encourage the municipality to increase their knowledge about sustainability. Moreover, the questions would preferably be designed to overcome barriers to sustainability within municipalities in both the short and the long term perspective.

To provide decision-making support, the 3GGQ-results (with yes or no answers) can be gathered into a scoring table, and in some cases be accompanied by the compliance of the SP's. The scoring table would not determine if the action will be chosen or not, but rather indicate how the strategic action is in support of the vision (and the SP's) and how well it may function in the future towards a sustainable society, also in terms of financial aspects. Should then complementary questions based on the S-E-A-T model also be included in such scoring system? It is argued that a scoring table would enhance the decision-making process of choosing the

right strategic actions amongst a list of creative actions. Scoring is also easier to analyse after having included everything and arrived at a total score for each action.

Questions can also be asked in a way that would require deeper descriptive answers, which consequently would be open and explorative questions. Those answers would be important for deeper understanding of the question matter and also to foster new possibilities and creative ideas that would not have been thought of before.

There is a great need to keep the systems and the birds eye perspective, recognise possibilities among measures, and keep track of the needed coordination between measures. Correlation questions would determine interrelation opportunities and help to ensure a positive combination of the measures and that a thorough systems perspective has been applied.

In order to provide flexibility to fit all municipalities (as described earlier), the importance of the answers should be adjustable. This could be done by providing a weighting system to the questions which indicates the relevance of each question to each municipality. Such weighting would ideally be done prior to the start of the prioritisation process in order to achieve neutrality in the answering process. The above illustrated ideas on how strategic support in the prioritisation process can be crafted will be further elaborated on later in the thesis.

The very last thing to keep in mind when designing questions is the overlap outlined in chapter 4.3.1. Questions should then be designed to consider both the administrative and technological sphere. For example, a question regarding availability could be phrased as "*Does the measure have enough resource base?*" or "*Is the measure ready/easy to apply in terms of development of new vehicle engines?*"

The full strategic guidance tool and the application of it can be found in the appendix A.

5 Conclusion

5.1 Research Question 1

> *"An exploration of national and municipal level visioning towards sustainable transportation: How would such visions ideally look like and is there a need for national and municipal differentiation?"*

The visioning process and its' components is described in chapter 1.1.4. It was found that the system in which transportation planning occurs overall tends to be wrapped by the same boundaries regardless if it relates to national or municipal planning of transportation. This could arguably be explained by the fact that it relates to planning around the same topic, but on different scales. The exploration of core values was done to determine common patterns amongst users and identify what values ought to stream through and comprise transportation, now and in the future. The core values were not surprisingly found to be the same on national and municipal level. One explanation of this could be that Sweden altogether, has a number of deeply rooted fundamental values within the culture, and that a municipality correspond to the very same culture. The core purpose on the other hand seemed to be slightly different between the two levels. What is important to say is that a core purpose of an organisation would ultimately be made up by timeless constraints that would not change regardless if the surrounding conditions change (Collins and Porras 1996). It could therefore be argued that the core purpose of the transportation sector in fact should be the same on a national and municipal level. Complications could potentially arise if transportation is planned across geographical borders, for the Swedish society as a whole, when its purpose is different depending on the geographical constraints.

It was also found that a BHAG/s (chapter 1.1.4) may well be formed at a national level and function as a future reference point of success for municipalities. Strategic goals would on the other hand vary depending on each municipality´s individual conditions and focus areas. It can therefore be concluded that the difference in visioning between municipalities is where the conditions starts to be clear, which is the strategic goal creation. It was found that vivid descriptions are usually not currently being conformed at any of the societal levels and would, if constructed, most likely be different due to varying conditions. The vision statement itself varies widely between societal levels and between municipalities largely due to some differences described above. Furthermore, competition and a

need to differentiate could be another potential reason. It can also be concluded that the common mix-up between visioning and action selection on higher levels, both at national and municipal levels, put constraints to the flexibility of both visioning and planning as a whole. What is important to say is that it was complicated in the sense of comparing the various visions on a wider scale due to the different vision building techniques.

Usage of common and identical vision building techniques across the spectrum is recommended. Consequently, there is a need for clearer guidelines regarding visioning which at the minimum should emphasise a unified core purpose of transportation in Sweden. Competition should be put aside and instead seek shared mental models, which would enhance the chances of prosperous cross-societal and cross-geographical collaboration based on mutual interest. The thesis highlights a need to link various parts of societal planning and perhaps visions for sustainable transportation should also reflect such linkages in order to recognise a systems perspective that goes beyond transportation itself.

5.2 Research Question 2

> *"What are the potential areas of improvements, actions and aspects within municipal planning that will support and enhance the chances of success of sustainable transportation?"*

This thesis reviewed planning through the lens of FSSD after having outlined fieldwork findings and then presented areas of improvement and potential challenges within the process. The research question provided essential information and ideas for the administrative sphere of the S-E-A-T model which were presented in 4.3. Success factors within planning of sustainable transportation highlighted a wide range of areas related to all stages of the process that if covered and considered enhances the chances to arrive at success.

