

Tomorrow's Transport Starts Today

STT Netherlands Study Centre
for Technology Trends

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STT Netherlands Study Centre for Technology Trends¹ has been organising wide-ranging, participative foresight studies on the cutting edge of technology and society for some 45 years already. The study centre offers enthusiastic stakeholders an open space to meet one another and to build inspirational images of the future in a creative way.

The subjects for these foresight studies are chosen by the members of STT's Governing Board. This Board consists of more than forty high-level members from the government, industry, knowledge institutions and society. STT is a non-profit organisation. The activities are funded by contributions from the government and industry.

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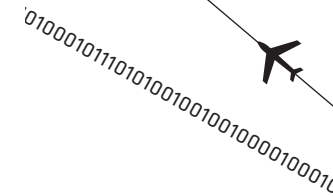


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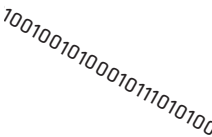
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Tomorrow's Transport Starts Today

Transport your thoughts into action
- Comprehensive Summary -

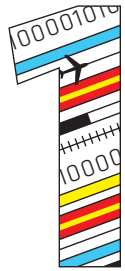
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Introduction

What will our transport look like thirty years from now? Looking back in time shows us just how much things can change in thirty years. In 1983 Dutch homes didn't even have computers yet, let alone an internet connection. You used a phone connected by a cable to make a phone call. You found your way about by using a paper map. Eastern Europe was still behind the Iron Curtain and the founder of Facebook, the biggest company for social media in 2012, wasn't even born yet. In this publication we look thirty years ahead and present six images of possible transport in 2040.

Super Intelligent Transport: a foresight study

The foresight study 'Super Intelligent Transport' by STT Netherlands Study Centre for Technology Trends (STT) takes a look at what transport might look like in thirty years' time. To do this, the expertise, visions and ideas of many experts and stakeholders from industry, science and the government have been brought together and integrated. This comprehensive summary describes the results of this study. In the original Dutch publication 'Het vervoer van morgen begint vandaag'² the results, the developments behind them, and their possible consequences are described in more detail.

Aim and underlying assumptions

The whole idea behind sketching images of the future is to make stakeholders look at transport in another way, to make them aware of what the future might bring and in this way

to work together to start bringing tomorrow's transport to fruition.

The underlying assumption is that transport is not an isolated phenomenon; transport is closely connected to people's behaviour, to technological developments and to society. That is why – besides looking at possible new *modes* of transport – we first looked at the future *demand* for passenger transport. What will the need for transport be in 2040? As a first step to sketching what transport might look like in thirty years, we have chosen to develop an image of the total future transport system and how it fits into society. In these images the focus was on passenger transport in the Netherlands. Additionally, a few ideas about future freight transport have been sketched out. As our guideline for developing images of the future, we have assumed that over thirty years transport will be 'super intelligent'. 'Super intelligent' refers, in this case, to a transport system that can self-regulate, steer and drive itself; challenging the reader to think out of the box.

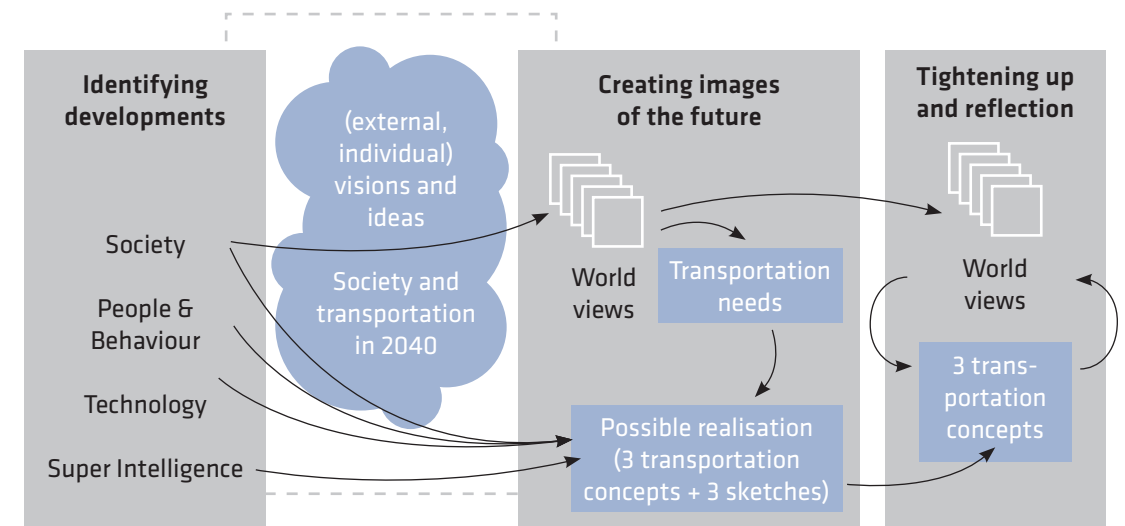


Figure 1 Approach STT foresight study Super Intelligent Transport.

Approach

The foresight study Super Intelligent Transport is an explorative and qualitative study with a broad approach. In the period 2010 – 2012, some seventy stakeholders from industry, knowledge institutions and the government as well as students and (young) highly gifted people have actively contributed to the thinking process about the development of these images of the future. During thirty meetings and creative, interactive sessions they introduced their visions and ideas about the future of transportation. We deliberately sought out representation from the triptych technology, behaviour and market. In addition, we had bilateral talks with some captains of Dutch industry. Additional input came from desk research, interviews and various symposia and conferences.

Please, join us on a journey through the images of the future that we have developed about our society in 2040, the transportation in those images and the developments behind it.

² The translation of this Dutch title is 'The Transport of Tomorrow Starts Today'.

Context



2 Society

Transportation is a complex societal domain because of the many relationships it has with a wide range of other facets of society. Therefore, in this STT foresight study, transportation is regarded as a function within society. Society as we think it could well be in 2040 is our starting point for images of the future in transportation.

Framework for images of the future in transportation

Answering questions about the future demand for and mode of transport is not about wanting to predict the future but merely to explore what the different possibilities are. In this way, stakeholders can get an idea of possible futures and this will allow them to take advantage of (un)expected developments. People and their needs for living, working, recreation and consumption play the central role in this study. In order to research different future possibilities, four scenarios of Dutch society in thirty years time have been sketched out – hereafter referred to as ‘world views’. These world views form the context that enabled us to estimate the demand for transportation and as such they are not future goals in themselves. Two trends in society – the further increase in individualisation and the continuance of globalisation – and their counterparts form the framework for this study.

The framework (see figure 2) invokes stakeholders to think about two important facets of transportation: the *number* of passengers and

Two relevant trends in society

Further increase in individualisation

More individualisation entails a growing emphasis on individual needs and self-interest. A person likes to decide for himself what he does, where he is and the way in which he fulfills his desires. That is why the demand for tailored products and services will increase – inside and outside the domain of transport.

Continuing globalisation

On a worldwide scale, companies and economies are becoming increasingly interwoven, partly because of the increase in ICT use. Global flows of goods and transfers of people are increasing. The category of activities (local, regional, national or international) that is going to increase or decrease predominantly, will influence the type of transport and traffic flows that will play an important role in the future. Where and for whom will (Dutch) people be working in thirty years from now? Where will the production of food and goods take place?



Figure 2 The framework with the four world views developed as a societal context for images of the future in transportation.

amount of freight that need to be transported, and the distance they need to travel. Are collective passenger transport and collective freight transport an appealing option to fulfill transportation needs? And if so, under which circumstances? What will be the ratio of local production against import from elsewhere? And what impact will that have on the type and volume of the goods that need to be transported and the distance they have to travel?

Ultimately, people and their feelings about different modes of transport play an important role in what the future will look like.

Descriptions of the world views in 2040

Each sketch of a world view has its own characteristics and transportation needs. These are briefly described in this paragraph.

Individual Prosperity



Individuals strive for prosperity, luxury and wealth.

They work on a casual basis for different employers. They make their contribution to global, virtual, shifting teams from their homes in an urban area. They are not interested in the origin of the products and services that they consume, as long as they are delivered in time to their door and are fully adjusted to meet their wishes. This luxury is not available for everyone. Both within and outside of the Netherlands, a big lower social class exists that has to make ends meet on a restricted income; it is a society of 'keep up or get left behind'.

Travel in this world view is a lust and a must. Proximity is secondary to accessibility. Journeys are ad hoc. The government lays down few restrictions; the individual's freedom of choice is foremost. Hence, people travel a lot for their work, study, leisure and personal health. Many activities are interwoven. This results in an increasing number of individual journeys, zigzagged across the country, Europe and even further afield. Some of these journeys take place virtually. Flows of freight are also global. The people who are unable to keep up in this society mainly travel short distances.

Global Awareness



In this scenario, people mainly live in cities. Tasks are extensively divided, hence people are highly specialised in their profession. The dominant work field is the services industry. New technologies are maturing. Products and services are produced where direct and indirect costs combined are the lowest. Government

agencies around the world direct people to a collective awareness of values and norms. These agencies take the lead, aiming for a healthy environment and managing the responsible use of natural resources. Companies make sure that the economy runs smoothly.

