Master thesis

# Creating value out of data: A product strategy in a moving mobility market

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MASTER THESIS

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By Lisanne Zwinkels

In collaboration with

ARS | T&TT

TU Delft

# COLOPHON

Master thesis:
***Creating value out of data: a product strategy in a moving mobility market***

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# ABBREVIATIONS

ARS T&TT - ARS Traffic and Transport Technology

C-ITS - Connectefd Intelligent Transport System

C-V2X - Continuous Vehicle to X

DSRC - Dedicated Short-Range Communications

DW&S - Data Warehousing & Sensoring

FCD - Floating Car Data

GPS - Global Positioning System

IoT - Internet of Things

ITS - Intelligent Transport System

ItTs - Invitation to Tenders

MCD - Mixed Car Data

NDW - National Data Warehouse

TDW(C) - Traffic Data Warehouse (Cockpit)

VRU - Vulnerable Road Users

# ACKNOWLEDGEMENT

The graduation project is a project that is executed individually, but luckily I did not have to do everything by myself. I am very grateful to the people who helped me and I would like to thank some of them in particular.

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Next to that, I want to thank my colleagues at ARS T&TT. They were all helpful to provide me with information I needed. A special thanks goes to Mozhdeh Gholibeigi, my company mentor during this project. From the beginning she was very involved in my project. She supported me on every step, even though the topic was not exactly her discipline. I also want to thank Willem van Leusden for jumping in the project in the last phase. He supported me where it was possible in the last steps of the project.

Finally I would like to thank my friends and family for the support, talks, discussion and inspiration.

# SUMMARY

This Master thesis is written to finish the Master program Strategic Product Design in collaboration with ARS Traffic and Transport Technology (ARS T&TT). The main objective is to create a product and marketing strategy for the data warehouse department of ARS T&TT. The design process the project went through is the fuzzy front  end shown in Figure 1. In the beginning the direction was fuzzy, but in the end it was a clear direction.

ARS T&TT is operating in the market of Intelligent Transport Systems (ITS), it is building smart solutions to improve the traffic flow. The department of Data Warehousing & Sensoring (DW&S) is responsible for the data coming from stationary sensors along the road side. Currently, the market of traffic data is changing, because of the emergence of in-car data such as floating car data. Next to that, there is no established approach for development of innovative products that will meet the requirements of the evolving ITS market. Further, there exists no insightful business modelling and marketing strategy such that the corporate can unlock all the business potential of the products. DW&S started developing a data visualiser to be more pro-active and invest in the business. The product is called a Traffic Data Warehouse Cockpit (TDWC). This viewer is the starting point of this project.

To create solutions in this moving market a thorough market analysis is done. The analysis focusses on the company itself, the competitors, the context in which the problem is occurring and the customers. Three future directions emerged from the analysis. The directions are: market growth for ARS T&TT, the emergence of sustainable cities and the development of the technology around autonomous vehicles. Those directions are plotted into a strategic roadmap from now till 2030. This roadmap presents the technological developments in this time period, the market trends are plotted and the product developments of ARS T&TT are presented and

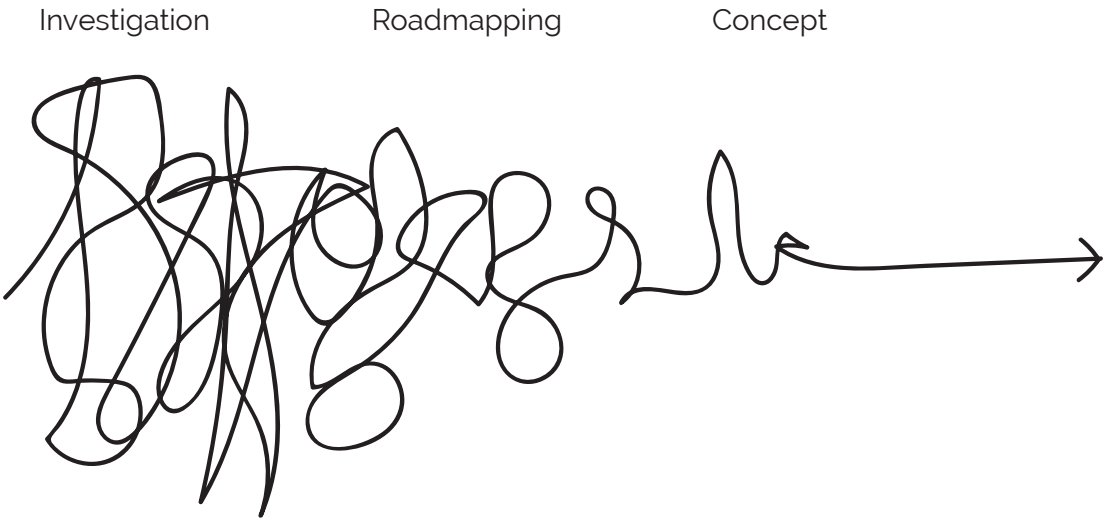


*Figure 1. The fuzzy front end, a visualisation of the direction of the project over time (Sanders & Stappers, 2006).*

aligned with the market and technical developments. Two product lines were presented in the strategic roadmap and next to that also the business models fitting these product lines are created. Future scenarios are made to do an in depth business modelling analysis for the future product portfolio of the data warehouse department of ARS T&TT. Business model solutions are presented for those scenarios and also a path to change the current business model into the future models is created.

In the end of the project the marketing strategy for ARS T&TT is designed. This strategy includes the marketing goals, brand positioning, brand strategy and paths to reach the goals. Figure 2 shows those marketing building blocks in a visual. The Marketing activities are visible for external parties, but the other building blocks are under the surface. The final advice how ARS T&TT should set up their marketing activities is presented in three paths to reach the marketing goals. The first pathway is to increase the visibility for the potential foreign partners by seeking for new channels. The second pathway will make ARS T&TT not only being a supplier, but next to this also an advisor to its customers (the road operators). This will build trust and the customer get to know ARS T&TT better. The third pathway is improving the focus of the communication. The current communication is focusing on the features ARS T&TT is selling, but it should change to a benefit-focused communication to attract the attention of the customers.

The final advice to the ARS T&TT are written in a strategic product road map and a marketing strategy to prepare ARS T&TT for the moving mobility market in the future.

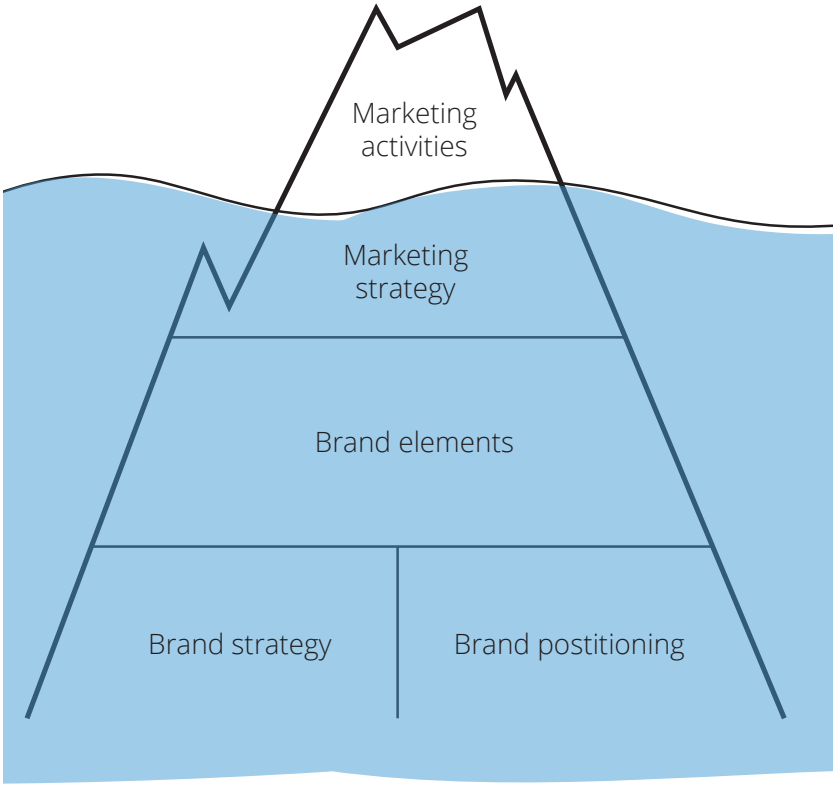


*Figure 2. The tip of the iceberg: Marketing activities and the brand building blocks (brandfabric, 2018).*

# CONTENTS

*“Smoking used to be sexy and a symbol of freedom. When we found out that it was unhealthy, for yourself and those around you. Then the tax on it was increased and it was eventually outlawed in many places. That tipping point will also eventually come for self-driving a car.”*

*- Dariu Gravila*

# 1. PROJECT BRIEF

## 1.1 INTRODUCTION

Today a great deal of data is being collected around us, without us even noticing. Data collection has grown immensely over the last decade. An example of a data collection system is a cookie on a website, this measures data from Internet users to be able to show them the right advertisement on the Internet. Another example is the local supermarket, this gathers information via the client card to improve the customer experience in the shop.

One of the domains benefiting from this recent expansion in data collection is the automotive industry. On the motorways, sensors (e.g. cameras, radars, lasers) measure data coming from traffic on the road. This high-level data is sent to data warehouses and cleaned and processed by companies like ARS T&TT. After that, ARS T&TT sends the data to suppliers of traffic information and traffic control centres. These organizations manage to communicate proper traffic information to the road users.

ARS T&TT has been providing traffic and transport technology solutions to businesses and government bodies since 1997. The company is active in its home market in the Netherlands, but also internationally (ARS T&TT, 2018). ARS T&TT is a technology-driven company; it reacts to the wishes of the clients by providing feasible technological solutions. ARS T&TT has a strong relationship with NDW (Dutch National Data Warehouse), an umbrella organisation that gathers different sources of data and provides a complete overview of traffic data in the Netherlands to road operators. This project is done in the department of DW&S. This department is responsible for all data coming from sensors along and within the roads.

The market in which ARS T&TT is operating, the ITS market, evolves in a very fast pace. The vehicles on the road are getting smarter, they are containing more sensors than before. This means the vehicles itself are gathering data. This data is competitive to the data ARS T&TT collects with the stationary sensors along the road. Therefore ARS T&TT wants to find a way to create more value to be future proof as well. They developed a data visualization platform called the TDWC, see Figure 3. TDWC is a visual analytic framework that provides an overview of traffic conditions via interactive functionalities supported by processing large amounts of data. Figure 3 shows the interface of TDWC with the intensity and speed of a certain location at a certain day. Besides statistical data visualization, TDWC provides comprehensive