Anchoring strategic decisions in wide-ranging political, public and business support would provide a solid and stable foundation for change and progress towards sustainable transportation with less risk for delays, financial insecurity and public dissatisfaction. Collaboration, stakeholder involvement and partnership would give strategic planning a wider perspective which could foster win-win situations based on mutual interest and cost sharing agreements. Such collaborative initiatives would, if executed well, redirect the focus from a competitive and problem solving

mindset towards a wider societal perspective rooted in a creative and opportunity based mindset. It is not enough to simply involve stakeholders and partners at certain stages of the process. Transparent communication and documentation is equally important in order to demonstrate and present progress in the agreed process. Methodical and accurate documentation, recording and follow-up procedures with regards to the strategy and its various sub-strategies are crucial. Synchronisation of other infrastructural strategies and overarching documentation is important in order to see and take into account the "big-picture", for the benefit of overall sustainable societal development. It was also found that clear responsibility allocation and expertise knowledge is prerequisite for efficient and smooth planning. Having the most suitable individuals and groups doing the right things will both lower the risk of failure and would help discover pitfalls as well as weaknesses early in the process. Collaboration and partnership could pose effective and smart ways to overcome economic and capability complications.

One important strategic move and recommendation is for municipalities to organise regular extensive workgroup sessions with experts, stakeholders, businesses, and other important players throughout the process, not only in the early stages but continuously. Strategic alliances with e.g. businesses, other sectors of society, universities, research programmes and international players, could not only foster creative ideas and secure forefront knowledge but also enhance consultation with a genuine notion of involvement. Furthermore, certain complicated tasks could potentially be outsourced to external players to a larger extent than today in order to ensure top-quality expertise, efficiency, and enable municipalities to focus on the right things. One area as such, could be public awareness programmes through professional marketing and communication. Municipalities could, for example, gather inspiration from the business environment to improve awareness and demand for sustainable transportation by looking at steps taken by businesses when introducing new products onto the market. Clearer guidelines and procedures for better timing and synchronisation of other interrelated societal strategies is another crucial element towards a well-functioning transportation system and the society as a whole.

5.3 Research Question 3

> *"What are the emerging innovations and possible solutions towards sustainable transportation?"*

Various measures and strategic decisions naturally make up the lifeblood of planning and the transition towards sustainable transportation. Decisions are made within the administrative sphere of the S-E-A-T model for either internal procedures or specific measures within any of the other three spheres separately, combined or interrelated (chapter 4.3.6). The intention of this research question was to predominately get a thorough understanding of social and technological studies and findings for transition of transportation systems towards sustainability. Innovations and possible solutions could either be specific technological, social and/or environmental actions formed into smart stepping stones towards sustainable transportation.

The five subsystems suggested by Cars et al (2008) were found particularly useful for both technological and social aspects (1.1.6 and 3.1.4). It was found that the *Resource base, Energy carrier, Motoring system and Infrastructure* mainly relates to technological aspects which consequently formed an important platform for the mapping of technological trends and innovations. The platform as such, provided a logical way to understand and explore how various technological components for specific sustainable solutions systematically correlate to each subsystem. It was further found that all solutions, regardless if they relate to all four subsystems or not, required some sort of expertise knowledge, more or less, for preparation or implementation. The remaining four subsystems were therefore supplemented with a *Knowledge base* subsystem. It was found that emerging innovations are solutions that are somewhat unproven and less tested in reality, as they are still in the pipeline while trends often tend to be new and innovative, yet tested and proven in reality.

The study shows that emerging innovations would be the ones that are based on natural resources for propulsion, ones that requires very little land-use, have a low flow of metals and chemicals (which is handled in a closed loop), produces a minimum of emissions, and are suited for different human needs. Current technological trends on the other hand were found to be solutions such as, green cars, tram, walking, biking, ship electric propulsion, fast trains replacing flights, and track guided personal vehicles.

The *Social subsystem* which is the fifth subsystem suggested by Cars et al (2008) were given its own sphere within the S-E-A-T model (4.3) in order to give it further strength due to its significance. More socially oriented studies and solutions touched upon areas such as, social behaviour change, satisfier for public transportation, social injustice, and capturing and analysing human transportation patterns. The study showed that changing

social behaviours takes time and process to build citizen's trust and awareness of sustainability and consensus are required in early stages. When a municipality is planning for transportation, more strategic measures tends to be more human oriented rather than only focusing on infrastructure building and technological innovations. How to provide the equal rights for accessibility of transportation is a very important question that city planners should ask themselves. Strategic planning should optimize the opportunities for people's mobility needs in order to get more efficient socialising actions. The study also showed that future transport should be integrated with the future society development where social justice is considered.