In this world view, people's desire to travel is restricted by the strict rules that governments all around the world impose on travelling. The main reason for this is that they govern based on the lowest possible integral costs for activities and the production of goods. In some places certain activities and production are simply not permitted. People partially use virtual alternatives. The consequences for goods are that production and trade mainly take place within one continent.

Powerful Region



In this world view people's trust in governments and in countries and people that are further away has strongly diminished. People focus on acquainted others and they have a strong regional network of friends, relatives and other contacts. In this *civil society*³ people look after one another and take care of their surroundings. Strong restrictions on the living environment form the main conditions for economic development. Intensive re-use and recycling restrict trading between regions. The accent has shifted from economic ownership to right of use. Regions offer

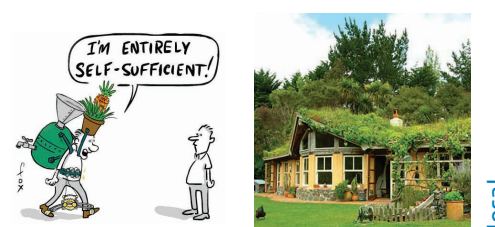
³ *Civil society* can be defined as organisations outside the circles of the government, the market and family and friends.

the most vital facilities within their boundaries so inhabitants hardly need to leave the area.

People's desire to travel within the region is high. They like to meet one another face to face, although they don't want to travel too far for this. Proximity is important. A region can vary in size from an urban area with a number of city centres to a group of provinces. The desire to travel outside one's region is limited and exchanges of knowledge and contacts mainly take place virtually. Time pressure, in trade as well as in travel, is considered unpleasant. Freight transport, including the transportation of recycled products, also has a regional character. Products are manufactured within the region as much as possible. Transportation across the region's borders is restricted to raw materials, semi-finished products and luxury goods that cannot be obtained or recycled within the region.

Self-sufficient Unit

individual



In this world view a worldwide crisis has led to a very different society as compared to the one in 2013. People want to be as independent as possible. In thirty years small-scale communities predominate, and thanks to technological development one's immediate surroundings offer enough livelihood. Exchange of knowledge, often virtual, plays an essential role. People live as self-sufficiently as possible and work in accordance with the cradle to cradle principle. Large-scale, global passenger and freight transport are things of the past. Because

self-sufficient communities need a relatively large amount of space, there has been a move towards the countryside. Existing urban areas have been redesigned.

In this world view, citizens see travel as bothersome. It is therefore important that facilities, work and social contacts are all close by. One's place of residence is also one's living environment. Physical transport of passengers or goods is therefore mainly local. A supply of just a few raw materials is all that is needed from outside. Contacts and exchanges of knowledge outside of one's own living area are made virtually.



Building blocks for images of the future in transportation

People and some of their (expected) needs and (expected) societal and technological developments, as well as possible connections between these, form the building blocks for the images of the future in transportation that we have developed. A selection of these building blocks is presented below.

People and their needs

People are social beings. They need social interaction with one another. In the past, physical proximity was important for that purpose. Nowadays, they also have a virtual social circle.

☐ Freedom (of choice)

A person likes to decide for himself what he does, where he is, with whom he meets and how he fulfills his wishes. This freedom can be at odds with a healthy living environment, the physical safety of others, or with the law.

☐ Safety

A person strives to have a certain level of safety, especially for activities necessary to reach a higher goal. No traffic accidents, violation of his privacy, or unauthorised use of his personal details, for example.

☐ Trust

The belief that you can rely on someone else, an organisation, or a product. This notion is an extension of the above mentioned building block.

Society

As mentioned on p. 9 the way society is set up is important for the *demand for* as well as the *mode of* transport. In the sketched world views we have linked global trends, particularly individualisation and globalisation, with future demands for transport. Other societal developments are also important building blocks for the future demand and mode of transport.

☐ Tailor-made

A service or product is made to fit the specific needs that a person has at that moment.

☐ Convenience

A user doesn't have to do anything extra – or very little extra. He therefore can concentrate directly on the activity that he wants.

☐ No personal property

To use an item you don't have to be the owner of it.

☐ Pay per use

You only pay for the time and the intensity with which you actually use an item or service.



Figure 3 What used to be separate products – an alarm clock, radio or calculator, for instance – are now just applications on another product.

❑ Goods become services

What were previously physical products have become virtual products or services. Or the function of a certain device is integrated into other devices.

❑ Self-organisation

People increasingly take matters into their own hands to get things organised. Thanks to the advanced developments in the fields of ICT and artificial intelligence, devices can also increasingly organise themselves.

Technology

Besides developments in the behaviour and needs of people and developments within society, there are also technological developments that have a big influence on the demand for and the mode of transport.

❑ Autonomous vehicle

An autonomous vehicle can get from A to B on its own. Human intervention is not needed [A, B].

❑ Data coupling and data integration

Data coupling and integration is about linking data from different sources and locations. This



Figure 4 In several countries autonomous cars are already extensively tested in daily traffic. Photo: Autonomos LabsFreie Universität Berlin (www.autonomos-labs.com).

allows users to have the data presented to them in a useful way and it allows specific data that is required for certain services and products to be collected. The enormous amount of data that is and will be available – the so-called big data – enables additional services and products.

❑ (Smart) agent

A (smart) agent is a software programme that collects information, carries out transactions and / or provides orders on behalf of its user. When necessary, a smart agent uses real-time data for this. Over time he gets to know his user well, through following his behaviour, for example.

❑ Augmented reality

Details are projected as a 'visible' layer between the user and his surroundings to provide him with extra information and to support him in what he is doing.

❑ Telepresence

Telepresence is the illusion of physical presence in a place where you are not physically present. In its ultimate form, all your senses will be

stimulated, including touch, smell and taste. This is going beyond video conferencing, Skype, etc. Holography is one step in the direction of actual telepresence [C].

❑ Ambient intelligence

Smart, invisible technology in a person's surroundings enriches his life and makes daily life easier and more comfortable.

❑ Ubiquitous computing

Computational devices are integrated into a person's surroundings and don't need explicit human operation.

❑ Rapid manufacturing

Rapid manufacturing, such as 3D-printing, makes it possible to use a computer file to print out a usable end-product. To this end the product is built up on site, step by step, in layers of one or more different materials. [D]

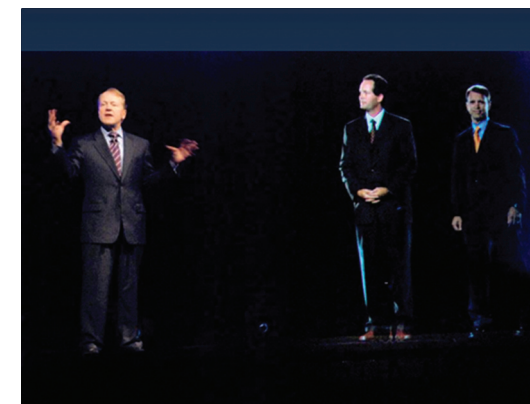
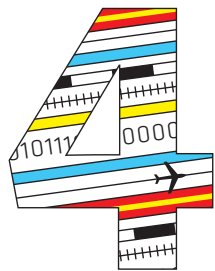


Figure 5 The world's first real-time virtual presentation during the opening of Cisco's Globalization Centre East in Bangalore, India in 2010. Photo: Cisco.



Super intelligence

In this foresight study the term *super intelligence* serves as an invitation to think beyond what has already been introduced to the market. For example, by thinking about transport systems that have (some) parts that do things on their own accord, that work together and correct mistakes. Or that organise, regulate, guide and learn by themselves.

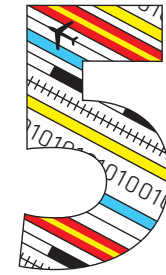
We are talking about super intelligence when the intelligence of the total transport system is bigger than the sum of the individual intelligent parts. The added value is created by the connection and the reciprocal interaction of the different parts (see table 1).

	An intelligent <i>vehicle</i> fully takes over the driving tasks from a person.
	Intelligent <i>surroundings</i> consist of buildings, spaces and objects that can communicate about local conditions or situations. A specific aspect of the surroundings is the infrastructure. Intelligent <i>infrastructure</i> informs other parts of the transport system about its local status. It also self-repairs small faults, thus increasing its availability and security.
	An intelligent <i>control system</i> has the right information to be able to proactively meet a certain goal in real time and to act accordingly.
	An intelligent <i>traveller</i> is for the purposes of this foresight study defined as a person who consciously or unwittingly uses the relevant information about possible travel options and corresponding time schedules to optimise his journey and who then takes action accordingly – both before and during travel.
	Intelligent <i>freight</i> communicates independently about its destination. When packaging is seen as a part of freight, intelligent freight also guarantees the conditions for delivering the goods in their proper state to their destination.
	The enabler for all these intelligent parts is information.

Table 1 Intelligent parts in a (super intelligent) transport system.

Images of the future in transportation

Combining the building blocks described in the previous section with the four world views, we developed three concepts for future passenger transport and three sketches for future freight transport. The following pages give a summary of the images of the future in transportation.



