3 Investigate Potential Technologies

Figure 3.1 Investigate Potential Technologies within the Evaluation Process

Investigate potential technologies

The world is full of current and upcoming technologies which might affect transport and change how people are behaving. To help to scan the potential technologies, the STTRIDE project recommends carrying out an investigation which includes the following steps:

- Clarify the context in which the investigated technologies should work
- Set the time horizon (in years) to get a better understanding of what is the target
- Set the basis for reference material: what is acceptable and credible as a source?
- Set the research questions and associated search terms to find the right references; these might change during the process as knowledge about the subject is increased
- Record the findings in a uniform way to help the analysis and comparison of technologies.

3.1 What is the context?

Understanding the context is a crucial step in the beginning of the investigation. The world is full of technologies and there are lots of connections between different domains; for example information and communication technologies are increasingly affecting more traditional domains such as transport. Especially when the time horizon is set far away into the future, the abstraction level for technologies should rise and the context can turn more into general technological trends.

The abstraction level of the technology is important to grasp before the investigation, because the investigation could be at the wrong level of detail, producing technological advancements which are either too detailed or too broad. The correct abstraction level may not be obvious before the search and may change during the investigation. As a rule of thumb, the abstraction level rises as the researched technologies go further from the core of the researched case.

Understanding the user needs is an important part of the context. Technologies that are not aimed at addressing the user needs are not often successful. The further the time horizon is set into the future, the more speculation is involved in the context of user need, as current users may not know the needs that are emerging in for example 15 years from now. What could be done is to base the context on educated predictions about the future. For example there are studies indicating how many elderly there will be in 15 years or how large the urban population will be at that time. Considering the requirements of different categories of user groups may help in understanding the context as well. Groups which are relevant may be different in different cases, but a few examples of groups that may be relevant to consider are as follows:

- people with mobility problems, including disabled and older people
- people with other mobility challenges, including travelling with luggage or accompanied by children

- people travelling in groups
- by gender
- young people
- urban dwellers
- rural dwellers
- people on low incomes
- users of different modes.

In addition there are few questions that could be helpful when understanding the context of upcoming technologies in mobility from the point of view of users:

- How much it would cost for the user?
- What would be the availability?
- What would be the journey time?
- How reliable would the journey be?
- How safe it would be, real and perceived (both in terms of accidents and personal security e.g. fear of crime)?
- How comfortable would the travel be?
- What kind of information is available and needed?

3.2 Setting the time horizon

Predicting the future often involves guesswork with some background knowledge. Technologies coming in the near future are often seen already being deployed in pilot cases and estimation of feasibility may be found from the pilot information. New technologies face the competition from already existing technologies and other upcoming technologies and predicting which technology will succeed and which will not, can be hard. Even if the technology has big industrial backers it may still be unsuccessful, due many reasons, of which competition and user acceptance are the main factors.

3.3 What kind of reference material is there for the technology scan?

The reference materials for near future technologies are often plentiful and sources range from academic papers to white papers to journalistic articles. When going further ahead in the technology horizon, the source material shifts more towards speculative rumouring and depending where the technology is coming from, the presentations in technology conferences or exploring academic articles are usually the source material. The quality and credibility of the source material needs to be checked and especially in non-peer-reviewed material, the motivation of the source should be evaluated. Reports from governmental sources are a good way to identify some technologies that are being deployed as well as a look to policies that affect the deployment.

3.4 Set the research questions and search terms

From the context and the scope, the research questions which the investigation should answer can be extracted. The answer usually is not only technology but the characteristics and potential it has. Search terms should be written down to create more rigorous research especially when there is more than one person doing the research. These search terms might change during the process as knowledge about the subject grows.

Search terms will lead to lists of references to be sifted for relevance before they are reviewed in detail. The text box overleaf provides a checklist for selecting the references in this sifting process; this is available in the template file on the STTRIDE web site.

Example research questions

- How are changing traveller needs leading to changes in the technological focus in transportation?
- What technological trends are affecting transportation in general?
- Which kind of technical advancements are seen to make a paradigm shift?
- What technologies can be identified behind the trends?
- How mature are the identified technologies?
- Which technologies are competing with each other?