The study identified that some of the explored technological solutions can be applicable in a short-term perspective and thereby considered *transformational solutions towards a sustainable transportation*. It was concluded that such solutions could be: bio fuelled electric hybrid vehicles, increased public transportation, increased manual propulsion, switch from usage of cars/trucks to trains/tram/busses, expansion of rail network, and high speed trains to decrease domestic and shorter international flights. It was also found that other explored solutions were more long-term and could be viewed as solutions part of a *future sustainable transportation*. Such solutions could be: electric vehicles (electricity or hydrogen fuel cells), extensive public transportation, manual (walking, cycling, etc) and natural resourced direct propulsion (wind, sea-current, thermal, etc).

It can be concluded that some of the technological aspects within the five subsystems presented by Cars et al (2008), are in line with the findings in the thesis, since some late transformational aspects are already available today. This proves that the technological development is fast due to governmental incentives and people’s willingness to move forward, probably because of the awareness of the climate crisis and ambitious climate goals. It can also be concluded and recommended that findings for this research question would function as an illustrative draft to foster new creative ideas for the C-step of the ABCD method (1.1.5).

5.4 Research Question 4

> *“How can flexible strategic guidance be provided to municipalities in order to prioritise compelling measures towards sustainable transportation?”*

This research question is fundamental and positioned at the very heart of this thesis. The answers of the first three questions fed into this research

question and ultimately informed how flexible strategic guidance should be formed and provided. A vision (figure 5.1) for the strategic guidance was created at an early stage of the thesis in order to give a clear idea of direction and to provide a clear reference point to backcast from throughout the process.

Figure 5.1: Vision for strategic guidance and its design

It was decided that the strategic guidance support should be used as a part of the ABCD method (chapter 1.1.5) which is a strategic tool made up by four simple steps: *A (awareness), B (current reality analysis), C (compelling measures), and D (prioritisation)*. Consequently, the strategic guidance support would be plugged into the D-step to provide support and guidance when prioritising from a list of compelling measures towards sustainable transportation. It was found that there are limited strategic tools and/or models available that take an overarching standpoint and at the same time are user-friendly and flexible. It was therefore decided to provide support that looks at transportation from an overarching perspective which recognises the systems perspective as well as the linkage between transportation and societal planning as a whole. Flexibility is fundamental due to the many conditional differences between municipalities across the country. Cars et al (2008) created an idea sketch for planning of sustainable transportation and suggested an overarching methodology based on a systems perspective. This idea sketch gave inspiration to the strategic planning support approach suggested in this thesis in form of useful elements and terminology (e.g. 5 subsystems) being used and put into the so called S-E-A-T approach.

This section will look into the creation process and use of the S-E-A-T approach, which contains a core model and a strategic guidance tool. To first identify the overarching inseparable cornerstones (spheres) of sustainable transportation was vital in order to then be able to determine the most essential aspects within planning of sustainable transportation. The five interlinked subsystems within transportation systems (read more 1.1.5) which were suggested by Cars et al (2008) were merged with a PESTEL model (4.3.1) which is a commonly used model for macro-environmental analysis of business. The fusion of the two models resulted in and formed

the robust spheres of the S-E-A-T model: *Social, Environmental, Administrative, and Technological*. The purpose of the S-E-A-T model was to categorise the most essential aspects within the strategic planning process, derived from the results of the first three research questions. The content fed into each sphere of the S-E-A-T model with the purpose to visualise the systems and bird´s eye perspective. Subsequently, this model then systematically informed and highlighted areas and aspects within the planning process to formulate strategic guidance questions around. It became clear when considering the S-E-A-T model that the strategic support approach of sustainable transportation would most properly be presented as a tool with a set of guiding questions.

The strategic guidance tool, which is fully presented in appendix A and further explained in 4.4, is made up by five templates, all of which should be covered and based on deep discussions within a workgroup containing key stakeholders, experts and planners:

1. The *Social* Template (measures/actions one-by-one)
2. The *Environmental* Template (measures/actions one-by-one)
3. The *Administrative* Template (measures/actions one-by-one)
4. The *Technological* Template (measures/actions one-by-one)
5. The Answer Template (all answers goes in here)
   - This template also contains three crucial *Correlation Questions* (measures/actions combined).

An *"instructions and recommendations description"* is provided to give an introduction of the tool´s purpose and step-by-step instructions of how to use the tool (appendix A). The questions are intended to be guiding and are divided into two types, one that requires answers by the use of scoring and another that requires descriptive answers for deeper knowledge and anchoring. After having analysed each measure one-by-one the user moves on to answer three correlation questions to determine interrelation opportunities. Those questions are intended to ensure a positive combination of the measures and ensure a thorough systems perspective. It is as mentioned significantly important to conduct the exercise in a comprehensive workgroup of key stakeholders, experts, and planners, representing all involved areas that are touched upon in the questions. All answers should then be deeply analysed and subsequently allow participants and planners to easier map out a long-term strategy for sustainable transportation.

This is a first draft of a comprehensive tool for strategic prioritisation of compelling measures towards sustainable transportation and it has been purposely designed to be flexible enough to be used at any societal level. It is being suggested and recommended to first apply the tool at municipal level in order to then review and refine its usefulness and applicability. The tool must be used within the ABCD method to ensure a sustainability perspective in terms of backcasting from a principled definition of sustainability.