Passenger transport: Transportation on Demand



Transportation as a convenience service

Transportation on Demand

In 2040 moving yourself around has nothing to do with owning your own means of transport. Market players take care of individual transportation in all shapes and sizes, tailored to meet the specific need of a user at that particular moment in time. Transport will still be associated with status and image. However, it will no longer be about what make of car one owns, but the make of car one is seen in. Strong life-style brands were the first to catch on to how they could fully accommodate travellers' wishes and they have met these needs, amongst other things, through their own transport services and vehicles. These brands have become the unexpected competition for the traditional transporters. So don't be surprised if you see a self-driving vehicle owned by Apple or Walmart pass you by; or when you find yourself sitting in a train compartment with 'BMW-look and feel'.

As well as through image, the transporters differentiate themselves in pricing and in the types of transport services that they offer. That varies from just how tailor-made the transportation experience is for the user (one's favourite colour or sitting position, for example), to the

chance to do some shopping during the journey whilst enjoying a cocktail, or rather, being able to work in a functional and comfortable space.

A traveller can choose from a broad variety of means of transport: from a public, hired bicycle to an electric, covered moped, a closed people mover or a flying car. You can use these individual vehicles at any moment and location and they will bring you right to the doorstep of your destination. Or they will bring you to a



Figure 6 In Masdar City (Abu Dhabi) in 2012, self-driving vehicles bring travellers to their destination. Photo: Masdar City.

transport hub where you can change to another means of transport such as a high speed train, i-bus, metro, water shuttle or aeroplane. In this case, individual vehicles are used for the first and last mile transport when using collective transportation for travelling the main distance. Thanks to the seamless and frequent connections that collective transport offers you don't have to check timetables. It also forms a good alternative on congested or long routes.

As a traveller you leave the planning and reservation of a journey to your *digital journey assistant (DJA)*. Thanks to the detailed and reliable real-time information about travel times, routes and methods, a DJA warns you well in advance if changes in circumstances on the planned route occur. The DJA also guides you through a transfer and all the way to your final destination. It also deals with the payment of the journey. You don't have to stand in line for a ticket or to upload your payment card. You can travel without bothering about practical things. App stores contain thousands of digital journey assistants. There is one for each age group, image and type of user. The better apps distinguish themselves through their user-friendliness. As well as using the traveller's input about what he wants, a DJA can also deduce his likes from the traveller's travel patterns.

With **Transportation on Demand** a traveller doesn't have to worry about anything, he can use his travel time to do other things. Finding a free parking space is left to the autonomous vehicle itself when it doesn't have to immediately move on to another assignment. Door-to-door transport is therefore no longer reserved for people who can afford their own chauffeur. Also, the traveller no longer has to worry about filling up or servicing the car. The

vehicles do that themselves, according to the transport service providers's protocol. And what does all of this cost? It's not too bad. A traveller no longer pays for 'non-use' and the depreciation of the vehicles is indirectly paid for by all of the users together.



Figure 7 In several crowded city centres, such as in London and Paris, the individual traveller can already make use of rental bikes or cars for door-to-door transport without having to worry about the servicing of the vehicle.

Preconditions

The following preconditions have been assumed when putting together **Transportation on Demand**:

- Autonomous vehicles are allowed on the public road network and they are insured for any responsibility should they be involved in accidents. Law and regulations must be adjusted for that.

2040

Transportation on Demand in practice

What is your travel need at this specific moment? Are you going to work on your own? A small, compact vehicle waits at your front door. Are you going to do your shopping? Then a vehicle with extra storage space will be there. Are you going on a family holiday? Then a big vehicle with extra legroom and a big boot will be waiting for you, with a place for the children to play – there is no need for them to sit still on long journeys anymore. Are you going somewhere far away for business? Then an individual vehicle will bring you to a high speed train – as they have very frequent departure times, there is practically always one ready to leave.

A 'chauffeur' is included with each service. After all, the vehicles drive themselves. So, once you have arrived at your destination, you can just step out and off you go. In this way, travel is made very convenient.

- The acceptance of autonomous vehicles by users and other parties involved in traffic.
- Trust between service providers and travellers and amongst service providers mutually to share information. Only then can the specific, individual travel requirements of a traveller be fulfilled to the optimum.

Transportation on Demand in the different world views

With **Transportation on Demand** travellers don't have to worry about transportation. A traveller no longer owns a vehicle. The reasons why differ per world view: convenience, reduction of costs or awareness of the effects on the living environment.

Figure 8 shows for each of the four world views to which degree **Transportation on Demand** fits in. In the full Dutch publication of the Super Intelligent Transport foresight study we describe in more detail how **Transportation on Demand** fits in a specific world view and why.

What already exists on a small scale

Transportation on Demand is not yet a reality. But you can already see various parts of the transportation concept both within and outside of the transportation domain. To illustrate this, a few examples:

- With the car share concept Car2Go in various cities worldwide, including Amsterdam, you can make use of a rental car for getting around the city without having to make a reservation. Just as with a taxi, there are no fixed boarding places and you also don't pay for the parking time. Once you have entered your travel requirements, an app finds the nearest available car. Immediately after you have used it, the car becomes available again for others. [E]
- The Freie Universität Berlin has linked the autonomous vehicles that it has developed to an app so that these vehicles can be called like a taxi. [F]

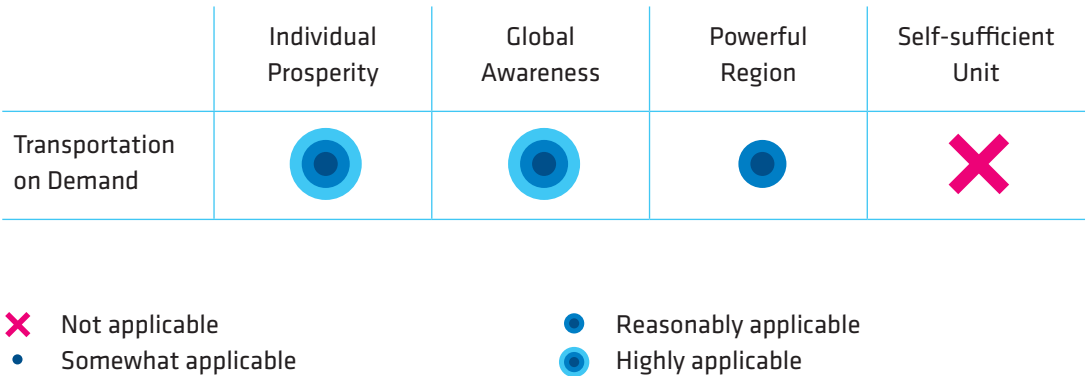


Figure 8 Degree to which *Transportation on Demand* fits in each of the four world views.

- Using your diary and any traffic jam warnings, the FileAlarm app will give you a warning signal if you need to leave early. [G]
- Google filters and presents results of search requests using the previous search requests of a user: a form of deducing requirements and interests from (previous) behaviour. [H]

A brief reflection on *Transportation on Demand*

Table 2 summarizes the most important strong and weak points of *Transportation on Demand*. It also indicates opportunities for society that this transportation concept offers as well as threats from external influences upon its realization.

In the full Dutch publication of the Super Intelligent Transport foresight study we describe the effects that *Transportation on Demand* has on the world views – sketched in chapter 2 – more extensively, as well as going more deeply into specific aspects such as safety, economy, spatial planning, energy and raw materials. We also reflect upon areas of tension that *Transportation on Demand* can bring about.

Strengths	Weaknesses
<i>Transportation on Demand</i> relieves the traveller of any worries: flexible, simple to use and the journey is fine-tuned to fit the person. - Autonomous transport ensures an increase in safety and traffic flow. - More independence for older citizens or people with no driver's licence, for example. - More time available for work and leisure as travel time can be used for other activities. - Vehicles and space are used more efficiently because they are shared.	- Not owning your own vehicle means dependency on service providers and technology: what if the service is bad or the system breaks down? - Service providers optimise their own ambition (their operational efficiency in relation to what the client pays for) and do not optimise in the interest of the traveller or society as a whole. - A number of jobs will become redundant.
Opportunities	Threats
- Advertisement on the trip: thanks to sponsoring, transportation is available for everyone. - The opening up of new markets (based on autonomous transportation) and the expansion of current markets (including ICT sector, <i>digital journey assistant</i>) will contribute to an increase in employment. - Transportation as a service platform. - Opportunities for the Netherlands to position itself as a world leader in the field of transportation services and ICT, based on autonomous transportation.	- The traveller doesn't experience untroubled transport because the services (from different providers) don't have good connections. - Users and society as a whole don't accept autonomous vehicles. - The traditional car driver wants to do his own driving. Through this he impairs optimal traffic flow and safety. - The design of smart agents and their supporting systems can't guarantee the amount of privacy that travellers require. - The security of ICT infrastructures and applications is unreliable.

Table 2 Reflections on the *Transportation on Demand* concept.