3.5 Record the findings in a uniform way

It is important to record the findings in a consistent and uniform way to help with the analysis and comparison of technologies in the next stage of the process. Templates are provided on the STTRIDE web site for recording the findings. They can be changed according individual requirements, but they offer a good set of things to think of when planning the investigation of potential technologies.

3.6 What to do after the investigation?

Depending on the investigation parameters used, the outcome might be a list of tens of different technologies. The next module, ‘Analyse Potential Technologies’ on the toolkit page of the STTRIDE web site, offers a ‘light’ analysis process which can be used to help with the final selection of one or more technologies to implement.

An example of a reference checklist

The following checklist could be used to select which references to review more thoroughly.

- ✓ Date of publication – should be 5 years or newer
- ✓ To what extent does it address our research questions for this task?
- ✓ Are findings transferrable on a transnational and /or trans-modal basis?
- ✓ To what extent is it evidence based, e.g. is it based on empirical research, best practice or informed opinion?
- ✓ If it is research based, is sample size representative? Any notable points such as control group methods should be recorded
- ✓ Has it been reviewed?
- ✓ Are there any flaws or gaps in the findings? Are these acknowledged?
- ✓ Apply an 'evidence hierarchy' that places peer reviewed journal articles at the top and industry publications, press reports, at the bottom.

Table 3.1: Basic technology information and reference information

Basic information	
Reference: e.g. please use Harvard system & include weblink if relevant	
Type of publication: e.g. journal article, other article, book, book chapter, working paper, project report, conference paper	
Client (if relevant): e.g. government dept, EC, industry	
Type of study: e.g. literature review, primary research, meta analysis, quantitative or qualitative	
Geographic scale: • is the scale transnational / country / regional / local? • which transnational area / country / region / locality is covered?	
Quality	
Level on 'evidence hierarchy'	
Are findings transferrable on a transnational basis?	
To what extent is the document evidence based? e.g. is it based on empirical research, best practice or informed opinion	

If research based: • what is the sample size & is it representative? • what are the key elements of the methodology? *e.g. randomised control / before & after surveys / after survey only / focus groups / interviews* • which year were data collected?	
Has the document been reviewed? **If so, please specify method of review.**	
Are there any flaws or gaps in the findings? • specify flaws/ gaps • are these acknowledged?	
Findings	
Research question 1	
Research question 2	
Research question 3	

Table 3.2: Technology information sheet

Technology	[the name of the technology]	**ID**	[use unique IDs]
Technology Readiness Level	[See Table 3.3.]	**Time horizon**	[years]
OSI Layer	[See Table 3.4.]	**Domain**	[categorise the technology]
Geography	[Where the technology will be used]	**Source(s)**	[name the source(s)]
Relation to modal change	[How does the technology relate to modal change?]		

Table 3.3: Technology Readiness Level

TRL 1 – Basic principles observed
TRL 2 – Technology concept formulated
TRL 3 – Experimental proof of concept
TRL 4 – Technology validated in lab
TRL 5 – Technology validated in relevant environment
TRL 6 – Technology demonstrated in relevant environment
TRL 7 – System prototype demonstration in operational environment
TRL 8 – System complete and qualified
TRL 9 – Actual system proven in operational environment

Source: European Commission (http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-ga_en.pdf)

Table 3.4: OSI Layers

OSI Model			
Layer		Protocol data unit (PDU)	Function[3]
Host layers	7. Application	Data	High-level APIs, including resource sharing, remote file access
	6. Presentation		Translation of data between a networking service and an application; including character encoding, data compression and encryption/decryption
	5. Session		Managing communication sessions, i.e. continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes
	4. Transport	Segment, Datagram	Reliable transmission of data segments between points on a network, including segmentation, acknowledgement and multiplexing
Media layers	3. Network	Packet	Structuring and managing a multi-node network, including addressing, routing and traffic control
	2. Data link	Frame	Reliable transmission of data frames between two nodes connected by a physical layer
	1. Physical	Bit	Transmission and reception of raw bit streams over a physical medium

Source: Wikipedia (2018)