It can also be concluded that the S-E-A-T model, from which the tool and its five templates are derived from is suited to be used within both the B-step (current reality analysis) and the C-step (brainstorming of compelling measures) as a reference point. This would provide structure; enhance creativity and the chances of having covered the right and most essential areas to be able to answer all the tool´s questions accurately and systematically within the D-step. It can also be concluded that the exploration of technological trends, emerging innovations and socially oriented solutions could function as an illustrative draft to foster new creative ideas for the C-step within the ABCD method. The combination of the ABCD method, the S-E-A-T, model and the tool with its guiding questions (making up the S-E-A-T approach as illustrated in picture 5.2), consequently form a robust concept for strategic planning of sustainable transportation which is rooted in a bird´s eye and systems perspective, and ultimately based on backcasting from the principles of sustainability.

5.5 Overall Conclusion and Future Research

This study arrived at specific recommendations regarding visioning of sustainable transportation. Such recommendations touched upon a need for clearer visioning guidelines, common vision building techniques and an urgent need for shared mental models across societal levels and geographical borders. Themes of possible sustainable solutions and actions were explored and could ultimately function as an idea sketch and creative inspiration for planners of sustainable transportation. The cornerstones (spheres) of sustainable transportation were identified to be: *Social, Environmental, Administrative, and Technological (S-E-A-T model).* It is believed that none of the four spheres should or can be removed if sustainable transportation is to be achieved. The study moved on to identify essential aspects for each sphere of the S-E-A-T model which then informed how to construct a tool for strategic prioritisation of compelling measures towards sustainable transportation.

What the strategic guidance tool (figure 5.2) does is to provide transportation planners with guiding questions that are relevant in the essence of sustainability, and systems thinking in order for planners to easier be able to map out a long-term strategy for sustainable transportation. The strategic guidance tool is believed to be solid as it is predominantly based and elaborated on peer reviewed and well tested models, definitions and methods, such as the FSSD, a principled definition of sustainability, the ABCD method and PESTEL.

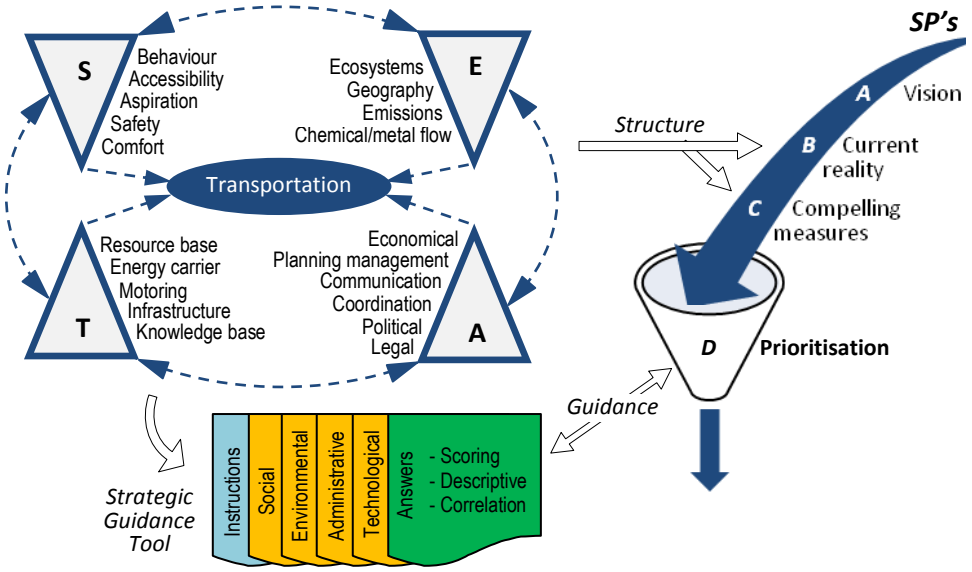


Figure 5.2: The S-E-A-T approach

Limitations. The authors recognise that the S-E-A-T approach, (the S-E-A-T model and the strategic guidance tool) have its limitations. It needs to be tested at municipalities and by experts to review and further refine its usefulness and applicability. The authors therefore particularly recommend transportation planners and key stakeholders within Swedish municipalities to test and use the S-E-A-T approach within the ABCD method in order to make it more robust and solid. As of being intentionally constructed flexible, non-presumptive, and guiding, the S-E-A-T approach could potentially also be used globally, yet it is important to recognise that it has mainly been constructed by the use of Swedish sources and partners and from a Swedish perspective. Practitioners of the S-E-A-T approach particularly need specific knowledge in sustainability (chapter 1.1.1), backcasting from a principled definition of sustainability (chapter 1.1.3), the ABCD methodology (chapter 1.1.5), the FSSD (chapter 1.1.2) and

workgroup procedures in order to enhance the chances of successful usage and outcome. The S-E-A-T approach must be used within the ABCD methodology in order to ensure a robust sustainability perspective and backcasting from principled definition of sustainability. It might also be complicated and time-consuming gathering key stakeholders for the recommended workgroup sessions when using the S-E-A-T approach. The approach needs to be continuously refined and developed in order to encompass changing conditions and uncertainties surrounding planning of sustainable transportation through time.