Future Challenges for *Transportation on Demand*

As indicated before, the parts needed for the *Transportation on Demand* concept are already available on a small scale. For larger scale use of this transportation concept, a number of challenges will have to be mastered, including:

- The parties involved will have to reach agreement about a protocol for mutual data and information exchange between

objects so that the interoperability between objects from different suppliers can be guaranteed and so that objects crossing the country's border won't cease to function reliably.

- The ICT infrastructure will have to be adjusted in order to be able to cope with, and guarantee, the increasing amount of communication between means of transport, infrastructure and users, 24/7.

Transportation on Demand

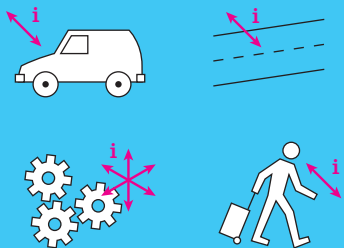
Basic outline

- Consumers don't own the vehicles they use; market players offer individual transport services.
- Autonomous transport: Relocations present themselves. The traveller has no concerns about the vehicle after he has used it.
- *Digital journey assistants* do all logistic planning - the traveller has nothing to worry about. These *smart agents* also summon a means of transport and make sure the payment for the journey is made. They even anticipate any changes in circumstances and guide the traveller through any transfer.

Paradigm shift compared to how it is now

- Consumers don't own their own vehicles.
- Because of autonomous vehicles, human drivers aren't needed.

Super intelligent parts



- Separate parts from individual intelligent means of transport and from the transport system as a whole will have to be technologically integrated into one reliable, safe and secure system, even if it crashes.
- In a well-used, complex transport system, safety has to be guaranteed. Also, it is important that when an incident does take place, this can be isolated so that the whole system doesn't go down with it. Failsafe design of vehicles, infrastructure and control systems are crucial.
- To make sure that society doesn't come to a standstill, alternatives have to be developed for situations where the underlying technology is unexpectedly and temporarily unavailable.

It goes without saying that travellers will have to be tempted and stimulated into accepting and using **Transportation on Demand** with its autonomous vehicles and the services that will thereby be made possible.



'Non-transportation'

Virtual worlds play an important role in daily life in 2040. The possibilities they entail are unprecedented. ICT technology has developed to a point that virtual representation of a person or an object has the same value as physical presence. This applies in terms of experience as well as the legal validity. **'Non-transportation'** – virtual travel – is a fully-fledged alternative to a physical journey. Whereas projection used to be

restricted to a 2D screen with unreliable sound quality, it is now just as if it were real life. As intelligent applications become increasingly more interwoven into the surroundings, the more opportunities arise to develop a whole range of activities in those surroundings. To take part in a specific activity you no longer have to be physically present. That means: less need to physically go somewhere. If someone doesn't have the time or money or doesn't feel like physically going, then he just relaxes and works from home. The virtual world can also, to a large extent, satisfy the biological urge to travel.

Thanks to 3D printers and urban farming, goods and food are produced locally. In the most extreme cases a person is **Always at home** and maintains all the contacts that he wants, business and private, virtually from home. He even experiences holidays on the other side of the world from his own home.

'Non-transportation' doesn't really mean that someone is housebound. Location independent facilities make it possible to study, exercise, work, relax or meet friends wherever he likes:



Figure 9 With **'Non-transportation'** the home traveller has the world at his fingertips in his own home.

from a community centre, at a friend’s house or whilst sitting on the beach - the world is his playground.

For every activity a traveller can choose whether or not he wants to be physically present. His *virtual companion* (VC) helps him to make the choice to travel or not, both for business and for private matters. A traveller can operate his VC with his thoughts – he doesn’t have to make any effort.

People with a great urge to travel combine ‘Non-transportation’ with physical transportation.

For this, (autonomous) vehicles are used for the physical relocation, whilst virtual projections during the journey make it possible to relax and contact friends or colleagues. In this way, these people frequently get out and about and are almost *Always on the move*. The physical shape of this kind of travelling is the *Living Cocoon*: a sort of camper 4.0. This vehicle functions as a work, living and leisure room. Using this, the new nomad makes his wanderings without really noticing that he’s moving, whilst his own surroundings are always there with him. In other words: always on the move and yet always at home.

2040

‘Non-transportation’ in practice

To *move or not to move* – that is the question that you, as a traveller, will ask yourself in the year 2040. Your virtual companion helps with answering that question. This assistant has grown fully accustomed to you and is more aware of your preferences and dislikes than you are.

In the *Always at home* situation, when making appointments, the task of a VC is limited to the actual setting of the time. Indeed, your location is always your home. And yet you still experience the meeting as a real life occurrence because all of the walls of the space that you are in, including the floors and ceiling, function as a life-sized screen. They form a 360° 3D image, filling every corner. The people you are talking to are projected into this room as a hologram. External devices can make sure that you also have the appropriate smell and touch sensations. In short: as a home traveller you get the feeling that when you are in contact with someone, you are at the appropriate place.

Travelling is so very different with a *Living Cocoon*. Equipped with all of your basic needs, you can cross the continent as a new nomad via ‘Non-transportation’, surrounded by all that is dear to you. When you are enjoying yourself at a certain location, you stay longer. Once in a while you meet up with friends at a physical location. The Netherlands is seen as a favourite international meeting place because of its easy accessibility and mild climate. You can also do a reality check whilst travelling: you can compare the virtual representation of the area that you are travelling through with the real life version. Amazingly, there is very little difference.

Preconditions

The basic assumption for the ‘Non-transportation’ concept is that virtual meetings have the same value as real life meetings and can take place wherever one wishes. To achieve this, a number of preconditions have to be met, including:

- Sufficient capacity of ICT connections (number of bits) and speed (number of bits per second).
- ICT services have to be secure and able to dynamically adapt to different surroundings.
- A robust ICT infrastructure with, for example, (high-speed) wireless internet access and energy supply is crucial for this concept.

‘Non-transportation’ in the different world views

Thanks to virtual travel options people are not restricted in their choice where to live and work. The virtual travel options are sometimes chosen for convenience or are necessary for exchanges of knowledge, other times they are stimulated by the government as an alternative to physical travel. Society’s norms and the upbringing of a specific person are important

factors in the desire to be physically or virtually present. As a result the effectiveness to which virtual travel and more specifically ‘Non-transportation’ can contribute to fulfill a person’s need to travel differs per world view. Figure 10 shows for each of the four world views to which degree ‘Non-transportation’ fits in. In the full Dutch publication of the Super Intelligent Transport foresight study we describe in more detail how ‘Non-transportation’ fits in a specific world view and why.

What already exists on a small scale

‘Non-transportation’ is not yet a reality. But you can already see various parts of the transportation concept both within and outside of the (virtual) transportation domain. To illustrate this, a few examples:

- Using a 360° viewer, a spectator can choose his own perspective. He can, from a distance, walk around in other surroundings. A first step towards this is the well-known Street View from Google. [1]
- Using holography, someone doesn’t have to be physically in a place and yet can still be there. Examples include Airport Assistants at Luton Airport in London and at New York

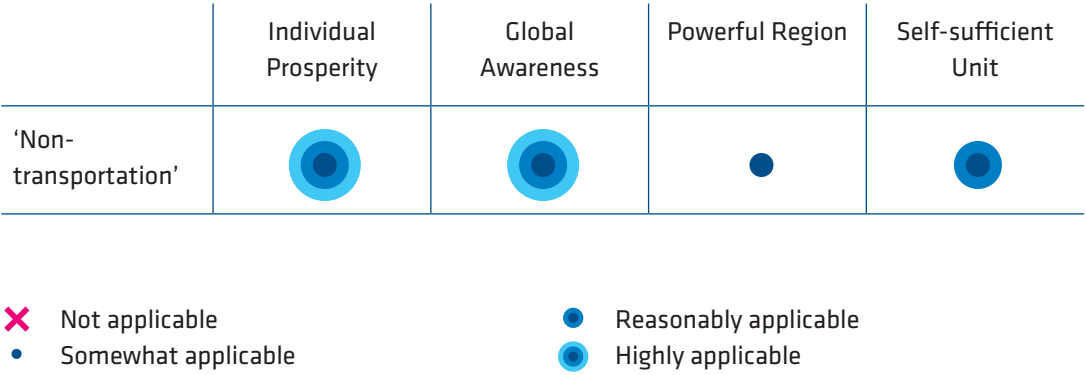


Figure 10 Degree to which ‘Non-transportation’ fits in each of the four world views.

- airports [J]. A person on the other side of the world can also appear live on a stage here.
- Thanks to all mobile devices a user has continuous access to his social contacts and all sorts of information. As well as via laptops, telephones and tablets, this is also possible via a contact lens⁴ that is

⁴ Innovega, together with the American Defense Advanced Research Projects Agency (DARPA), is developing a contact lens that helps you to see small, multi-coloured 3D pixel images that are projected on top of your image of the real world.