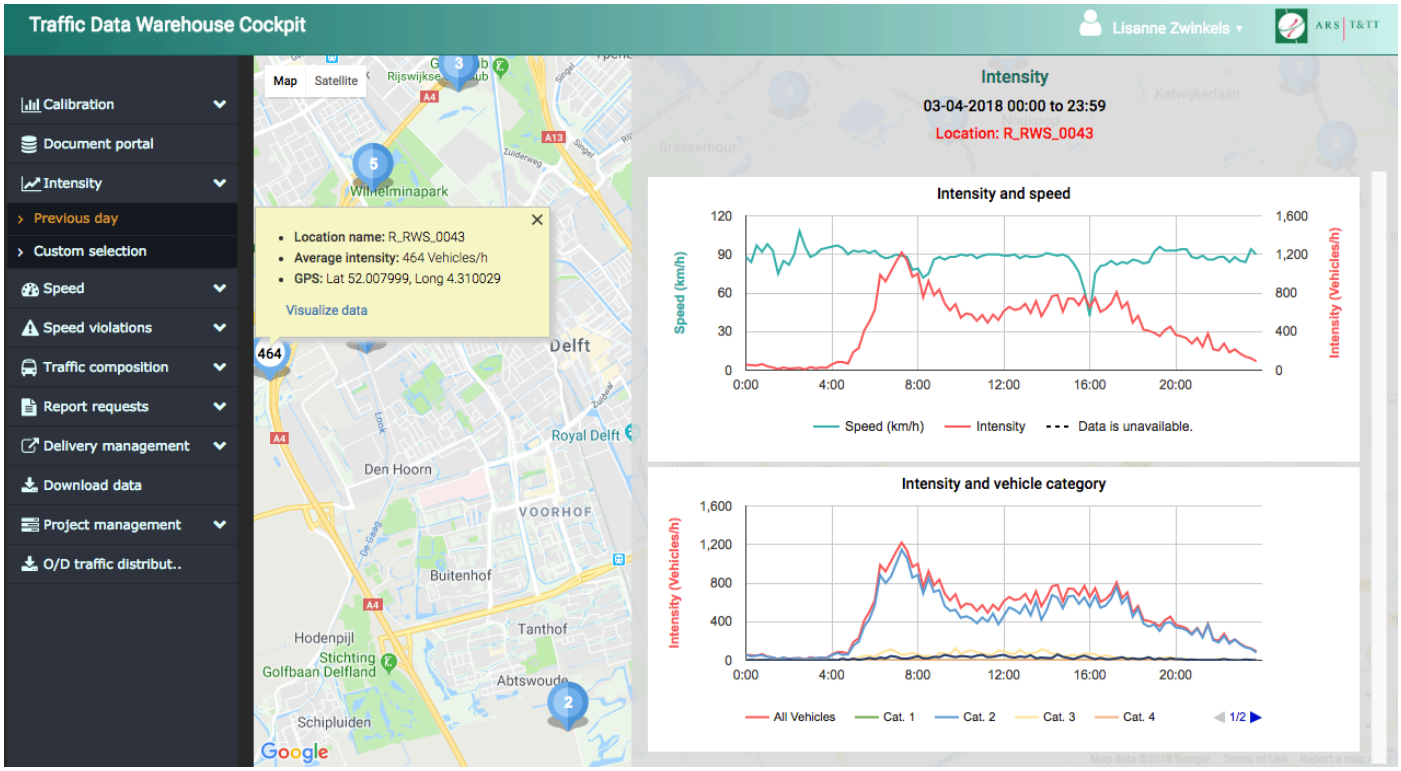


*Figure 3. An example user interface of TDWC: the traffic data analytics framework of ARS T&TT.*

data analysis and predictive models, supporting insightful decision making.

Generally ARS T&TT is project-oriented and wins contracts by signing up for tenders. Due to the competitive changes in the market it could need a more active attitude towards this market. This thesis focusses on facilitating such a procedure for the data warehousing business line of ARS T&TT by providing the necessary means towards the objective of successful business development.

The first chapter describes the context of the project. It starts with the problem definition resulting in the assignment. Then the approach describes the methods and the consecutive steps of this project. Appendix A contains the initial project brief of the project.

# 1.2 PROBLEM DEFINITION

A major part of the business in which the data warehousing department of ARS T&TT is involved, is in cooperation with NDW. But the number of contracts ARS T&TT has with NDW are decreasing, because of the emergence of new technologies. Floating Car Data (FCD) is one of the new technologies NDW has acquired. This data is cheaper and easier to receive than the traditional stationary sensor data. ARS T&TT should be creative to find solutions to react to this decrease of business. Instead of being reactive to the wishes of NDW, ARS T&TT wants to have a proactive attitude. Therefore ARS T&TT should get more knowledgeable about the market they are operating in, so they know their potential and existing customers better.

Those (potential) customers have a lot of different needs and wishes regarding traffic data. For example, the police wants to know where they should measure the speed of cars to catch speed offenders, but the provincial government wants to reduce traffic jams on the motorways. At this moment the overview of the needs and wishes of the customers and potential customers is lacking. Therefore it is hard to find an effective way to introduce products in the market.

ARS T&TT has started to develop a new platform, TDWC. This platform is being used by several customers already. To position the new platform strongly in the market ARS T&TT needs to design a marketing strategy that gives direction to the introduction of the new product. Formulating this strategy requires analysis to make sure the platform is introduced to the right target market and in the right way. To make sure that the product will fit into the future market of ARS T&TT a clear future product vision is needed. The future vision of the market will give direction to decisions that needs to be made in the near future as well. Next to the product vision also a business model for TDWC is needed, to make sure the product is valuable for customers and the company itself.

Currently, there is no established approach for the development of innovative products that will meet the requirements of the evolving ITS market. Further, there exists no insightful business modelling and marketing strategy such that the corporate can unlock all the business potential of the products.

# 1.3 ASSIGNMENT

Given the problems and bottlenecks described in chapter 1.2, the focus of this project is to propose: Create a vision (2030) for the Department of Data Warehousing and Sensoring of ARS T&TT in the ITS market and develop the roadmap to achieve this vision. Furthermore, design the product and marketing strategy of the Traffic Data Warehouse to position the TDWC into the market properly.

At the end of this project I would like to deliver two deliverables to ARS T&TT and the TU Delft:

1. A strategic roadmap visualizing the future developments of the Data Warehousing and Sensoring department.

2. A marketing strategy of the product including an operational marketing plan and a future-proof business model.

# 1.4 APPROACH

This chapter describes the methodology and the methods of this project. First the steps and sequence to the final marketing strategy are described, than the methodology is explained. The project consists of three phases which are presented in Figure 4. In the following paragraphs we will discuss three phases: Research and analysis, Product strategy and Marketing strategy.

**1. Research and analysis; Investigating the ITS market**

The first phase of the project consists of an investigation of the ITS market using different analysis-methods. The 4 Cs analysis (Company, Competitor, Context and Customer) is the framework for this investigation. This framework contains a clear overview of the market analysis. Part of the data (Company, Competitor and Context analysis) is investigated using desk research and deeper data is gathered using internal interviews (Customer analysis). Subsequently, the customer value canvasses and a SWOT-analysis combines the information to find interesting gaps and insights. The analysis provides the knowledge needed for both the product strategy and the marketing strategy.

**2. Product strategy; designing a strategic roadmap**

In the second phase the product strategy is designed and visualized as a strategic roadmap (Simonse et al., 2015). The first step when making a roadmap is creating the product vision. A clear vision provides

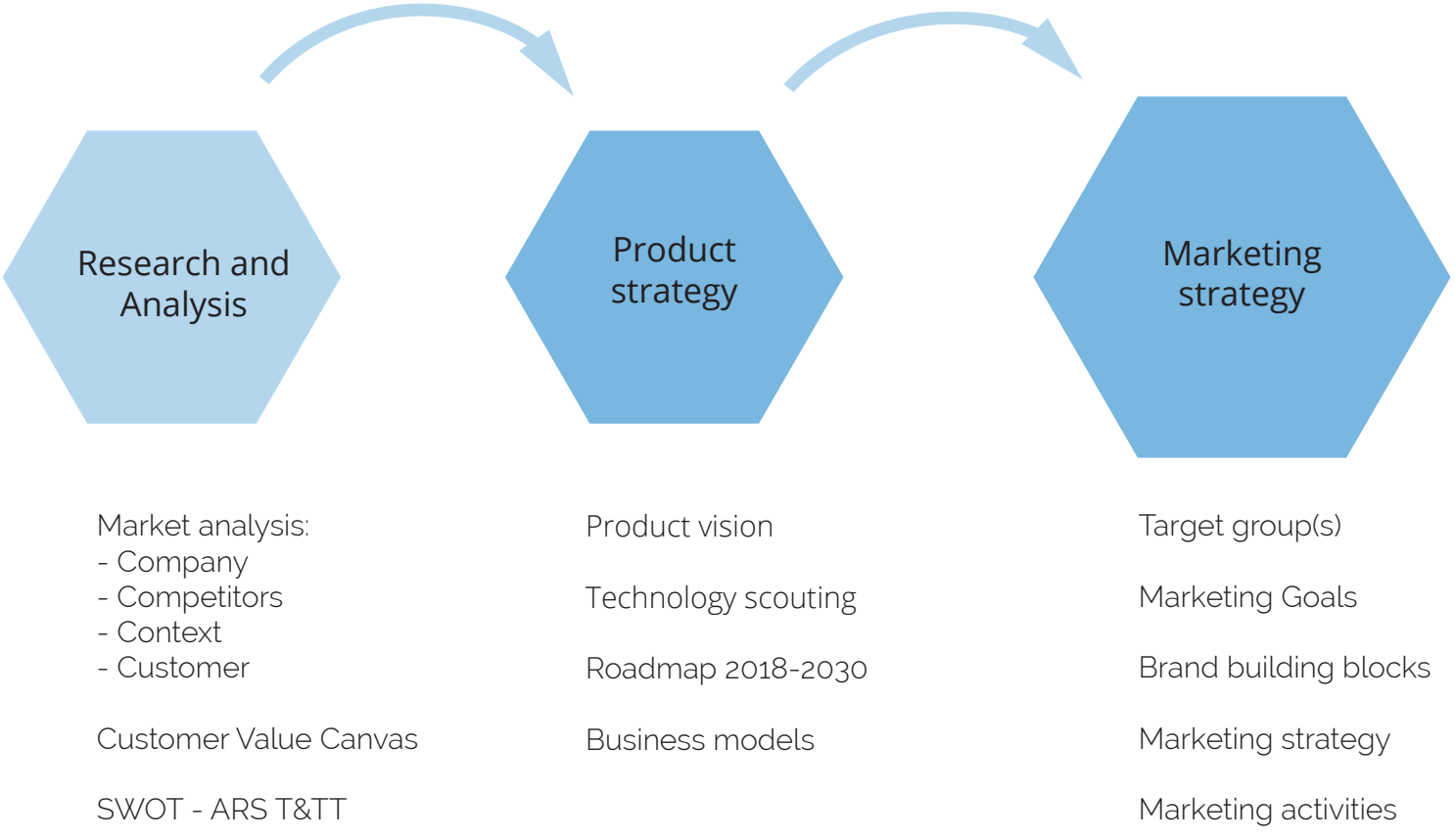


*Figure 4. The sequential block diagram of the proposed approach.*

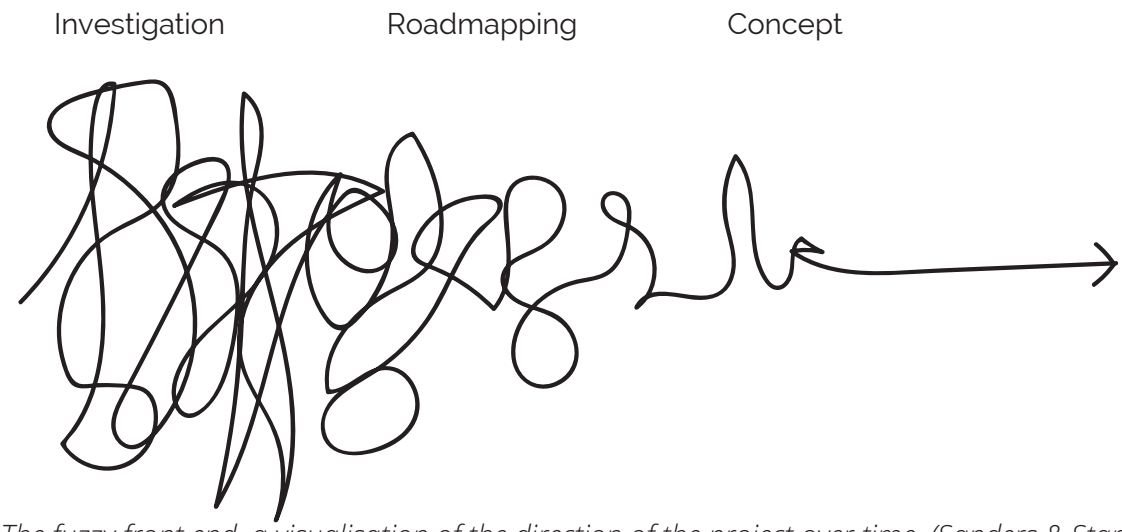


*Figure 5. The fuzzy front end, a visualisation of the direction of the project over time. (Sanders & Stappers, 2006)*

direction to all the people involved in the project (Lynn and Akgün, 2001). After that, the roadmap is constructed with the relevant market, product and technological developments included. The goal of the roadmap is to inform project team members and the company about the development of the product. The roadmap time line is set from today until 2030. This time line is chosen because the market is changing in the coming years. Automated vehicles are probably emerging on the road by 2030. The roadmap shows the way ARS T&TT should react on this changes in technology. This way ARS T&TT is ready for the disruptive changes in the market in 2030. The viability of the roadmap is checked using business models. Different scenarios are created and the business modelling helps to find a way ARS T&TT can play a role in those future scenarios.