Further Research. It is believed that this thesis has taken a significant step towards further studies within each sphere of the S-E-A-T model, by identifying the essential components for strategic planning of transportation from a bird´s eye perspective. The authors believe that the thesis has laid the groundwork for a comprehensive PhD study of sustainable transportation from the perspective of the S-E-A-T approach. A group of PhD students could investigate and study each sphere of the model in depth individually, yet in a clustered and cooperative way in order to produce a comprehensive study that further maps the correlation and systems perspective within the approach. Such study could thereby move step-by-step down from the bird´s eye perspective to produce further support down the line based on the very same mindset. The authors recommend studies on how the full methodology proposed in the idea sketch on *sustainable traffic solutions* by Cars et al (2008), the ABCD method and the S-E-A-T approach can be used jointly when planning for sustainable transportation.

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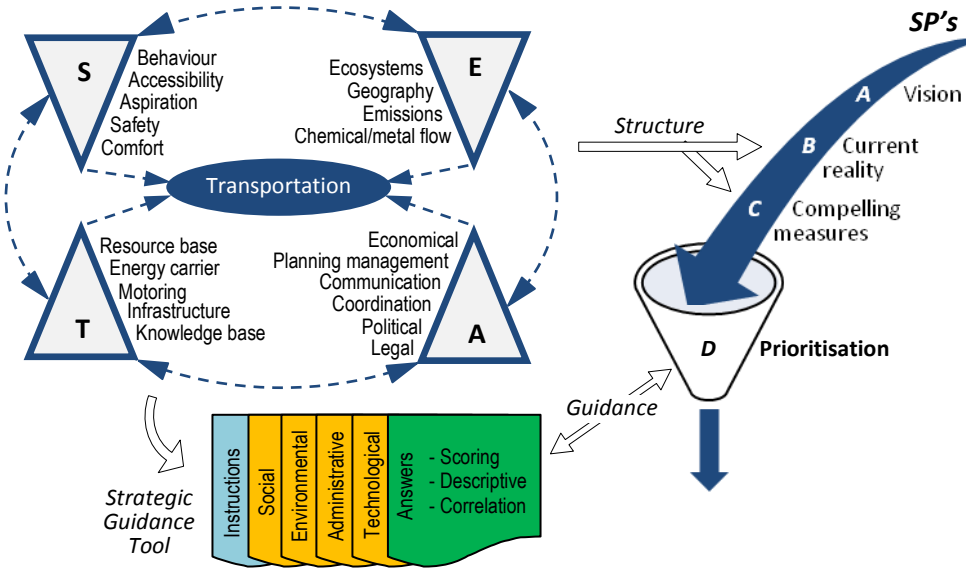
7 Appendices

Appendix A: The Strategic Guidance Tool

Instructions and Recommendations

This is a strategic tool containing guiding questions from a bird´s eye and systems perspective. Its intension is to support planners in the prioritisation of compelling measures towards sustainable transportation. The strategic guidance tool (within the S-E-A-T approach) is best used within the D-step of the ABCD method which is fully described within this thesis. The authors strongly recommend reading the thesis in order to get a full understanding of how to use it and the ideas as well as perspective behind it. The discussions and conclusions chapter are of particular importance as it justifies the S-E-A-T model and subsequently also justifies the areas of which the guiding questions has been based on. The S-E-A-T model can also, as described in the thesis (read more 5.4), be used to function as a reference point and provide structure within the B-step (current reality) and C-step (compelling measures). The figure below illustrates the S-E-A-T approach which contains the S-E-A-T model, the strategic guidance tool with its guiding questions and the ABCD method.



The tool should be used within a diverse workgroup of key stakeholders, decision makers, planners and experts. Time, diplomacy and patience are other key elements within the process.
The proposed tool contains guiding question, either scoring or descriptive, for each sphere within the S-E-A-T model. The tool has been divided into five different templates:

1. *The Social Template (questions)*
2. *The Environmental Template (questions)*
3. *The Administration Template (questions)*
4. *The Technological Template (questions)*
5. *The Answer Template (answers and correlation)*

Each question´s applicability should be given a weighting score 1 to 10 (high score=high applicability).

The first column of each template tells the user what type of question it is (scoring or descriptive) and ultimately which table within the answer template the answer would go into. The second column is where the user adds the weighting score. The third column contains the code that tells the user where the answer would go within the table.

The scoring questions should be scored 1 to 10 (high score=high agreeability) and would naturally require extensive discussions and analysis at the point of scoring. All the scores for each measure should then be added up. The total score for each measure would consequently provide a good starting point for comparison.

The descriptive questions require answers with more depth and require extensive discussions and analysis both prior to commencement (point of workshop) and when all answers has been recorded.