Strengths	Weaknesses
- Facilitates the efficient and effective use of time during a journey and avoids travel time. - Appeals to the freedom of the individual to decide, from the comfort of his own (flexible) surroundings, whether or not he wants to travel.	- Virtual meetings are not yet considered to be a fully accepted alternative to physical meetings. - Will an increase in freedom of choice make people happier? Or will this make us even more stressed and confused? - Who will invest in the necessary infrastructure?
Opportunities	Threats
- Stimulates the ICT sector, hardware as well as applications. - Stimulates the development of new (virtual) services. - Stimulates an economy that is time and location independent. - Virtual applications make distant places accessible. - Stimulates a non-work related development of areas: The Netherlands as a worldwide meeting place. - Stimulates a new industry for means of transport. - Minimises harmful emissions because of decreased physical travel.	- From a social aspect, <i>Always at home</i> seems to be too isolated. - A lack of standardising platforms and protocol. - The emergence of fast, clean forms of physical transport limit the demand for virtual transport as an alternative for long distance travel.

Table 3 Reflections on the 'Non-transportation' concept.

- connected to a smart phone. [K]
- OLEDs (Organic Light Emitting Diodes) make full colour, full motion display on a flat surface possible without needing an underlying light source [L]. When OLED paper is used as wallpaper, it can serve as a big screen. [M]
 - Dutch jurisdiction has recognised the existence of virtual worlds through a ruling: the removal of a virtual mask from a computer game has been condemned as theft. [N]

A brief reflection on 'Non-transportation'

Table 3 summarizes the most important strong and weak points of 'Non-transportation'. It also lists opportunities that this transportation concept offers society as well as threats from external influences upon its realization.

In the full Dutch publication of this foresight study we describe the effects that the 'Non-transportation' concept has on the world views – sketched in chapter 2 – more extensively, as well as specific aspects such as safety, economy, spatial planning, energy and raw materials. We also reflect upon areas of tension that 'Non-transportation' can bring about.

Future challenges for 'Non-transportation'

- The 'Non-transportation' concept presents us with many challenges. Here are just a few:
- The success of 'Non-transportation' depends on the quality of virtual meetings. They must offer an experience equivalent to real life meetings, appealing to all of the senses (sight, sound, smell, touch and taste). Therefore, the necessary technology for virtual experience in touch, smell and taste will have to be (further) developed.
 - For virtual meetings to become a viable option, colleagues, friends, clients and other relations will have to accept virtual alternatives. After all, you need others to hold a (virtual) meeting. How can this acceptance be promoted?
 - In order to make virtual meetings a reality no matter who the service provider is, a protocol for the sharing of information regarding touch, smell and taste is needed.
 - The authenticity of the virtual representation has to be guaranteed; it has to be

- protected against hacking and fraud.
- The required infrastructure behind all of this is broadband technology that needs to be quick, robust and reliable. One question is: what extra capacity is needed when there is a massive use of virtual travel and will this will be available in time.

'Non-transportation'

Basic outline

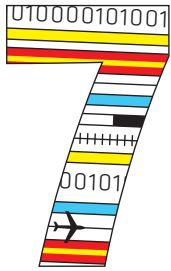
- People (also) move around virtually.
- A *virtual companion* helps with deciding on what the optimal virtual or physical travel options would be for someone, taking his agenda and personal preferences into account.
- Always at home*: the home traveller.
- Always on the move*: the new nomad travels about in his living cocoon.

Paradigm shift compared to how it is now

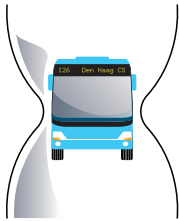
- Physical presence is no longer necessary because a virtual meeting has just the same value as a physical meeting. This applies in terms of experience as well as legally.
- Activities and locations are separated from one another.

Super intelligent parts





Passenger transport: Transportation in Scarcity



Restricting the impact of mobility
on the living environment by
working together

Transportation in Scarcity

Transportation constitutes the lubrication for our society. It facilitates activities that contribute to the welfare and prosperity of people and companies, and of the Netherlands as a country. At the same time, transportation puts pressure on welfare and prosperity by occupying space, time, financial means, raw materials and resources. Mobility also has an influence on public health, social safety and the quality of our physical living environment⁵.

In 2040 the detrimental effects of transportation prevail over the positive effects. That is why governments are enforcing – through legislation, rules and regulation – that the external costs of transportation are calculated into the price of travel. In this way they make people and organisations indirectly aware of the harmful effects of transportation and they can steer towards control on its use. By

⁵ Noise levels and the levels of CO₂ and particulate matter emissions are, amongst other things, important factors for the quality of the living environment.

so doing, citizens' desired 'right' to mobility is balanced against people's right to a healthy living environment. Mobility will be limited when it is harmful.

Through passing on the external costs, travel costs have risen substantially, regardless of whether or not you have your own means of transport. This automatically caused mobility to become scarcer. Each traveller pays in proportion to use for improvements on the quality of life.

Passing on external costs is a big challenge. External costs vary in time through changes in usage, weather conditions and availability. Also, circumstances differ depending on the area. That is why travel costs will be determined dynamically per time and location. Sensors from within the neighbourhood provide the information for this. The infrastructure communicates this variable price to travellers, vehicles and control systems.

The variable price makes finding out the most favourable travel option a big quest for travel-

lers. Luckily, support is provided by a mobility coach. This smart agent gathers information about the (intended) journey and gives clear details about the price and the expectations of what it will cost in time and physical activity. Additionally, the mobility coach gives insight into the harmful effect that the journey will have: for example, as a percentage of the annual average amount of noise a person produces or in relation to journeys made by friends. Based on the price prognosis, the mobility coach suggests a means of travel. In this way the mobility coach supports travellers in their quest of estimating and restricting the harmful effects of their journey.



Figure 11 The mobility coach helps to find the most beneficial travel option.

2040

Transportation in Scarcity in practice

"How do I keep my mobility score as low as possible?" That is the challenge recurring every day. There is a lot of mutual competition within your company or amongst your group of friends. As well as saving costs it is also about winning: a good reputation and every now and then a hamper of locally produced goods.

You travel less over long distances because of increased prices. Within your own area, you make good use of collective transport or a bike. Albeit, the bike is no longer guaranteed to be the best alternative because of all the bike traffic jams. However, you do still lower your mobility score through cycling: the effect on your health through physical exercise is rewarded as a positive effect! Another way of lowering your score can be achieved by combining your travel with shopping, not only for yourself but also for your neighbours. This will also strengthen your local social contacts.

Preconditions

The basic principle behind *Transportation in Scarcity* is that in 2040 there will be at least one scarce element related to transportation. *Transportation in Scarcity* is a way of dealing with the harmful effects of travel on those scarce elements. This implies that a few preconditions have to be met:

- The rules and regulations to restrict harmful effects have to be clear and constant. They also have to be embedded into the surroundings and infrastructure so that they can provide guidance.
- The availability of sufficient and robust bandwidth is essential to be able to cope with the increased data communication due to the constant synchronisation of the transport system's intelligent parts.

Transportation in Scarcity in the different world views

Transportation in Scarcity appeals to a collective awareness of the impact of human action on the environment. A collective awareness of scarcity is a precondition for the success of this transportation concept as much as the necessity to restrict harmful effects is.

Figure 12 shows for each of the four world views to which degree *Transportation in Scarcity* fits in. In the full Dutch publication of the Super Intelligent Transport foresight study we describe in more detail how *Transportation in Scarcity* fits in a specific world view and why.

As figure 12 shows *Transportation in Scarcity* is not likely applicable within the world views Individual Prosperity and Self-sufficient Unit. This does not mean that scarcity itself will not be an issue within these two world views. Within Individual Prosperity, people with a lack of money will experience transport as scarce means. Within Self-sufficient Unit there could be a lack of certain resources and means. Any directly visible harmful effects of travelling that are directly visible to the traveller himself or to others will be adjusted by the self-correcting power of the small community.

What already exists on a small scale
Transportation in Scarcity is not yet a reality. But various parts of this transportation concept can already be seen within and outside of the transportation domain. To illustrate this,

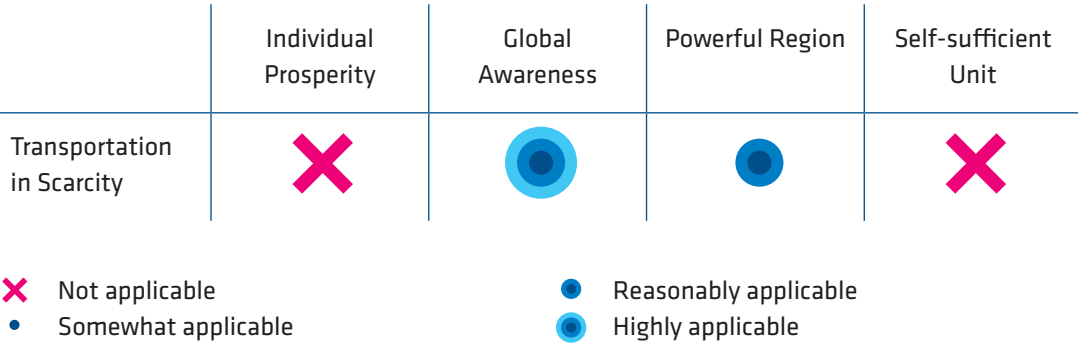


Figure 12 Degree to which *Transportation in Scarcity* fits in each of the four world views.

here are a few examples:

- The detrimental effects on space and the living environment are already partially reduced through policy and regulation. Take European emission standards for lorries, for example, and environmental zones in some European cities, or national Dutch policies for parking permits and time windows for deliveries to shops.
- Some Dutch employers let their employees choose their own form of transport by offering them a mobility budget instead of the usual lease car. Service providers in the Netherlands like Mobility Mixx [O] and XXImo [P] meet these needs with a mobility pass.
- Various quality labels try to raise consumer awareness about the impact of a product or service on people and the planet. Take, for example, ecological footprints like the CO₂ and water footprints or eco labels and fair trade labels for food and consumer items and the energy label for Dutch homes.