**3. Marketing strategy: three pathways to increase market share**

The analysis and the product strategy influences the marketing strategy. A literature study on the implementation of a platform like this is needed to gain specific knowledge about these kinds of product implementations. The marketing strategy contains several paths to reach the marketing goals. The target groups are dependent on the customer segmentation made earlier in the process. The marketing plan describes how to target all groups in a tactical way.

Even though it seems that the design process sketched in Figure 4 is a linear process, it is not. The phase of the design process in this project is the so-called fuzzy front end, showed in Figure 5 (Sanders & Stappers, 2006). Similar as the line in the Figure, the project is going into a lot of different directions in the beginning. As the project progresses further, the direction which it is heading becomes more clear. In this design process the direction is not always in the same direction as the final solution is. Sometimes a step back is necessary to find the best ideas to go on in the project.

Besides, the project is also fitting the Double Diamond model created by the Design Counsil (2006) shown in Figure 6. During a design process diverging and converting is a common activity. In general a diverging step is a part in the process where choices are created. A converging step is a part in the process where the choices are made. In this design process the start is the project brief. This describes clearly the goals and assignment of the project. After that the project start diverging to investigate the context of the problem. Then the project is converging into a clear product vision (road to the future). After the vision there is a diverging part again to find out what possibilities are available to reach the vision, there are several business models developed in this step. And then the final converging step took place to deliver the marketing strategy for ARS T&TT.

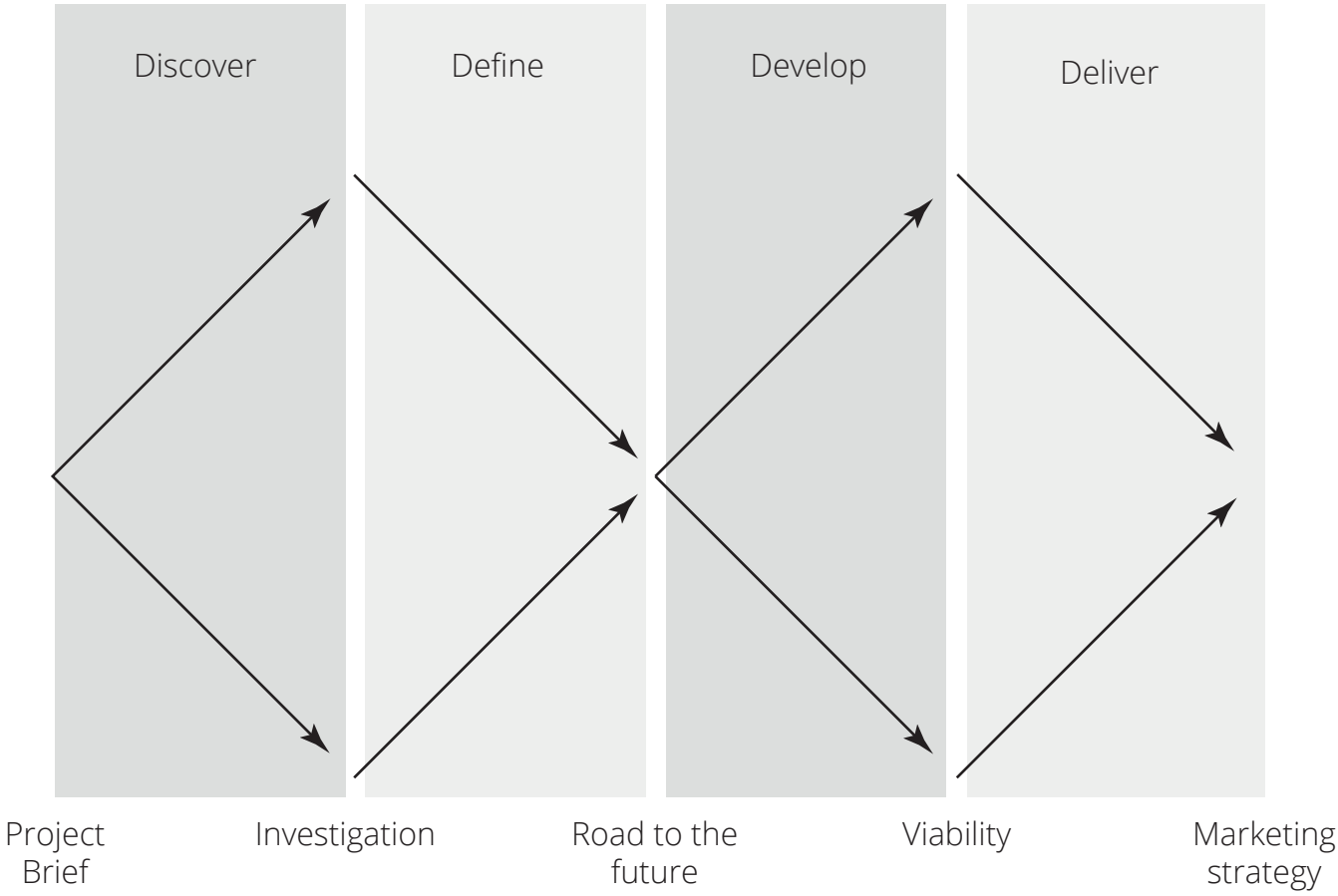


*Figure 6. The Double Diamond model (Design Council, 2006) , converging and diverging during the process.*

# 2. INVESTIGATE THE ITS MARKET

A 4Cs analysis creates a clear overview of the industry ARS T&TT competes in. This method has a broad perspective on how the market looks like (Lehman & Winer, 1997). It contains a framework in which all aspects of the market fit. The company analysis provides insights into the company, the department and the product that this project is about. The competitor analysis provides an overview of competitors in the industry and how they differ from ARS T&TT. The context analysis shows interesting developments and trends in this same industry and the customer analysis shows deep knowledge of the current customers of ARS T&TT as well as the potential customers.

A scope makes it easier to make decisions about what is part of this analysis (Figure 7). For this project the market definition is the following: The ITS market in the Netherlands. The focus of the market is in the Netherlands, because this is the country ARS T&TT is based and most of their customers are here. The scope of this project consist of four circles. The data visualizer ARS T&TT has created, is in the smallest, first circle. The department of DW&S copes with data from road traffic only (second circle). ARS T&TT is doing business in the ITS market (third circle). The fourth circle, the IT market, is included in this scope, due to the fact that companies which have a lot of experience in the IT market are able to step into the ITS market as well. The ITS market is growing fast. According to market analysis, the market grows by 5.65% per year (Marketsandmarkets, 2018). This growth will arouse curiosity in other companies, so it is important to include possible new entrants in this analysis as well.

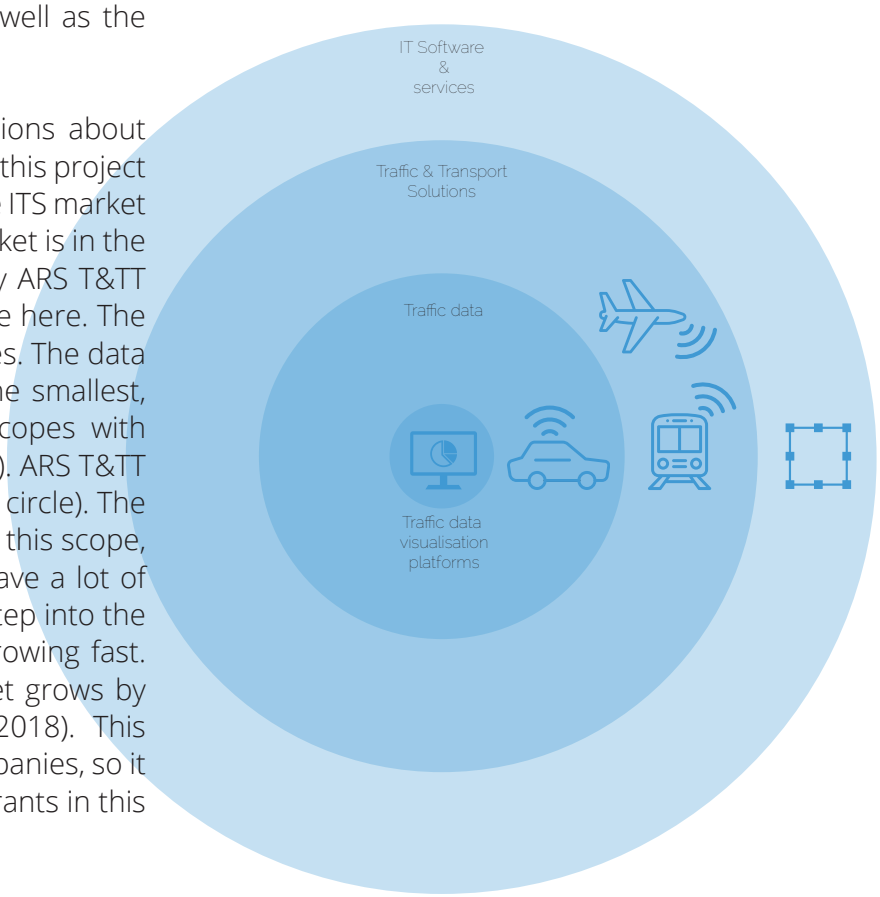


*Figure 7. The scope of the analysis visualised in four circles.*

# 2.1 COMPANY ANALYSIS

The goal of the company analysis is to get an understanding of ARS T&TT. In the end of this chapter the strengths and weaknesses of the company are clear. The analysis describes different levels of the organisation: The company itself, the department DW&S and the product TDWC.

ARS T&TT has been providing traffic and transport technology solutions to businesses and government bodies since 1997 (S1). The headquarters of the company is located in the Netherlands (S2), but it is also operating internationally (India, Europe, North America). ARS T&TT is a technology-driven company; it develops systems for traffic information, route control traffic, dynamic travel information and data warehousing. The company is specialized in intelligent solutions for the market of ITS. Its key areas of specialization include:

- Strategic, tactical and operational consultancy on ITS issues
- Optimization of existing traffic information and traffic management centres
- Dynamic travel information for road traffic and public transport
- Dynamic guidance systems for bus stations and car parks
- Speed limit enforcement (average speed and single point systems)
- Access control systems and enforcement
- Automatic enforcement of restricted environmental zones
- Traffic planning systems
- Road pricing and toll systems
- Fleet management
- 24/7 international monitoring and operation of ITS systems

Currently, ARS T&TT has nearly only governmental customers. Due to this, the organization is used to wait until the customer wants something (via a public tender) and then the organization reacts to this tender and develops what the customer wants (S3). This is a passive attitude towards the market (W2). To keep market share the company must change to a more pro-active company that knows the needs of the customer before they know it themselves. This also means that the marketing capabilities of the company should increase, because there is no marketing department at this moment (W1).

**Vision / Mission (the right to exist)**

ARS T&TT has combined their strategy into a mission statement. Figure 8 shows the key advantages of ARS T&TT its mission visually.

In the world-wide trend of urbanization and growing mobility, the owners of infrastructure face increasing pressure to optimize the utilization and safety of their infrastructure, taking into account the public demand for environmental sustainability and the control of public expenditure. ITS will be a vital part of the solution since that is cheaper, faster to implement and in many cases even more effective than traditional methods that deliver capacity and safety (ARS, 2017).