The technological question shall be answered by first figuring out if the measure support future usage of each theme or is a stepping stone towards those and then answer “Yes” or “No” in the corresponding column. The workgroup shall then answer similar to the descriptive questions and put the answers in that column of the answering table.

The four templates (social, environmental, technological, legal) do not have to be answered in any particular order. It is though important that each question is given a weighting score and run through GGQ 1-3 (read more 4.3). The user should after having completed all the questions answer the three *correlation questions* of which have the purpose to map correlation

opportunities between the measures. Collective analysis can take place once all questions have answered and recorded. Municipality´s could certainly add more questions if needed due to some unique conditions.

The Social Template

Answer Section	Weight (1-10)	Code	Question
Scoring		S1	Would it be possible for this measure to reach citizens future needs of transportation?
Scoring		S2	Would this measure ensure the citizen's need of safety?
Descriptive		S3	How can this measure level out the inequality within transportation determined by disposable income, age, gender, culture, and disability?
Descriptive		S4	How would this measure contribute towards social behavioural change towards sustainable and/or public transportation?
Descriptive		S5	How would this measure increase the user's convenience, accessibility and reliability of transportation?
Scoring		S6	Would this measure increase the user's awareness of sustainable solutions for transportation?

The Environmental Template

Answer Section	Weight (1-10)	Code	Question
Scoring		E1	Would this measure to a large extent contribute to lower the municipality's emissions as noise, green house gases, particles, etc?
Descriptive		E2	How can this measure make a positive impact on the ecosystems within the municipality?
Descriptive		E3	Concerning geographical means, how would the land-use of this measure affect the municipality and its inhabitants?
Scoring		E4	Would this measure have a minimal impact on the landscape and wildlife?
Descriptive		E5	How can this measure decrease the flow of chemicals and metals and especially leakage of harmful substances into the biosphere?

The Administrative Template

Answer Section	Weight (1-10)	Code	Question
Scoring		A1	Can this measure be strongly anchored in wide political support?
Descriptive		A2	How can this measure be rooted in strong public support and how would it be communicated and marketed towards the general public to build wide-ranging awareness in order to maximize demand and efficiency?
Scoring		A3	Are there sufficient monetary resources available to finance this measure?
Descriptive		A4	What planning and monitoring tools, procedures and documentation would this measure require in order to ensure adequate follow-up and transparency?
Scoring		A5	Can we acquire all necessary and adequate expertise and/or knowledge enhancement to pursue this measure?
Descriptive		A6	Can this measure pose strategic collaborative opportunities based on mutual interest across geographical borders with neighbouring cities and municipalities?
Scoring		A7	Can this measure be effectively synchronised with other infrastructure and societal strategies?
Descriptive		A8	How would this measure enable us to collaborate across societal-levels, e.g. with County, Regional and/or State level players?
Scoring		A9	How can this measure be based on strong stakeholder consultation and involvement and what positive side-effects would it have?
Scoring		A10	Would it be possible to support this measure by the use of certain economic and/or legal measures?

The Technological Template

Answer Section	Weight (1-10)	Code	Question
Technological		T1	Concerning technology, can this measure support future usage of each theme or be a stepping stone towards those?

The Answer Template

The Scoring section:

Guidance question	Measure 1 score (1-10)	Measure 2 score (1-10)	Measure … score (1-10)
GGQ1			
GGQ2			
GGQ3			
S1			
S2			
S6			
E1			
E4			
A1			
A3			
A5			
A7			
A9			
A10			
Total			

The Descriptive section:

Guidance question	Measure 1 Answer Description	Measure … Answer Description
S3		
S4		
S5		
E2		
E3		
E5		
A2		
A4		
A6		
A8		

The Technological section (T1):

Technology future		Support of the measure	
Subsystem/ category	**Theme**	**Yes /No**	**Description**
Resource bases	Solar, Sea, Geothermal, Wind, rest products, biomass		
Energy carriers	Electricity grid, Hydrogen fuel cells, Rechargeable battery, Bio-fuels		
Motoring	Electric, Human-powered, Sailing, Sterling engines, Electric-hybrids		
Infra-structure	Track guided vehicles, public transportation, Human-powered transportation, Traffic mode integration, Green cars and busses		

The Correlation Section

Number	Question
Q1	How can multiple measures be used collectively to move our municipality towards a sustainable transportation vision?
Q2	How can this measure positively affect other measures?
Q3	How can these measures contribute towards the overarching sustainability vision for the municipality?
Number	**Answer Description**
Q1	
Q2	
Q3	

Appendix B: Case study of Transportstyrelsen

The results were produced both at the ABCD-session held 2nd February 2010 and collaboration via phone and email.