A brief reflection on *Transportation in Scarcity*

Table 4 summarizes the most important strong and weak points of *Transportation in Scarcity*. It also lists opportunities that this transportation concept offers society as well as threats from external influences upon its realization.



Figure 13 Environmental zones in some Dutch and other European cities restrict harmful emissions by transport in those areas. Foto: Pichugin Dmitry / Shutterstock.com.

Strengths	Weaknesses
- Advances the quality of the living environment and the health of people. - Stimulates an efficient use of infrastructure and means of transport. - Contributes to the collective awareness of the harmful effects of transportation. - Mobility is limited when it is harmful. - You are not charged for harmful effects if you don't add to them.	- The positive effects are not directly visible for the individual citizen. - When budgets remain the same, the higher out-of-pocket costs for travel limit individual choices. This creates a rift in transport for the rich and the poor. - In order to achieve the required effects, similar measures have to be taken in other areas, such as housing. - When multiple harmful effects are taken into account, the related impact on the environment and underlying goal for pricing become less transparent for citizens and companies.
Opportunities	Threats
- Dealing with scarcity stimulates innovation and creates commercial opportunities (e.g. the mobility coach). - Stimulates local production of groceries and goods. - Stimulates the clustering of activities.	- There is no unambiguous picture of the scarce elements and the way they are affected by travel. - People and companies don't have enough experience with scarcity so there is insufficient support for radical measures. - Existing transport companies lobby against rising costs. - Cleaner travel evokes compensatory behaviour. - Competing countries do not demand that the external costs of transportation are calculated into the price of travel. - Sharing details concerning a journey can be seen as an invasion of privacy and an invitation to commit fraud.

Table 4 Reflections on the *Transportation in Scarcity* concept.

In the full Dutch publication of this study we describe the effects that the *Transportation in Scarcity* concept has on the world views – sketched in chapter 2 – more extensively, as well as specific aspects such as safety, the

economy, spatial planning, energy and raw materials. We also reflect upon areas of tension that *Transportation in Scarcity* can bring about.

Future challenges for *Transportation in Scarcity*

Before *Transportation in Scarcity* can be realized on a large scale a number of developments and decisions need to be made:

- It must be determined which external costs have to be calculated into the direct costs of transportation and how.
- New methods and applications have to be developed to give people more insight into just what role scarcities play in travel so they know what to base their choices upon.
- By not competing for scarce products but by working together instead, people and organisations can use these scarce products efficiently and effectively.
- There is a lot of data available about passenger transport and scarce elements. The challenge is: interpreting this data and any additional requirements and bringing them together into good policies.
- The way a person travels is often due to routine. Since a person seldom directly experiences the harmful effects his journey causes, it is not easy to make him change his routine.

Transportation in Scarcity

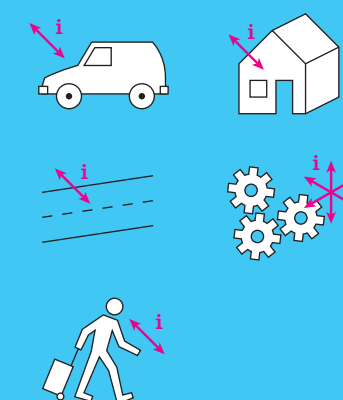
Basic outline

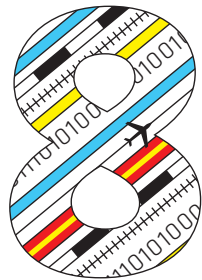
- The external costs of mobility can vary per moment and per location and are determined dynamically and calculated into the price of the journey.
- Mobility is limited when it is harmful.
- Travellers' personal travel needs are met within the context of differing elements of scarcity.
- A mobility coach helps the traveller to get an idea of the costs of mobility and how to save on these costs.

Paradigm shift compared to how it is now

- No unlimited mobility: the extent of mobility is dependent on its harmful effect on natural resources, public health or living environment.

Super intelligent parts





An outline of Freight Transport

In addition to the three concepts for passenger transport, three ideas for future freight transport will also be briefly described: *No people around*, *Freight out of sight* and *LinkedIn for freight*. More ideas about what freight transport could look like in thirty years can be found, amongst others, in the policy recommendation 'Dutch Logistics 2040 – designed to last' by the Council for the Environment and Infrastructure [V].

Brief outline of freight transport: *No people around*

In 2040 end products will find their own way to end users. Thanks to autonomous vehicles, robots and functions such as tracking & tracing, people will no longer be involved in the transport of goods. In the logistics of transport, technology also takes over human tasks: smart agents, on behalf of the shippers, transporters and customers, arrange when, where and how an order will be picked up and delivered. Men, as an 'unreliable' and 'delaying' factor – have been cut out.

Preconditions

Two preconditions for this sketch of freight transport are:

- Mutual trust in the market so that information about the transport can be shared with other parties.
- A good ICT infrastructure between the various parties is in place.

The underlying thought for this form of freight transport is pressure on the cost of logistics and relatively high prices for transportation.

What already exists on a small scale

What current applications can be seen as a step towards *No people around*? Here are two examples:

- Dutch Vanderlande Industries' baggage handling system at Amsterdam Schiphol Airport is an example of intelligence at a local level. The system manages the whole process itself.
- Robots as helpers for housework can pick up objects, hold them, move them and put them away. [Q]



Figure 14 Automated Guided Vehicles on the grounds of ECT Euromax. Photo: ECT.

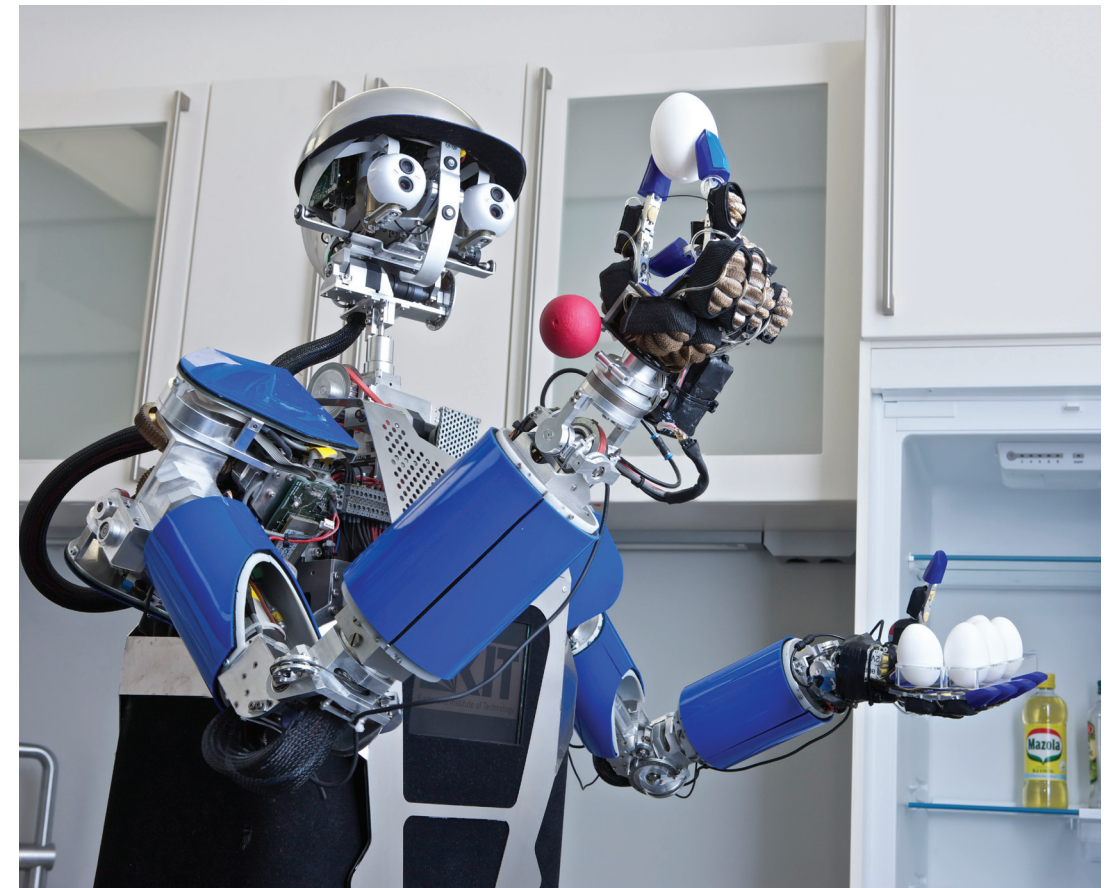


Figure 15 ARMAR, the helping hand in the kitchen, can hold and move breakable items such as eggs. Photo: Courtesy of the Karlsruhe Institute of Technology.