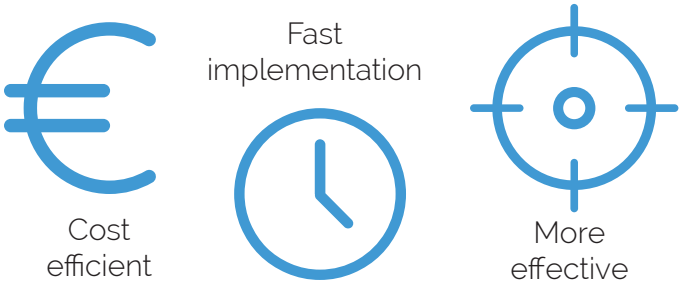


*Figure 8. Mission of ARS T&TT visualised.*

**Department of Data warehousing & sensoring**
The department of data warehousing and sensoring ensures that the huge volumes of real-time traffic data obtained from a variety of data sources and locations are recorded and maintained for traffic management, traffic information, traffic analysis and decision support. With almost twenty years of experience they can provide their customers with independent, reliable and unprejudiced advice for traffic research and data analysis.
Currently, ARS T&TT uses the different types of sensors (video, loops in the road, blue tooth, GPS, radar and FCD) as sources for its traffic data warehouse.

ARS T&TT has implemented traffic monitoring and data warehousing services for a multitude of clients since 2003. NDW is the most extensive example so far, with nearly 10 million traffic data updates per day from locations all over the Netherlands (S4). Online data services for NDW include information on traffic intensity, vehicle classification, speed and estimated and realized travel times. NDW covers nearly 10,000 km of motorways, national roads and urban roads. The data from NDW is distributed to all traffic information service providers and major road operators in the Netherlands.

Below, Figure 9 presents the end-to-end system the department of DW&S is responsible for. The sensors are the input for the data warehouse of the department (S5). The data warehouse shares its information with the data viewer and with other systems. The department is responsible for both outputs.

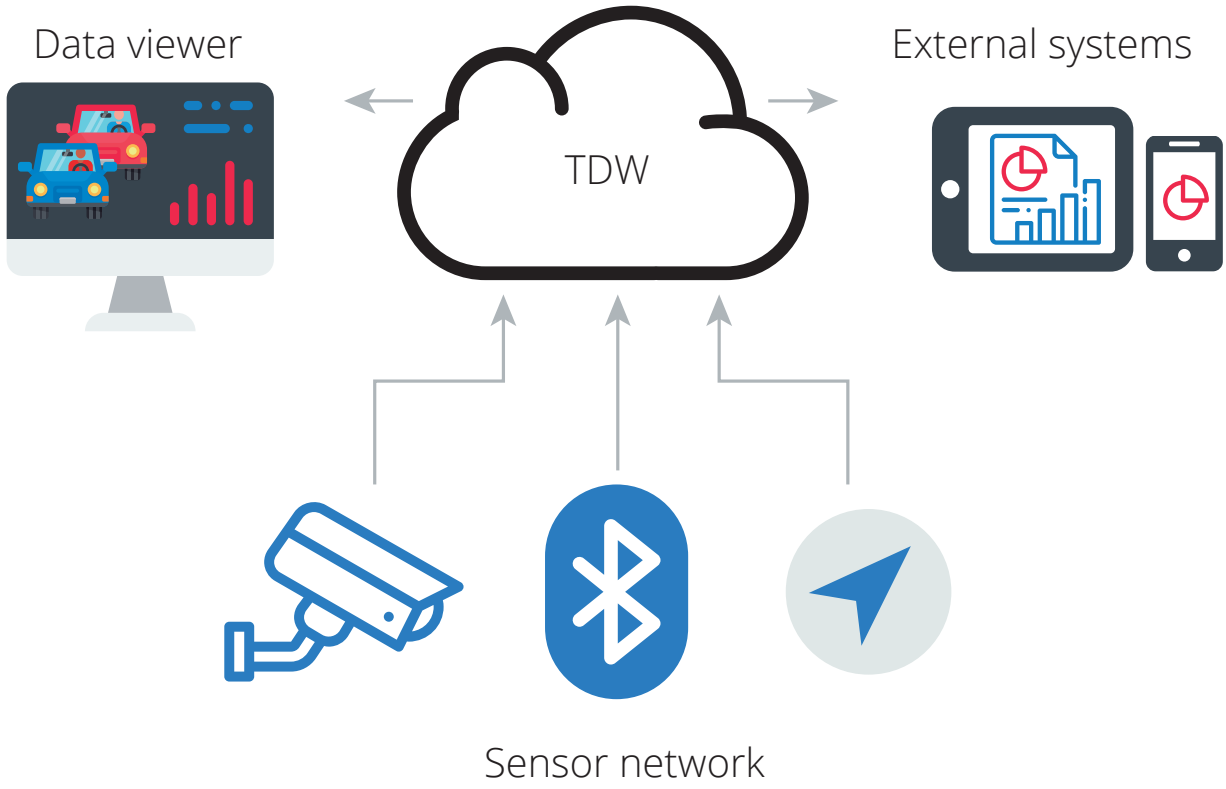


*Figure 9. The end-to-end data system the department of data warehousing and sensoring is responsible for.*

**Traffic Data Warehouse Cockpit**
TDWC is a visual analytic framework providing an overview of traffic conditions via interactive functionalities. Besides its statistical data visualization, TDWC provides comprehensive data analysis and predictive models, supporting insightful decision-making by road authorities. TDWC is designed with the help of a modular database that makes it flexible and scalable when introducing new features and new multidisciplinary data. This will also promote the development of correlation analysis models, where various stakeholders can enjoy insightful analysis.

The advantages of TDWC are summarized:

- User-friendly and self-managed service
- Fast and focused multi-level analytic
- Data analytic governance
- Advisory support for decision making for smart mobility policy implementation
- Customized visualization
- Enterprise reporting

The functionalities of data platforms are divided into three categories: operational features, tactical features and strategic features. Strategic features help policy makers understand why incidents happen on the road. Strategic functionalities are the most complex functionalities with the use of crossed data. Operational features support short-term decisions, for example to check where cars are violating the speed regulations. Tactical features are in between these two functionalities. They support decision-making about how to solve incidents that shows up.

At this moment the data visualizing platform of ARS T&TT has only operational features, but the platform is going through continuous enhancements to improve the platform. A strategic product roadmap is needed to decide on which tactical or strategic functionalities should be added and in which order.

# INSIGHTS

S1 - ARS T&TT has a strong network regarding road authorities in the Netherlands

S2 - ARS T&TT has a stable position in (at least) the Dutch ITS market

S3 - ARS T&TT is strong in writing tender offerings, they mostly win on quality (but is not the cheapest)

S4 - ARS T&TT has an excellent network with sensors at the Dutch roads

S5 - ARS T&TT has its own data warehousing centre with data

W1 - ARS T&TT has a lack of marketing experience in the company

W2 - ARS T&TT is used to a passive attitude toward the market.

*These codes refer to strengths (S), weaknesses (W), opportunities (O) and threats (T) derived from this analysis. In chapter 2.5 the SWOT-analysis combines all the insights.*

# 2.2 COMPETITOR ANALYSIS

This competitor analysis provides an overview of 14 competitors that are operating in the Dutch and international market. This results in a better understanding of the position of ARS T&TT in the market, because the differences between ARS T&TT and the competitors are clear.

ARS T&TT is operating in the Dutch ITS market. This analysis has started with a broad viewpoint to verify that no main competitors are overlooked. Later in the process the number of competitors narrowed down to the ones that have the most overlap with TDWC. The main question of the competitor analysis is to see how ARS T&TT can differentiate itself from its competitors. Alongside that, the competitor analysis also gives an overview of the market. The competitors within this analysis are chosen based on the company its Business Plan (ARS T&TT, 2017), NM Magazine (a trade journal of the ITS market in the Netherlands) and conversations with different ARS T&TT employees. The selected companies compete with ARS T&TT on size, target market and competences. Companies that are a lot smaller, for example start-ups, are not taken into account. They are not seen as a direct threat yet, because of their size.

**Competitors in the Dutch ITS market**

Figure 10 shows all 14 selected competitors operating in the Dutch and international market that provide a clear overview of the market. First, four quadrants divides the competitors into groups, based on the size of the competitors and the existence of a traffic data visualizer within its company. After that, the companies are compared to each other regarding these six criteria:

1. Does it currently have similar clients as the data warehousing department of ARS T&TT?
2. Is it active in the same geographical market as ARS T&TT (in the Netherlands)?
3. Does it have its own data warehousing (instead of external data)?
4. Does it have experience in other markets than the ITS market?
5. If it does have a traffic data visualizer, is it similar to TDWC?
6. Does it have its own hardware system?

The questions are based on Chen (1996) his theory about market commonality and resource similarity. Chen states these two characteristics can compare competitors better.

The information needed to answer these questions comes from open websites (Internet) and from information available within ARS T&TT. Appendix B shows a description of all competitors mentioned in this overview. The overview is filled with plus and minus signs depending how they fit the given criteria. The next paragraph explains how the table is filled with an example of Be-Mobile.

Be-Mobile, in the first column, is targeting governmental road authorities, like ARS T&TT does, so it received a double plus sign. Be-Mobile is mainly operating in the Belgium market, but also active in countries around them. Because of this they received one plus sign for the second criterion. Be-Mobile uses only floating car data (FCD) to perform its analysis. This is different from ARS T&TT, although the amount of floating car data they use is substantial. Due to the different sources in data Be-Mobile received a +/- sign for this criterion. The fourth criterion is the experience of the company in other markets. Be-Mobile only focuses on the ITS market and so they received a double minus sign for this criteria. The fifth criterion checks if the competitor has developed a data visualizer. Be-Mobile does have a data visualizer, but it is not similar to TDWC, because it shows different information to different target groups. Therefore this criteria received a plus sign. The last criteria compares the hardware systems with the systems of ARS T&TT. Because Be-Mobile does not use stationary sensor hardware they received a double minus on this criteria. This same reasoning is done for all other competitors in the overview. In the end, the CEO of ARS T&TT has validated the overview to make sure no wrong interpretations of the data are made.

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| 4. experience | - - | + | + + | - |
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| 4. | + + | + | + | + + |
| 5. | - - | - | +/- | - |
| 6. | + + | - - | + | - - |

*Figure 10. Competitors in the Dutch ITS market, an overview.*

The competitors with the most similar characteristics and resources as ARS T&TT has, are the most competitive to ARS T&TT in the market of the traffic data visualizers. The further analysis focuses on those companies to verify what the strengths and weaknesses of ARS T&TT are, compared to those competitors.

The more profound research is done with: Technolution, Vialis and Sweco. Technolution and Vialis have the most commonality in product features and target market compared to ARS T&TT. Sweco has less commonality, because they have no similar data visualiser as ARS T&TT has, but they do have experience in other markets. This experience is valuable for them, because they could use that to build a data visualiser faster than ARS T&TT or other competitors in the ITS market are capable of.

Next to the three biggest competitors Figure 10 also shows that a lot of companies exist in the Dutch ITS market, that ARS T&TT can not ignore. Besides, the same number of companies can jump in the ITS market quite easily, because of the strong resources they have. Technical start-ups could be surprising competitors, or opportunities for investment, as well in a few years. They are not comparable in size yet, but innovative start-ups can be promising for the future. Nonetheless, start-ups are not taken into account in this analysis due to size difference.

**Review of the data visualisers**

The main question for the competitor analysis is 'What are the commonalities and differences between ARS T&TT and its competitors?' This provides ARS T&TT a clear overview of the differences between itself and the competitors, so it can differentiate itself from its competitors regarding the positioning in the market. Furthermore, it contributes towards decision making about the future directions of its product portfolio.
The following sub-questions support the main question. The answers discuss the position of ARS T&TT and its competitors in the market

- What are the features of the data visualizer?
- Where is the data coming from? Which kinds of sensors?
- Who is the main target group of the data visualizer?
- How does the company position the product into the market?