System boundaries:

Ethical	Culture (also a means to change behavior, heritages)	Political initiatives
Time (convenience, accessibility, flexibility)	Public desire (dream, ideal solutions) + corporate (demand)	Related systems and solution
Traffic density	Safety (environmental, human, design)	Financial (investment)
Old vs new infrastructure	Landscape and biodiversity (and ownership)	Environmental Influences
Gender issues	Technology advancement	Legal
Carriage	Routines and behaviours	Goods

The **Core values** were found to be *safety (security, environmental, trust), convenience, affordability (value for money and/or limit), and equality among humans.*

The **Core Purpose** was first found to be "*People want to transport goods and people*", but later developed to "*Facilitate and support our wishes, needs and demands (Socializing, curiosity, exploring, economical)*"

To find the **Envisioned future**, the meeting asked: in a sustainable society - what does transportation look like? The following components were found:

Quiet systems	Almost zero emissions
Availability	On demand services
Driverless	Less parking space
Safety (environmental, personal, animals)	Electric (grid net provided) driven vehicles that shifts to hydrogen fuel cells when needed
More travelling, but not per capita (in the industrial world)	Trackguided vehicles will play a major part and partly replace the road transportation of today

The **BHAG** were to be reached by 2030 and included fossil free fuelled vehicles, driverless track guided vehicles on demand, shopping transportation on demand.

Appendix C: Case study of Jönköping Municipality

We applied a case study of Jönköping Municipality through an ABCD analysis to demonstrate where the strategic guidance tool will be plugged in.

A. Awareness

Step 1. Finding system boundaries

System Boundaries of Jönköping Municipality		
Where to draw the borders of the region itself. Region transportation is between municipalities.	Business and their policies/circumstances/benefits	Landscape (topography)
Existing infrastructure, traffic density, types of traffic	Density of population	Development areas
Where people and goods are going and their starting points (hospital, warehouses, shopping areas, ...)	The city structure (also on the countryside - towns)	Offer, range
Different types of transportation requires different types of structure (density, effort, ...)	Timing of strategic actions	Economy
Synchronising of different types of transportation when going from one to another	Future ambitions (regional, national, world)	Reliability
Safety (environment, goods, people, equipment)	Politics (public, municipal, gov.)	Legal issues
Socio-grafy (students in campus, families in housing areas, ...)	Attraction of the city/region	

Step 2. Creating a Vision

Core values: *Safety (security, environmental, trust), convenience, affordability (value for money and/or limit), and equality among humans*.

Core purpose: "*Bridging distances to enable people to meet their basic human needs and to help advance the societal development*".

BHAG: *"Carbon neutral by 2050"*

Strategic Goals:

1. Increase the public transportation with 100% by 2020
2. Decrease greenhouse gas emissions with 40% by 2020
3. Establish the best track-based transportation network in Sweden by 2040

Vivid Description for the Envisioned Future:

"I arrived to Jönköping early after two hours comfortable and consultancy productive ride from Stockholm with the high speed train. The sun was shining and it had recently stopped snowing. I recalled that there usually was smog back in the 20th century, but the sky was clear today and there was nothing but a wonderful smell from the popular bakery store 500 meters from the station. I was on my way to the annual international congress on sustainable transportation and I was wondering if Jönköping would win this year again. The municipality had indeed made a fantastic journey from being dependent on fossil fuelled cars, trucks, buses and old train tracks and also the dirty and noisy highway passage through Jönköping municipality.

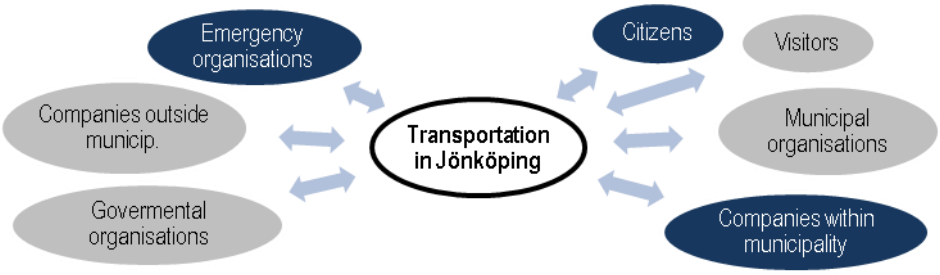
I jumped on the tram towards the congress at Elmia and cleared the fee with the cell phone. Families with their perambulators went smooth in and out the tram and even the man who had just moved back from Australia got off with all his extensive luggage fast as the helper/security and other passengers helped him off with a smile. At the conference, Jönköping was announced to be one of the nominated cities to the grand sustainability price. They have made improvements regarding their affordable, equal, convenient and safe light-weight tram network to replace all the buses, and also reduced the usage of personal cars rapidly because the tram network where so popular, even from the suburbs. In year 2040, Jönköping won was because their city core had a reduction to 1/10 of personal cars in the city core and the municipal vehicle fleet was almost entirely all-electric. At that time, they were also as the first municipality in the world close to reach the carbon neutrality target set up for year 2050.