Future challenges for *No people around*

In order to implement *No people around* on a larger scale, some things need to be accomplished:

- The creation and strengthening of commitment and mutual trust between the parties involved in order to reduce inefficiencies in the system, to share information and to cooperate fruitfully. For this, a level playing field has to be created for all parties, whether big or small. An important facet of this is the development of a business model where all parties involved receive a share of the profits.

- A change in mentality whereby the service providers share tasks and don't strive to keep everything in their own hands.
- A (further) decompartmentalisation of supply chains and sectors.

Brief outline of freight transport: *Freight out of sight*

Goods transport themselves seemingly invisibly. You can't see them in the open air: that space is reserved for people and other matter that need fresh air and daylight. An extra world is created underground where goods are relocated without people being involved. On the outskirts of the city or region cargo is split into smaller volumes and moved from the main lines of the underground transport network onto a regional distribution system. Once they are close to their final destination the goods are taken up to local distribution centres at ground level. The customer can collect it from there or it can be put onto an overnight transport system to the final destination.

Preconditions

A precondition for *Freight out of sight* is:

- The pressure on current means for transport, infrastructure and environment has strongly increased, partially due to the growth in interregional and international freight flows.

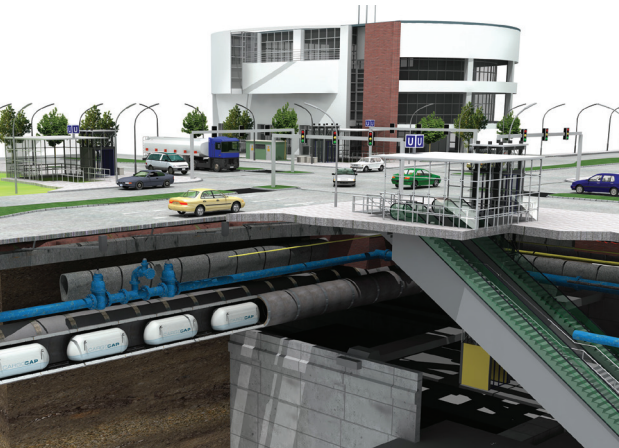


Figure 16 Freight transport and passenger transport move by different routes through a multi-layered infrastructure. Image: Cargocap (www.cargocap.com).

What already exists on a smaller scale

Two examples of current applications that are steps towards *Freight out of sight* are:

- In several industrial areas the transport of some bulk products is done via pipelines, such as on the Dutch Maasvlakte – the main area for port activities and industry of the port of Rotterdam. [R]
- In a part of the Dutch city of Almere domestic waste is transported underground. [S]

Future challenges for *Freight out of sight*

In order to implement *Freight out of sight* on a larger scale, there are some things that need to be accomplished:

- The initial investment costs for constructing an underground network are very high. Security costs involved in building tunnels form a very important component of these costs. Questions are: which party or parties will be willing to make this investment and what would be a cost-effective business model for exploitation? An alternative is to build the extra transport layer above the ground rather than underground.
- Many (ideas for) underground transport systems in the past have disappeared because they were (estimated to be) too expensive. As new techniques are now (becoming) available, these systems can be built much more efficiently and cost-effectively. The challenge is to reassess the opportunities and restrictions of underground distribution networks using the norms and values of today.

Brief outline of freight transport: *LinkedIn for freight*

The system organises, people execute.

You hardly ever send a package via external transport companies. Instead, you use a logistical matching system to send your package via your own social network or your network's network. That is the idea behind *LinkedIn for freight*. Freight transfers are linked to people's intended movements that are shared via smart agents and a LinkedIn-style platform. It mainly concerns local and regional freight transfers on an ad hoc basis.

Preconditions

A precondition of *LinkedIn for freight* is:

- For the system to be a success, a broad network of reliable users is very important. Insurance against loss, damage or theft could help to stimulate its use.

What already exists on a smaller scale

We haven't come across any existing social system for matching multiple transfers of freight on a small scale. In other areas there are initiatives

for such a system. Here are two examples:

- LinkedIn: this platform provides insight in your business (and social) network and the network of your network. [T]
- Filenetwerken.nl: this Dutch website offers people the opportunity to share a ride and thereby help to solve traffic problems and reduce travel costs. [U]

Future challenges for *LinkedIn for freight*

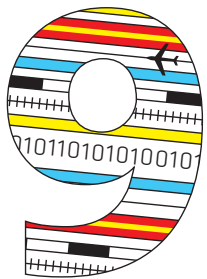
In order to achieve *LinkedIn for freight* on a larger scale, there are a number of things that need to be accomplished:

- A system that links the transportation of passengers to that of goods. For this it is necessary to know which goods need to be transported and which journeys travellers are planning on making. The question is: would publicly sharing this sort of information have something of a *Big Brother* feel about it?
- The demand for and supply of transportation have to be brought into balance so that deliveries of goods can be guaranteed within the required time.



Figure 17 People take along packages (for others) during their journey. ICT helps to find possible matches between planned trips and desired freight transfers.

Conclusions and recommendations



Conclusions

A number of current developments in our society, in human behaviour and in technology will have a great impact on why and how we will travel in thirty years' time. With these developments in mind, we have formulated three concepts for future passenger travel: *Transportation on Demand*, *'Non-transportation'* and *Transportation in Scarcity*.

These three concepts each describe different aspects of passenger transport: physical or virtual travel, a market-oriented or more government-driven transport system. The traveller's freedom of choice is the main factor in each concept.

We don't expect that one of these specific transportation concepts will offer a solution to all societal questions on its own. Also, the transportation concepts may turn out differently than how we have sketched them. However, we believe that these concepts together will determine the future of transportation: A future where the focus of transport has shifted from physical mobility to accessibility and from tarmac and tracks to ICT infrastructure; a future

	Individual Prosperity	Global Awareness	Powerful Region	Self-sufficient Unit
Transportation on Demand	Highly applicable	Highly applicable	Reasonably applicable	Not applicable
'Non-transportation'	Highly applicable	Highly applicable	Somewhat applicable	Reasonably applicable
Transportation in Scarcity	Not applicable	Highly applicable	Reasonably applicable	Not applicable

✗ Not applicable
● Reasonably applicable
● Somewhat applicable
● Highly applicable

Figure 18 Degree to which the developed passenger transportation concepts fit in the four world views.



Figure 19 Technology offers a helping hand when finding solutions to individual and societal transport questions.

in which transportation has become a service sector even more than it is now.

The three transportation concepts therefore comprise a system leap to a new system for passenger transport. A system that meets the transportation demands of a broad range of future societal scenarios for the Netherlands.

The passenger transportation concepts we developed and the imminent system leap lead us to three conclusions:

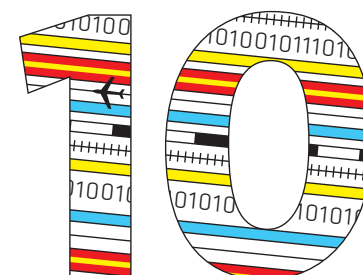
1. An individual increasingly becomes the central focus of the transport system and is served according to his specific needs, behaviour and opportunities. Although the transport system itself will be more complex, travelling becomes even easier for an individual, since all his

concerns will be taken care of by intelligent applications combined with super intelligent transport. As such super intelligent transport offers the opportunities to fulfill the individual travel requirements of every traveller.

2. Technology offers solutions to individual and societal transport issues such as safety and security, (predictability of) journey time, and (restriction of) negative effects on the environment. Distributed intelligence and collaborating human-centred, adaptive components help the individual traveller and enable new transportation concepts. For this purpose, existing basic technological know-how and components need to be integrated into robust, integral travel solutions. Additionally, preconditions like investing in a robust ICT infrastructure have to be met.

3. Transport, and super intelligent transport even more so, has a correlation with many facets of society. Therefore, the optimisation that super intelligent transport offers will entail an increase in (labour) productivity and a reduction in the waste of resources. In this way, super intelligent transport also tackles scarcity. At the moment, too little attention generally goes to the interrelationship between transport and society as a whole and spatial planning in particular. As a result, they don't reinforce each other as well as they could. Therefore, the interrelationship between transport systems and society deserves more attention, as well locally as regionally, nationally, and globally.

These conclusions also apply, in parts, for future *freight* transport.



Recommendations

The imminent system leap in transport as described above offers huge opportunities to the Netherlands. The Netherlands can position itself internationally as an important innovator in mobility. Its geographic and demographic characteristics, its challenges such as congestions and traffic related societal costs, and its innovational strength make the Netherlands an ideal testing ground for new transportation concepts.

Such an advanced international positioning would give the economy and innovation a major boost and in the long term it would provide a (knowledge) advantage over other countries. For passengers this progress would lead to new forms of travel and an increased level of comfort.