First, the product of ARS T&TT is described and subsequently, the products of the competitors are described. Finally, the conclusion discusses the similarities between the companies.

ARS T&TT – TDWC

TDWC is an operational dashboard that visualizes traffic data. The most important data it shows are: speed, intensity, traffic composition, speed violations and locations. The platform is not finished at this point, it is going through consistent involvement and enhancement. The data is coming from traffic video sensors, loops in the road, blue tooth sensors, GPS and radar. In the future floating car data and data from external parties will be added. The main target group of this product are the police and the local and central governments. The product is not positioned into the market yet.

Technolution – Moby Maestro

Moby Maestro focuses on the smart city. The platform controls all roadside equipment, like traffic control systems, parking displays, communication displays and cameras. The platform is build for operating and controlling the city, not for strategic or tactical analysis. The target group of the platform are Dutch municipalities. The product is positioned in the market as a real time, modular, controllable traffic management system (Technolution, 2018).

Vialis – Verkeer.nu

The features of Verkeer.nu also focuses on the traffic management of a city. The platform manages the traffic control systems of the city. The platform is a visualized dashboard in which the city government analyzes its traffic intersections or monitors its policy goals (Verkeer.nu, 2018).

Sweco – iCentrale

The platform of Sweco focuses on the controlling of

bridges, tunnels and locks. At the moment there are 150 decentralized control centers in the Netherlands. ICentrale wants to make them smarter, so that less control centers are needed to be managed by less people. It is a more time efficient way of working. The data used in iCentrale is coming from stationary sensor systems at the controlled bridges, tunnels and locks. (Loos and Westerman, 2017).

The four compared data platforms are quite different. Although, the exact target groups and features are not the same, all platforms are build to be used by the local governments (T1). TDWC should position itself clearly to show the differences between itself and the other platforms, so that no confusion will arise for the customers.

International market

This competitor analysis so far gave an overview of the Dutch ITS market. The Dutch ITS market has developed well, partly because of the umbrella organization (NDW) that cooperates with a major part of the road responsible governmental organizations in the Netherlands. ARS T&TT has a lot of experience in this well-developed ITS market, so it has opportunities to use its knowledge and experience in countries around the Netherlands. An overview of the European market helps analyzing the opportunities of ARS T&TT in Europe. The following questions are answered:

- Does a similar organization as NDW exist in the country?
- Can key partner companies be identified for ARS T&TT to get in contact with in this country?

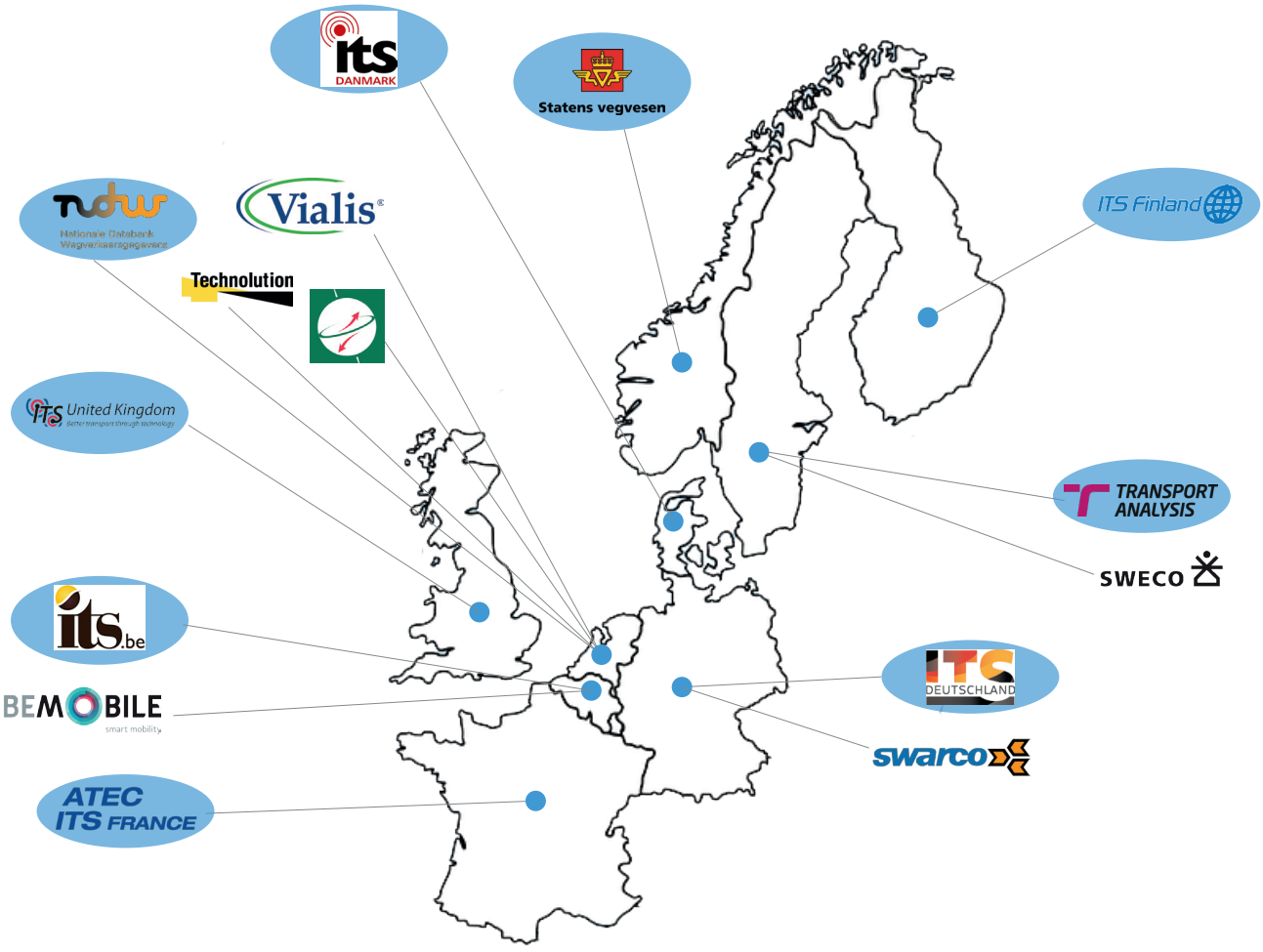



*Figure 11. An overview of the international key companies and ITS umbrella organizations.*

The countries that this analysis focuses on are: United Kingdom, Denmark, Sweden, Finland, Norway, Germany, France and Belgium. These countries are close to the Netherlands and they are well developed in general. Figure 11 shows the overview of this analysis. The logos with a blue circle around them are the umbrella organizations of the country. All countries do have such governmental organizations, but all of them seek for improvements of this type of organization to encourage collaboration between local and central governments (O1). The companies showed at the map that are linked to the countries are companies with a great market share in that country. These companies could be interesting for ARS T&TT to connect to, so they can see if collaboration in that country is possible. In further research a deeper dive is needed to see which countries are the most interesting to step into. The earlier experiences of ARS T&TT in those countries are very important for this analysis.

**Motivated countries**

Due to different reasons some countries are more motivated to adapt new ITS projects than others. In France, the UK and Belgium an extra motivation is found in this research (O2). In the other countries these motivations could also exist, but there is no information found about this.

France

Since 2010/2011 France strongly promotes ITS projects in the country. The French Ministry started a national transportation infrastructure plan, together with local associations at regional levels. The topics they focused on were:

- Optimization of the use of roads
- The use of traffic and travel data
- Security and road safety
- Management of traffic and merchandise transportation
- Technologies linking vehicles and infrastructures
- The development of technologies at the service of the elderly and people with reduced mobility

France really wants to unite the businesses, researchers, communities and state services to build a stronger ITS network (Export, 2016). ATEC ITS France is the recently coordinating organization of the ITS market in France. They are implementing Mobility 3.0, a plan that brings ITS companies together and that is initiated by the French Ministry of Transport and Economy.

United Kingdom

According to a report from the World Economic Forum (WEF, 2016), the United Kingdom is scoring relative high (9th position) regarding their total infrastructure, but much lower regarding their road infrastructure (29th position). The infrastructure on the road can be improved. This could be an interesting opportunity for ARS T&TT.

Belgium

According to European statistics Belgium has a higher death rate by road accidents than the other countries around Belgium. The death rate in the Netherlands is more than twice as low as the death rate in Belgium; 3,1 deaths caused by road accidents per 100.000 persons in the Netherlands and 6,5 in Belgium (Eurostat, 2015). These statistics can encourage Belgium to invest in more Intelligent Transport Systems.

The competitor analysis creates a thorough overview of the market ARS T&TT is playing in. The Dutch ITS market is quite saturated at this moment, but it is also working in a unique collaborative way (T2). Many other countries can still improve this.

# INSIGHTS

T1 - In the Netherlands, several companies invest in a visualiser for traffic data. However, they do not have exactly the same target group as ARS T&TT is having.

T2 - The Dutch ITS market is saturated, looking for opportunities in other countries is interesting.

O1 - In Europe, multiple countries do have an umbrella organisation to collaborate with the ITS in the country, but not as excellent as The Netherlands has.

O2 - France, the UK and Belgium have interesting motivations to invest in their smart infrastructural solutions.

# 2.3 CONTEXT ANALYSIS

The context analysis identifies potential business opportunities in the context of the ITS market. The analysis follows the DEPEST checklist, to make sure the overview is complete (Kotler & Armstrong, 1996). DEPEST is the abbreviation of Demographic, Economy, Political, Ecology, Social and Technology. The following chapter describes current trends, that could have influence on the ITS market.

**Demographic**

O3 - Urbanization / smart city

The upcoming smart cities do have a lot of influence on the ITS market, because the infrastructure is part of the city. 'Smart city' has different definitions on the Internet. In this scope the most important aspect of a smart city is that the city government is solving their ordinary problems, while using more and more data coming from different sources throughout the city. Due to urbanization, cities are getting more complex with different types of transport, interconnected citizens and lots of businesses and utilities (Neirotti et al, 2014). The growth of the population also increases the number of technical or organizational problems (traffic congestion and pollution for example).

**Economy**

O4 - Lean and agile supply chain management

Optimized travel information is highly relevant for companies that are managing lean or agile supply chains. Practices that can be improved when having accurate data information are:

- Flexibility of the transportation
- Using knowledge of the road users
- Waste reduction of time or emissions

In order to meet the customer demand efficiently and effectively, organizations integrated various supply chain methods. An innovative method for the supply chain market is the agile supply chain (Cicculo et al, 2017). Companies like Amazon and Aliexpress use this supply chain methodology to be more flexible and be able to quickly adapt to changing situations (new technology or economic changes). Another methodology is the lean supply chain, this is a method to eliminate waste or non-value steps along the chain. Lean supply chain is more applicable in stable, predictable business environments than agile supply chain.

O5 - Online groceries

Traffic data can help the e-commerce company reach the expectations of its customers by providing information coming from the infrastructural sensors. Doing groceries on-line is getting more popular every year. In 2017 25% of all groceries were ordered from a digital device in the Netherlands, in contrast of 19% in 2016 (CBS, 2017). Customers of the delivery services appreciate transparency in delivery. They want to know where their order is at specific moment and at what time the order will arrive.

**Political**

O6 - Environmental law in The Netherlands

The new environmental law in the Netherlands takes into account that the roads may not cross a maximum noise border, a maximum smell border and the air quality needs to be above a certain point. The controlling of this new rule will start in 2021 via data. The data ARS T&TT is gathering already (intensity and speed) can help while monitoring these values. (Rijksoverheid, 2018).

**Ecology**

O7 - Sustainability

In the market of infrastructure sustainability is important, since the total amount of traffic has a big impact on the environment. The sustainability trend will push the market to change. Sustainability is getting more popular in all kind of directions. Millennials wants to pay more if the brand or product has sustainable offerings (Nielson, 2015). Businesses are reacting on this development by putting the sustainability higher on the management agenda. Other trends, like zero waste, circular economy and lowering the foot print, are increasing in popularity.