An old friend of me had invited me for lunch downtown and I wanted to rent a car to try the roads as I barely do nowadays. It wasn't cheap, but I stepped into an antique biogas-electric hybrid from the 2030's and it silently but slowly took me to the communication hub on the city core border where l returned the car. I was late, but made it to the restaurant by their award-winning concept of moving walkways, which was built on the old roads and covered the whole city core. My friend, who also where in her best retired years, talked a lot of this new innovative track guided pod-car system built on existing roads coming up. As she did not want to drive herself anymore, that would enable her to travel to her grand children outside the city where the public transportation didn't work well. The time flew and I went back to the high speed train station as I had to pick up my grandchildren at the day-care at 4pm in Stockholm.

I watched the online news on the train that Jönköping won the sustainable transportation prize due to ambitious sustainability transport projects, which vision work started off as early as year 2010 and engaged most of the citizens."

B. Baseline Mapping (Current Reality Analysis)

Step 1. Analysing Stakeholders



(dark blue = high priority)

Step 2. Operational Analysis

What do we deliver?	What do we depend on?	What is left?	What do our operations look like?
Support mobility management (bridges, closer paths etc)	The need for society to move people and goods. (attractions, societal functions)	Degradation of physical means	Building infrastructure
Travellers moving from A to B to C	Natural resources	Noise	Pre-study (dialogue)
Services (maintenance)	Material	Emissions	Project – study
Societal services (road lighting etc)	Political decisions	Accidents	Construction – maintenance
Socialising possibilities (meeting friends and relatives)	Geographical and Topographical conditions	Pollution of nature (air, crust, water	
Entrepreneurial opportunities	Knowledge	Waste products	
Structure in society (physical structure	Economy		
Goods			
Knowledge			
Tourism			

Contributions (+) / violations (-) to the 4 Sustainability Principles:					
Resource Base	**Energy Carrier**	**Motoring**	**Infrastructure**	**Social System**	**Planning**
Wind power +	Fossile fuels --	Electric motor +	Car parking places +/-	Noise --	Long process time -
Hydro power +	Biogas +	Combustion engines --	Railways downtown -	Physical structures +/-	Many instances +/-
Compostable materials ++	Ethanol +	Electric hybrids +/-	Railway stations +	Emissions, particles --	A lot of stakeholders +
	Electricity +		Vehicle roads +/-	Job possibilities +	Many steps in planning -
	Fuel cells		Electric charging stations +	Shortening distances +	
			Airport -	Pollutions --	
			Bicycle roads +	Availability +	
			Railroads +		
			Bus stops +/-		
			Fuel station +/-		
			Walking paths +		
			Bus garages +/-		
			Lightning +/-		
			Signals, signs +		

C. Brainstorming of Compelling measures:

Resource Base	Energy Carrier	Motoring	Infrastructure	Social System	Planning
Waste management for biogas	Biogas	Electric	Public transport where people live	Programs for mobility management (get people to travel sustainable)	Integrate public transport in new living areas
Wind	Electricity	Magnetic	Trams		
Waste burning	Renewable (alcohols, biodiesel)	Combustion engines for renewable fuels	Separate public transport from cars		
		Hybrid	Electric charging stations & grid		

D. Prioritization:

The S-E-A-T approach and its strategic guidance tool will ultimately be applied here.

Appendix D: Tools, Methods and Concepts

Table: Tools, methods and concepts often used for transportation planning

Tools and Concepts	Useful for…					Key Factors…				
	Identification of environmental impact	Description of conditions in environment	Development of options	Assessment of environmental impact	Comparison of options	Information requirements	Cost and Time	Accessibility to the public	Can deal with uncertainty	Capacity to deal with health issues
Review of existing material on the environment, policies, laws and rules	√	√				•	$	😑		××
SWOT analysis	√	√			√	•	$	😑	o	××
Checklists	√					•	$	😑	o	×
Record Matrixes	√		√	√	√	•	$	☺	o	×
Cause-effect analysis, Causal loop analysis	√	√			√	•	$	☺		××
Geographic Information System (GIS)	√	√	√	√	√	••	$$	☺		×
Trend Analysis, extrapolation		√		√		•	$	☺	o	×
Expert Reviews	√	√	√	√	√	•	$	😑	o	××
Modelling			√	√		••	$$	☹	o	×
Scenario Technique	√		√			••	$$	☺	o	××
Life cycle analysis	√	√	√	√	√	••	$$	☹		
Cost-benefit analysis			√	√	√	••	$$	☹		
Multi Criteria Analysis			√	√	√	••	$$	☹	o	×
Vulnerability Analysis		√		√	√	••	$$	☹	o	××
Risk assessments, risk analysis	√		√	√	√	••	$$	☹	o	××
Ecological Footprint	√	√		√	√	••	$$	☺		
Consultation	√	√	√	√	√	•	$	☺	o	×

Symbols: √ Useful for, ● Requires less data base, ●● Requires more data base, $ Low cost and time, $ $ High cost and time required, availability ☹ Small to the public (difficult to follow and understand), 😑 Light availability to the public, the Grand ☺ availability to the public, **o** can cope with uncertainty, **×** Less capacity to manage health issues, **××** Large capacity to manage health issues.

Source: Naturvårdsverket (2009)