In order to seize these opportunities it is crucial that companies, knowledge institutions and governments work together and take an integral approach to transportation, interdisciplinary as well as cross-sector. We strongly recommend the compilation of a roadmap of what tomorrow's transport will look like and to act upon that now; a move ahead from talking about future transport to actually making it work. Important steps are, for example: investing in ICT infrastructure and applying existing technology (whether or not developed elsewhere) on a greater scale in practice. In this way any missing knowledge will be accrued.

The adjacent box gives three suggestions for possible pilot projects. Together with field research into drivers and barriers for mobility and with research into the social acceptance of

new forms of transport, these pilots will lay the foundation for tomorrow's transport.

Three pilots for the transport of tomorrow

As a guide for first steps on the roadmap towards a system leap in transport, we make three suggestions for pilot projects:

- *Autonomous taxi service*: from door to door without a chauffeur.
- *Virtuo-in* – local centres with virtual meeting facilities: making services for virtual instead of physical meetings accessible to everyone. So close and yet so far away.
- *Integral transport planner*: a travel planner that in pilot areas besides travel advice with regular means of transport, also gives alternatives with the autonomous taxi and with virtual travel. In this way, travellers can get a (even) better insight into their travel options and the associated costs.

Concluding remarks

A system leap in transport will not come about on its own. It needs input and dedication from all relevant parties, each having its own background and expertise.

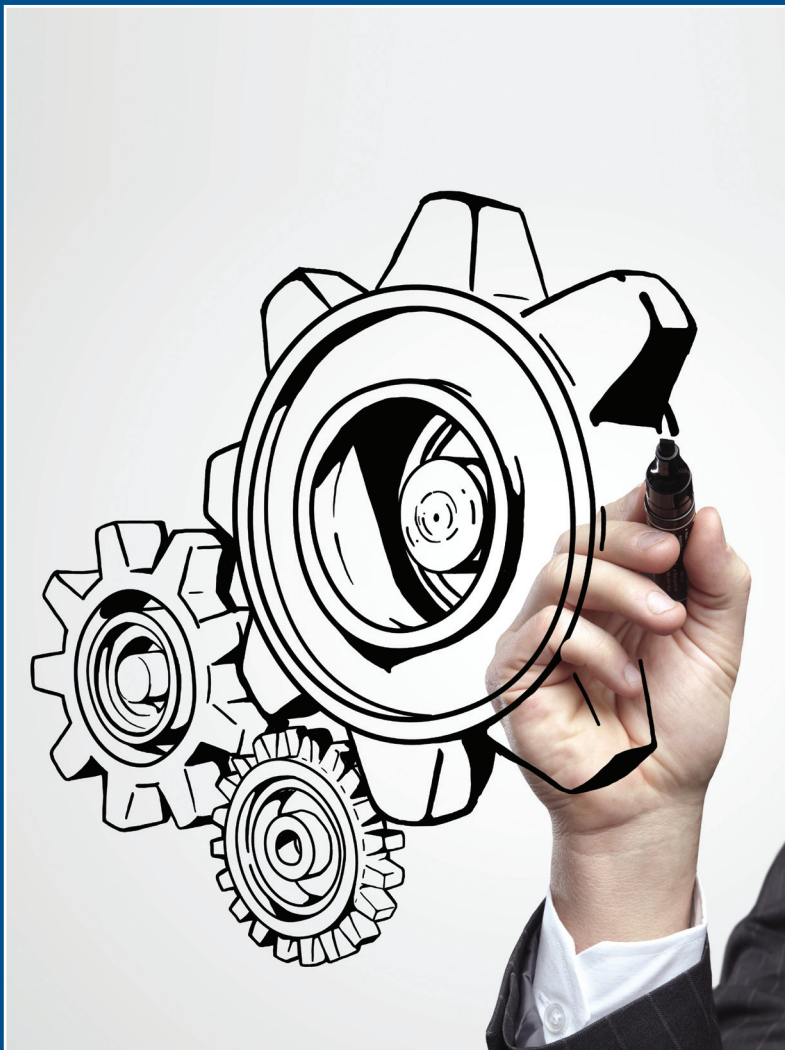
That is why we want to invite each of you who thinks about transport to turn YOUR ideas about the future into practice today: moving from talking to doing.

What can YOU do to seize the opportunities offered by the system leap in transport sketched out here? What is YOUR first step on the road towards tomorrow's transport?



Figure 20 A system leap in transport demands cooperation across disciplines and sectors.

Appendices



References and where to find more information

- [A] <http://www.autonomos-labs.com>
- [B] <http://viac.vislabs.it/>
- [C] <http://musion.co.uk/#!/the-experience/corporate-marketing>
- [D] <http://www.rmcenter.nl/2011/wat-is-rm/> (in Dutch)
- [E] <https://www.car2go.com/en/amsterdam/>
- [F] <http://www.autonomos.inf.fu-berlin.de/>
- [G] <http://www.tno.nl/filealarm> (in Dutch)
- [H] <http://www.google.co.uk/intl/en/goodtoknow/>
- [I] <http://www.google.com/streetview>
- [J] <http://www.prweb.com/releases/2012/5/prweb9543499.htm>
- [K] <http://news.discovery.com/tech/augmented-reality-contact-lenses-120203.html>
- [L] <http://techtv.mit.edu/videos/3175>
- [M] <http://www.techradar.com/news/world-of-tech/oled-wallpaper-to-spell-the-end-for-light-bulbs-660827>
- [N] <http://www.rechtspraak.nl/Organisatie/Hoge-Raad/Nieuws/Pages/Afhandigmakenvan-virtueelamuletenmaskeruitspelRuneScapeisdiefstal.aspx> (in Dutch)
- [O] <http://www.mobilitymixx.nl/> (in Dutch)
- [P] <https://www.xximo.com/>
- [Q] <http://www.robot161.nl/2012/04/robot-als-hulp-in-de-huishouding/> (in Dutch)
- [R] Verkeerskunde, 'Kolossaal ondergronds transport in Rotterdamse haven', <http://www.verkeerskunde.nl/kolossaal-ondergronds-transport-in-rotterdamse.29156.lynkx> (in Dutch)
- [S] <http://www.duravermeer.nl/projecten/details/1603/almere-ondergrondse-afval-inzameling-almere/> (in Dutch)
- [T] <https://www.linkedin.com/>
- [U] <http://www.filenetwerken.nl/> (in Dutch)
- [V] Council for the Environment and Infrastructure, 'Dutch Logistics 2040 – designed to last', June 2013. http://www.rli.nl/sites/default/files/dutch_logistics_2040_designed_to_last_uk_versie.pdf

Sources of illustrations used

For all of the images we have asked the owners for their permission to use. However, for a small number of images we have not been able to reach the owner. With the following listing, we hope to do them justice.

Figure 2

- <http://world3001.wordpress.com/2010/04/13/picture-of-the-future-2/>
- <http://www.duurzaamthuis.nl/zelfvoorzienend-leven-trend-2011>
- <http://www.gennepnu.nl/20070303%20100%20jarige%20krijgt%20de%20kogel%20van%20de%20gemeente.htm>
- http://www.treehugger.com/files/2006/11/rainbow_valley_farm_1.php

Other images in this publication where the source hasn't been mentioned are from Shutterstock.

About the publication

The full publication in Dutch 'Het vervoer van morgen begint vandaag – (ver)voer tot nadenken en doen' (STT publication no. 78) can be ordered from STT (info@stt.nl / +31 70 302 98 30) for € 17.50 plus postage & packaging.

Both the publication and this comprehensive summary were made possible thanks to the input from more than a hundred experts and stakeholders from the government, industry, knowledge institutions and social organisations. An overview of the main contributors can be found at <http://stt.nl/projecten/superintelligent-vervoer/netwerk/>. The full list of contributors and sponsors can be found in the full Dutch publication.

The images of the future developed here don't necessarily correspond one on one with the ideas or views of the individual participants or organisations – they have been abstracted from the range of visions and expertise of all of the people involved in the study. STT is therefore very grateful to all of the participants in this foresight study of Super Intelligent Transport.

Tomorrow's Transport Starts Today

Transport your thoughts into action

We are on the eve of big changes in our transportation: the first autonomous cars are already driving on American and European highways. Thanks to Skype, FaceTime and Facebook we can easily connect with people all over the world, friends as well as strangers. How will this influence the way we travel in 30 years? Will we wander around our country en masse in autonomous cars? Or will we be staying at home in 2040, because our home is fully equipped to participate in any desired activity virtually?

These questions have been the focus of the foresight study Super Intelligent Transport by STT (Netherlands Study Centre for Technology Trends). Together with over hundred enthusiastic stakeholders and participants from business, the government and knowledge institutions we have searched for possible answers and consequences. In this comprehensive summary we present the results of this quest: three transportation concepts about how passengers may travel 30 years from now. The summary also gives a sneak preview on what freight transport towards the end consumer can look like.

What may these transportation concepts imply for a country such as the Netherlands? What opportunities do they offer? What is needed to seize these opportunities?

Be inspired by these images of the future and find out what we can (and should) do today to seize the opportunities that new ways of travel offer. Tomorrow's transport starts today!