**Social**

T3 - Open source / sharing economy

The shared economy trend is noticeable on the

road. According to a predictive article of PWC 35% of the cars on the road in 2030 will be shared cars (PWC, 2018).
'Shared economy' is an umbrella concept of different concepts. Examples of these concepts are collaborative consumption, collaborative economy, on-demand economy, peer-to-peer economy, zero-marginal cost economy and crowd-based capitalism. Selloni (2017) distinguishes four drivers that supports the emergence of the shared economy.

- Technology, fast communication between individuals and easy communication between communities facilitate the shared economy.
- Environmental concerns, issues around global warming, acid rain, air pollutions are growing.
- Global recession, the most popular perceived benefit of sharing is saving money. This benefit will gain importance in times of recession.
- Community, direct contact among people who live in the same area but do not interact is stimulated by the online network.

**Technology**

O8 - Blockchain

Bitcoin is the digital currency that started using the blockchain technology. The blockchain technology behind the digital currency can be applied in other fields as well (Swan, 2015). The technology is already in widespread use in finance, secure voting and authenticating academic credentials. In the coming year also healthcare, manufacturing, supply chain logistics, and governmental services are among the sectors most likely to embrace blockchain technologies (Opensource.com, 2018). Blockchain has a lot more potential markets in which can adapt the technology, including the ITS market.

Technically, blockchain can be defined as a kind of decentralized shared register that uses chronological encrypted and chained blocks to store verifiable and synchronized data across a peer-to-peer network. Figure 12 visualizes the differences between a centralized network, a decentralized network and a blockchain network. Blockchain uses a distributed network to ensure the security. The key advantages of this technology are decentralization, trust, security, chronological data, collective maintenance and programmability. According to Yuan (2016) blockchain has the full potential of establishing a secured, trusted and decentralized ITS. The ITS market is trending towards a centralized market, therefore the security risks are increasing. In order to help the ITS market maintain its overall stability, profitability and effectiveness, there is a need to develop a secured, trusted and decentralized

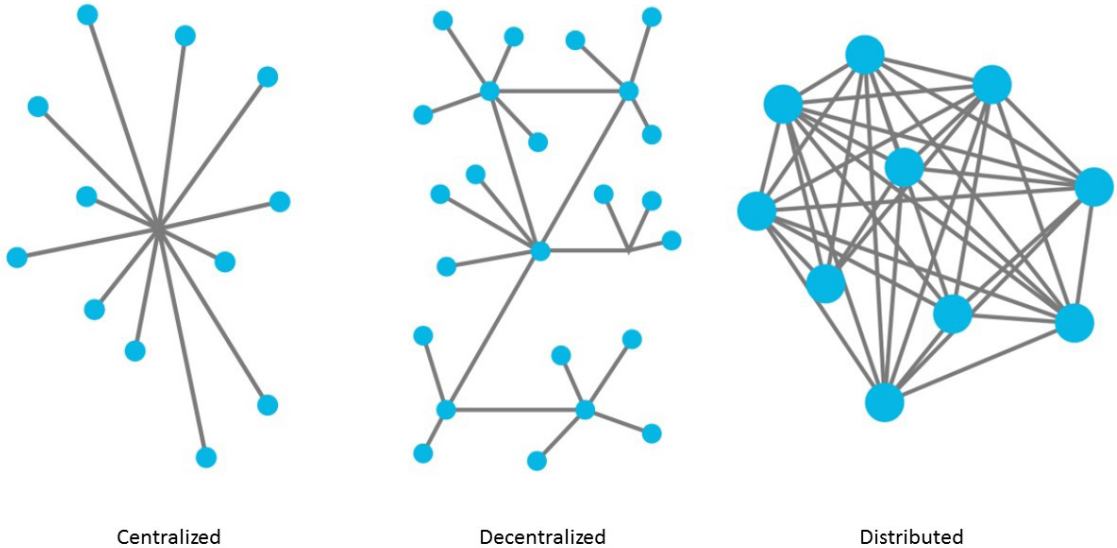



*Figure 12. Blockchain uses a distributed network, to ensure the security of the network.*

architecture. Blockchain can be the solution for this (Yuan 2016).

O9 - Developments in the area of connectivity
The connectivity of the end-user is increasing rapidly. More people are possessing a smart phone with Internet and these people are buying faster Internet. This facilitates a shift from roadside sensor systems to in-car services and services for the end-user. Not only the people, but also products are equipped with Internet (IoT) more often. The number of SIM cards for devices such as garbage bins, alarm systems and smoke detectors communicating over the Internet has risen from 1.2 million in 2013 to almost 4 million at the end of 2016 (Ministerie van Infrastructuur en Milieu, 2017).

O10 - Roaming data in the EU
Since 2017 people do not have to pay extra for phone-calls, SMS and mobile data traffic when they are traveling in the EU. This development makes the connectivity in Europe more accessible and stimulates real-time communication for ITS services, for example.

O11 - Internet of Cars
Self-driving vehicles and smart cars are connected with the Internet and GPS all the time. This means they send data to at least one platform all the time. This data type is called FCD. Also the data coming from smart phones or car kits are also part of this FCD, but these devices can be turned off, or are not always connected with GPS. Business Insider predicts that in 2021 82% of all cars are connected (Meola, 2016).

T4 - Cooperative ITS
Via long distance communication systems (3G/4G/5G) vehicles, public transport, traffic lights, sensors or other beacons can communicate with each other. This is called Cooperative ITS or C-ITS (Ministerie van Infrastructuur en milieu, 2017). A lot of new applications are available with this new technology. For example real-time advise to the driver about lane choices or construction zones. Hereby the driver its view is extended with information he cannot see directly. When individual road users can anticipate each other better, the travel times will be reduced and the road safety will be increased.

O12 - Modeled car data
Modeled Car Data (MCD) is a new data source for traffic information. A real time traffic model is connected with existing data, so individual vehicles can be followed (van der Bijl and Henkens, 2017). MCD is a combination between FCD and stationary sensors.

O13 - Electric cars
According to a predictive article of PWC, 40% of the cars on the road in 2030 will be electric cars (PWC, 2018). Almost all car manufacturers are investing money in the manufacturing of electric cars/vehicles. One of the current manufacturers of full electric cars is Tesla, shown on the next page. Electric cars has other needs and behavior. For example the car needs to charge its battery. And due to the electric motor the car can accelerate faster. This will have influence on the infrastructure and traffic models.

## INSIGHTS

All trends mentioned are relevant in the ITS market. ARS T&TT should keep them in mind when making decisions for the future.

During this project these trends are being used to come up with the future vision of the product and to build a roadmap for the department of sensoring and data warehousing. The trends are labeled in the text.

# 2.4 CUSTOMER VALUE MAPS

To get more insights in who the current customers of the traffic data are and who possible future customers can be a customer analysis is done. This analysis focuses on two questions:
- Who are the current customers of the data warehousing department?
- Who are future customers of the department? In what direction can this department grow?

The current customers gives good insights how the data is used today. This will help understand what the current customers value. These values are interesting, because future customers could value the same things, but are not using the services and products of ARS T&TT yet. This analysis shows a first ideation of possible customers in the future.

**Methodology**
In order to get a clear overview of the current customers of the data warehousing department of ARS T&TT the Value Proposition Canvas is used (Osterwalder, 2014). This canvas focusses on the customer profiles and the product features, see Figure 13. After filling in both sides a good fit should be developed to find the right product features to solve the benefits of the customers. The customer analysis focuses on the right side, the customer profile, of the map. The customer profiles shows the benefits the clients of ARS T&TT get from the products and services the company is delivering today. Together with the value proposition of the products and services this customer profile is the Value Proposition Canvas for a specific value proposition. The Value proposition and the customer profile interacts with each other through a so-called 'fit' between the two parts. If the customer profile is changing in the future, ARS T&TT should change the products and services they are delivering to find a new 'fit' between the needs of the customer and the products/services of ARS T&TT. Another scenario is that the wishes and needs of the clients do not change, but that the products of ARS T&TT are improving, due to technological developments. In this case the fit will change as well. The fit should be created before new products are developed, to make sure the customer is satisfied with the new technologies.

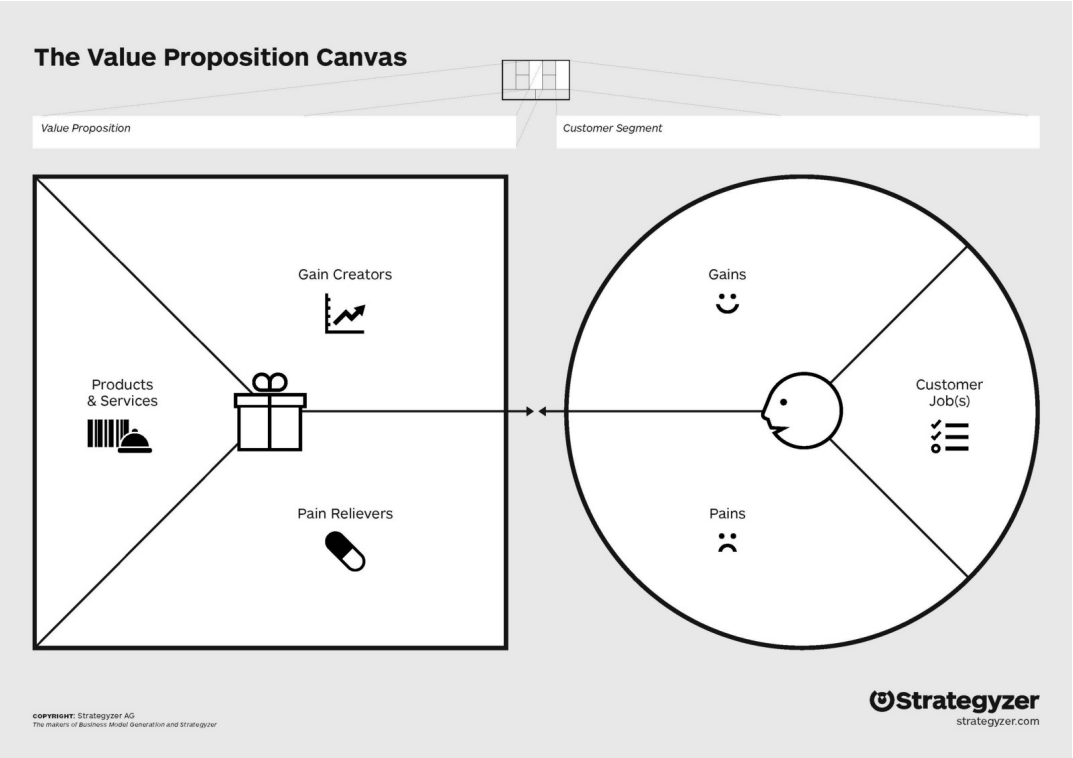



*Figure 13. Value Proposition Canvas of Strategyzer (Osterwalder, 2014).*

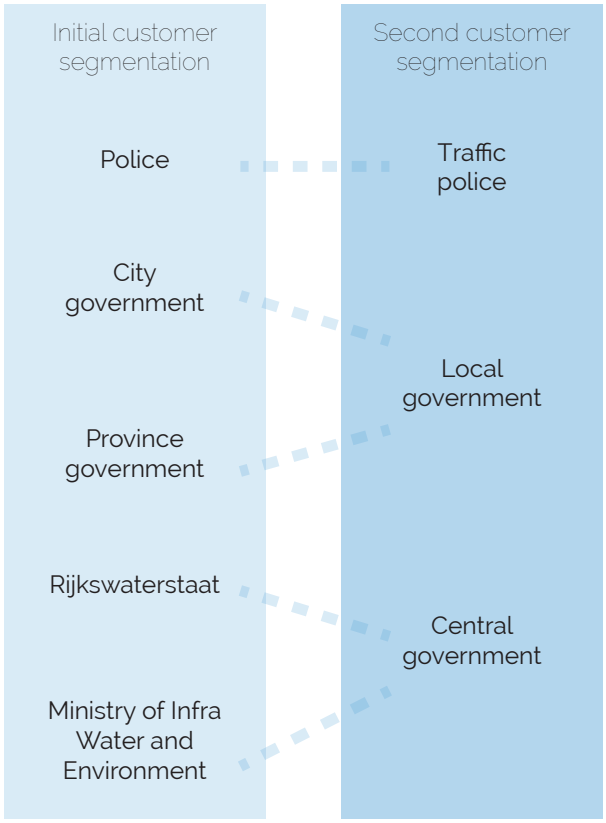



*Figure 14. Customer segmentation, the transition.*

The data warehousing department has different types of customers. Hence a customer segmentation is needed before the canvas can be filled. During the research the segmentations are changed sometimes to find the right set of customer segments according to the benefits for the clients.

To find out what the company knows about their customers one interview with two service managers has been done. Together with them the right side of the value proposition canvas (customer profile) has been filled for five customer segments. The service managers are the two persons of the department of Sensoring and Data Warehousing who are in contact with all clients of the department. Therefore these two persons are chosen for this interview. It is not necessary to interview more people from the inside of ARS T&TT about this topic, because others are not in contact with the customers. An initial customer segmentation is made before the interview took place. The interview is done with the use of an interview guide. The interview guide is presented in Appendix C. The purpose of the interview was to find out the current customer values. The interview is started with a short introduction about this project and the reason why the interview took place. After that the customer segmentation is discussed and for each segment the Value Proposition Canvas is filled. Osterwalder (2014) provided guiding questions for each part of the profile, this is used during the interview.

**Results**

After the interview, the customer segmentation changed from five into three categories (see Figure 14). The city government and the province government are combined into one segment; local government, because they nearly have the same jobs, pains and gains. According to the interviewees another group fits this segments; the regional government like Metropole Rotterdam Den Haag. (MRDH). These regional institutions are responsible for the connecting roads between cities. They collaborate with the city governments so that the budgets of both organisations add to develop these connecting roads. On the other hand the ministries and Rijkswaterstaat merged into one category; central government. Different from the local governments they are responsible for all roads in the Netherlands, also for the roads the local governments has responsibility for. The last category stays the same, the traffic police. The values of this

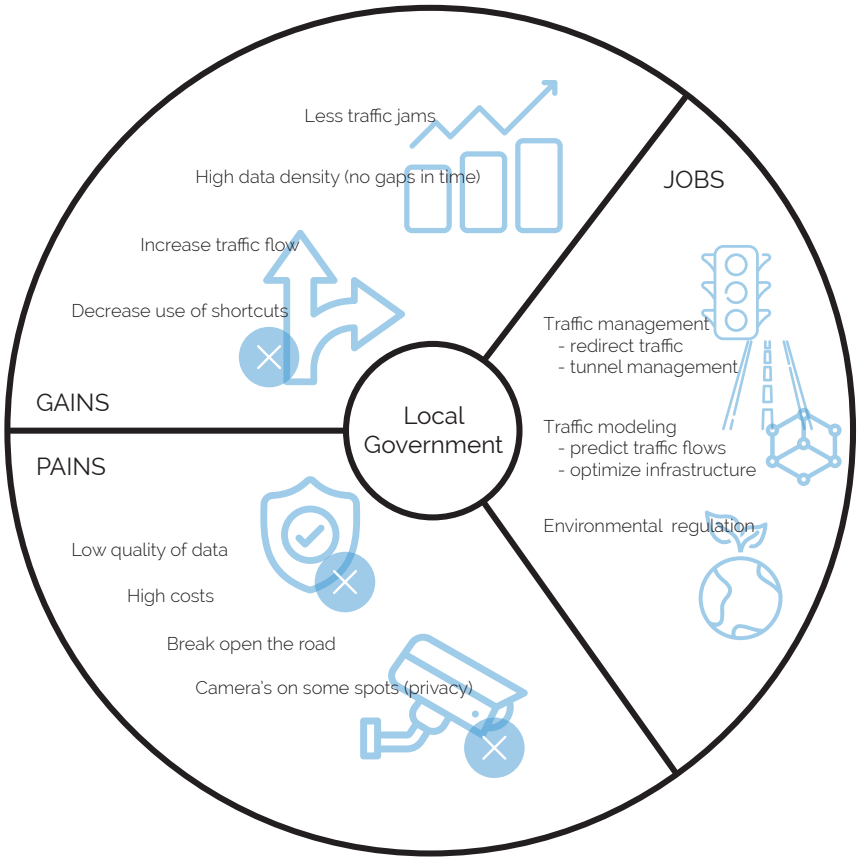



*Figure 15. Customer profile of the local government.*

category are very different opposed to the values of the local and central government.

Figure 15, 16 and 17 presents the three customer profiles, according to the service managers of ARS T&TT. The next paragraphs discusses the three customer profiles.

*Local government*

The local government is responsible for the traffic management of their part of the road. This includes redirecting traffic (when incidents happen) and tunnel management (managing the number of cars in tunnel). Next to traffic management the local government is also responsible for traffic modelling. This is split in two sub tasks; the prediction of traffic flows and the optimization of the infrastructure. Traffic modelling is a method to improve the traffic flow on the road. The last job the local government is responsible for is the environmental regulation. As already mentioned as a trend in the context analysis, in the future it is mandatory to control the environmental impact of the roads. Some local governments want to know already how much environmental impact the traffic has on their roads.

These jobs are linking with pains and gains. The pains are things that annoys the customer when they want to do their jobs. Gains are things that make them more happy when doing their jobs. For the local government the gains consists of: Less traffic jams, high data density (this means as less gaps as possible in the measured time), an increased traffic flow and a decreased use of short cuts. The connected pains are a low quality of data (T5), high costs, to break open the road (when placing sensors for example) and on some spots they are having privacy issues when placing cameras.

*Central government*

The central government has quite similar jobs as the local governments. The difference between their responsibility is, that the central government is responsible for all the roads in the Netherlands. The jobs they have are also the controlling of the environmental impact and the management of the traffic. Some of the gains are also similar to the gains of the local government: They want to increase the traffic flow and to decrease the number of traffic jams. But they also want a better collaboration between different organisations so that the jobs are done more efficient. Pains for the central government

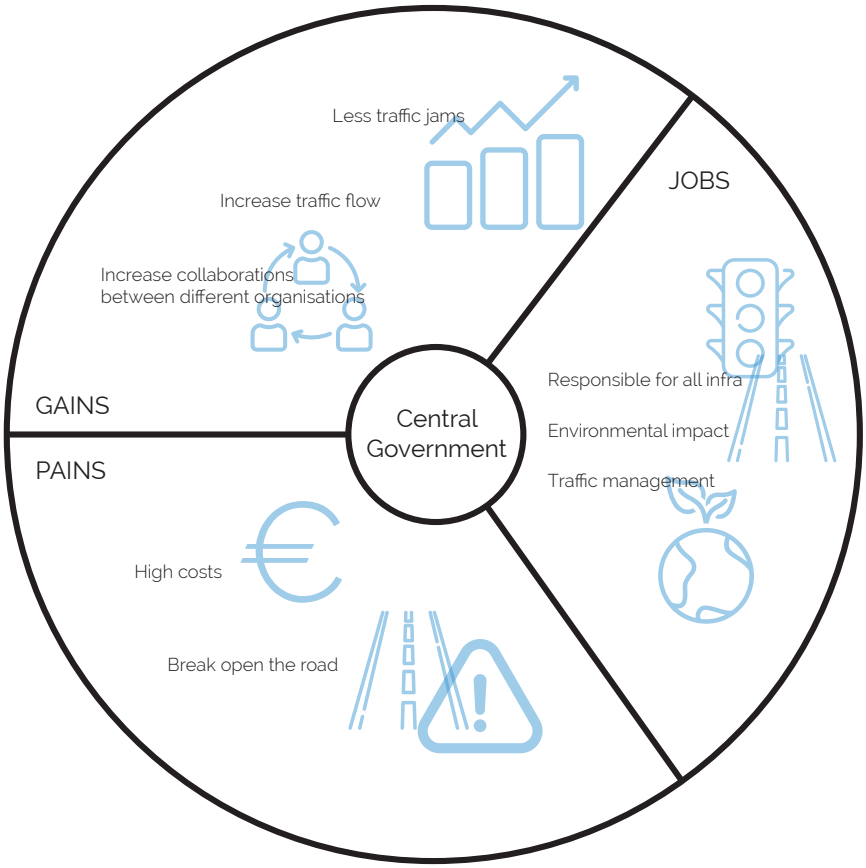



*Figure 16. Customer profile of the central government.*

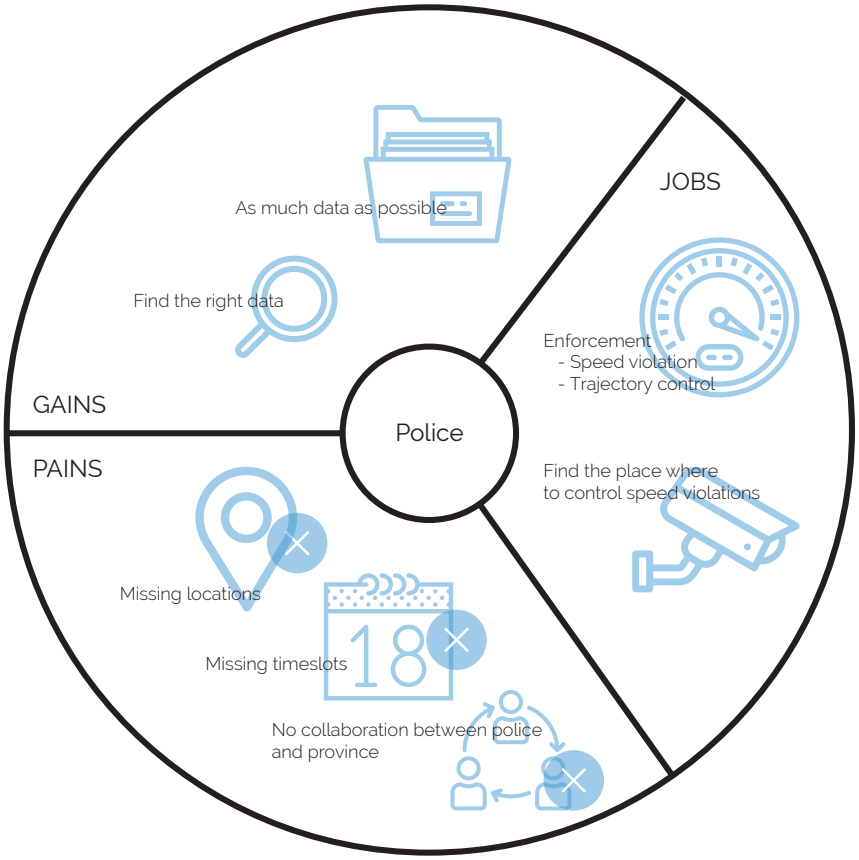



*Figure 17. Customer profile of the traffic police*

are high costs and also to break open the road for placing sensors.

*Traffic police*
The Traffic police is different from other governmental customers of ARS T&TT. The jobs of the traffic police is to enforce the traffic rules and to find places where to control the speed. Enforcement is both controlling single spot speed violators and doing trajectory controls, a speed control over a longer trajectory. The traffic police is not allowed to control traffic wherever they want to. They have to substantiate the reason why they want to control a certain point. Traffic data gives them information to validate their choices for where to control the traffic. The gains of the traffic police are to have as much data as possible (so no location gaps are possible) and to find the right data as soon as possible. The pains of the police are that they are missing locations, they are missing timeslots and there is a lack of collaboration between the police and the province. For example, the police wants more sensors along the road to have less gaps in their data, but the province is responsible for placing the sensors and does not see extra value in more sensors, so they are not placing them. Due to that the police experiences a lot of pains when doing there jobs.

The customer profiles created in this chapter have a fit with the current products of ARS T&TT. This is an interesting start for this project. If products/ services are changing, a new fit should be created, so it is important to look at the values the current customers have again. This way the customer is always involved in innovation.

## Market growth directions

It is important for ARS T&TT to know in which direction they have the best possibilities to grow. According to the growth strategy of Ansoff (Ansoff, 1965) a company has four directions to grow, depending on the market and the products they have (see Figure 18). There are two strategies in which a company can expand its market; market penetration and market development. The Dutch ITS market is developed very well and according to the current business managers of ARS T&TT the market is almost saturated. Therefore market penetration is not the best growth strategy for ARS T&TT anymore. Market development means that the company is going to search for new markets to step in. Two market directions ARS T&TT can step in are interesting Dutch markets other than ITS or ITS markets in other countries. Figure 19 shows the opportunities for ARS T&TT to grow its market as discussed.

Going back to the right side of Figure 18, this shows the directions in market growth with new products or services. There are two directions; new products in existing markets or new products in new markets. The last one is the direction with the highest risk, because both product and market are new. For ARS T&TT it could be interesting to change the products they are delivering, because of the saturated market in the Netherlands. The product strategy later in this report advices ARS T&TT about its product lines.

## Other markets

Together with the service managers of DW&S a short brainstorm has been done to come up with other markets in the Netherlands ARS T&TT could step into. The outcome of the brainstorm are three possible market opportunities: environmental organizations, logistic companies and event agencies (O14). These organisations could value the data ARS T&TT already

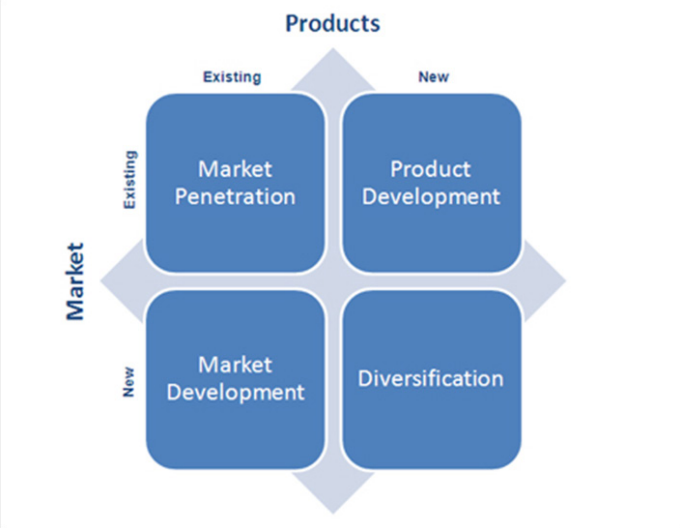



*Figure 18. Ansoff growth matrix (Ansoff, 1965).*

has. This way the product will not change, but only the market is developing.

**Other countries**

The ITS market in the Netherlands is saturated more than in countries around the Netherlands. ARS T&TT can play a major roll in copying the ITS market they have build in the Netherlands. The Dutch governmental organizations united the ITS departments in one organization (NDW). This way the ITS solutions are better cooperated and so they are more helpful for local and central government and also the police uses this system. In other countries this cooperation is less established. In the future this is a big opportunity for ARS T&TT. In the competitor analysis a deeper research is done into the companies that are already operating in these countries and in possible cooperating organization systems.

This chapter analysed and discussed several opportunities to grow the market share of ARS T&TT in the ITS market. The main insights are gathered in the orange box on the right.

## INSIGHTS

ARS T&TT should focus on market development or diversification to grow its market.

When developing new products/services a fit between the customer profile and the new products should be created.

O14 - Three other market segments that are probably interesting are: environmental organizations, logistic companies and event agencies.

The Dutch ITS market is almost saturated, but the established system is applicable in other countries around the Netherlands as well.

T5 - The quality of data is more important, therefore customers control the quality of the data more strictly.

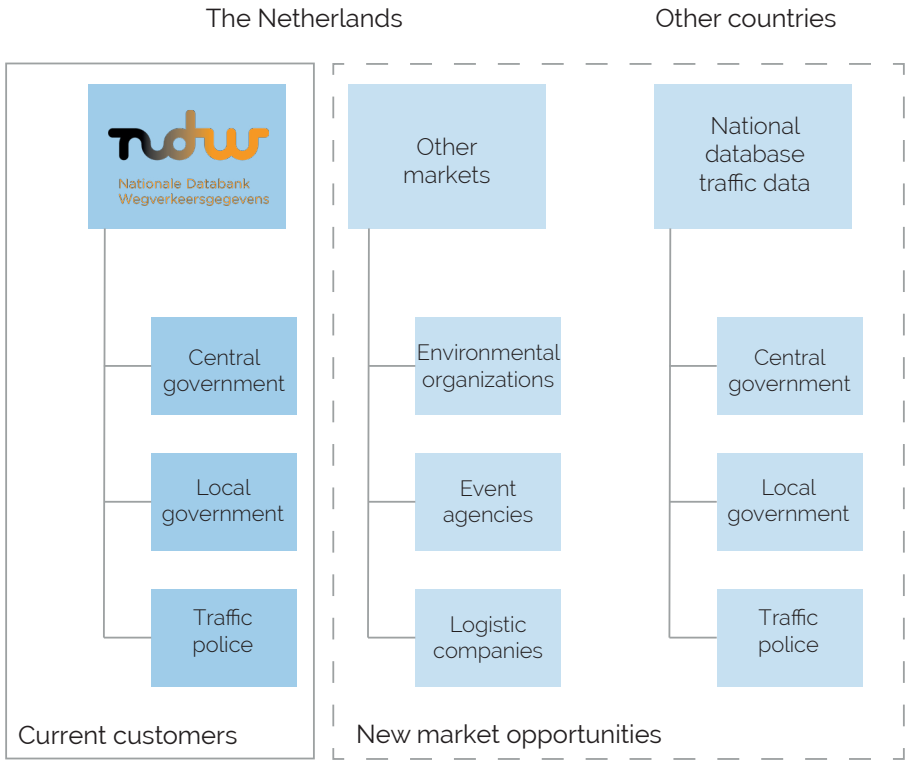



*Figure 19. New market opportunities for ARS T&TT.*

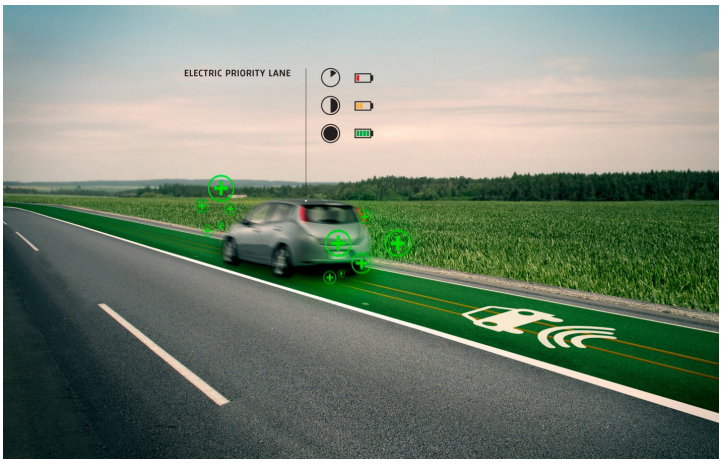
# 2.5 INSIGHTS AND CONCLUSION

In this chapter a SWOT analysis summarizes all insights coming from the 4Cs analysis. Figure 20 visualises a summary of all interesting findings from this analysis. The overview of strengths (see chapter 2.1), weaknesses (see Chapter 2.1), opportunities and threats (see Chapter 2.2, 2.3 and 2.4) support the decisions about which steps to take in the future. In order to find interesting areas for ARS T&TT in the ITS market a creative session is done. Before this creative session a table is created. The strengths and weaknesses of ARS T&TT are plotted on the vertical axis of the table. The opportunities and threats of the ITS market are plotted on the horizontal axis. This resulted in a table with 70 boxes. The boxes can be filled with ideas or search areas that are interesting combinations of characteristics of the company and trends in the market. The boxes were filled during the creative session. Two students of the Technical University of Delft joined this session. They had no previous knowledge of the ITS market nor the company. Right before the session they were introduced to the topic. Subsequently, the exercise started. Appendix D presents an extended report of this creative session. Figure 21 presents three examples of the resulting search areas, visually and textually. Figure 22 shows all search areas in the table used at the creative session. The next paragraph discusses the search areas.

| Strengths | Weaknesses |
|---|---|
| S1 - Strong network regarding road authorities<br>S2 - Stable position in the Dutch ITS market<br>S3 - Excellent at writing tender offerings, wins on quality<br>S4 - Wide scale sensor network deployment<br>S5 - Own data warehousing | W1 - Lack of marketing experience<br>W2 - Passive attitute towards the commercial market |
| **Opportunities** | **Threats** |
| O1 - Countries around the Netherlands do not have such a strong umbrella organisation as the Netherlands does.<br>O2 - France, UK and Belgium have remarkable motivations improving ITS<br>O3 - Urbanization / smart cities<br>O4 - Lean and agile supply chain managment<br>O5 - Online ordering<br>O6 - Environmental law in The Netherlands<br>O7 - Attention to sustainability<br>O8 - Blockchain developments<br>O9 - Developments in the area of connectivity<br>O10 - Roaming data in the EU<br>O11 - Internet of Cars<br>O12 - Modelled Car Data / Floating car data<br>O13 - Electric cars<br>O14 - Interesting new market segments: Environmental organisations, logistic companies and event agencies | T1 - The existence of competing companies with data visualisers<br>T2 - The Dutch market is nearly saturated<br>T3 - Open source / shared economy<br>T4 - Cooperative ITS that connects cars<br>T5 - Strict quality control |

*Figure 20. Strenghts, weaknesses, opportunities and trends: a summary of all insights from the 4Cs analysis.*


*This is an example of the idea to count bicycles. Modelling bicycles and pedestrians in the city is important to build the smart city concept. A city not only exist of vehicles and public transport. To model the complete city the pedestrians and bicycles are relevant.*




*This is an example of a sustainable direction. Investing in sustainable directions is the intersection point between the environmental trend and the characteristic of ARS T&TT that they are strong in writing tenders.*

*The last example is the intersection point between the lack of marketing and the smart city concept. An idea to increase the visibility of ARS T&TT in the market is to build a physical (not a sketch, like the drawing on the left) smart city in the office of the company. This concept city can show customers how a smart city will look like according to ARS T&TT.*

*Figure 21. Three examples of search areas to support the table with the intersections.*

**Search areas**

Intersections between trends in the market and characteristics (strengths and weaknesses) of the company are so-called search areas. These areas can be found through a creative process. To prepare for this creativity, the strengths, weaknesses, opportunities and threats from the analysis are divided into seven company characteristics on the vertical axis and ten trends on the horizontal axis. Some of the spotted trends are combined to overcome overlap in the search area table. For example O9, O10, O11, O13 and T4 all have something to do with the development of connectivity, so these are combined in one topic: connectivity. Also the trends to develop in other countries, other markets and environmental trends are combined in 'other markets'. The table is filled during a brainstorm workshop. In Figure 22 all ideas

| | Other countries<br>O1, O2, T2 | Smart city<br>O3 | Other markets<br>O4, O5, O14 | Environment<br>O6, O7 |
|---|---|---|---|---|
| Network road operators<br>S1 | | Counting pedestrians, bikers and scooters etc. | Weight of caravans in the road. | Road operators also care about the environment |
| Stable position<br>S2 | Copy good things to other countries | | | |
| Tender offerings<br>S3 | React on tenders in other countries | | Pitching ideas in other markets then ITS | Focus on tenders with an sustainable direction |
| Road sensors<br>S4 | | Weather data or data coming from satalites | | Vechicles receive information about their impact on environment |
| Own data warehouse<br>S5 | | | | Watch environment stickers in these zones. |
| Lack of marketing<br>W1 | | Build a show case of a smart city | Hiring a marketing expert with experience in similar cases | Stimulate car pooling behavior by showing data |
| Passive attitude<br>W2 | Copy current experience in less developed countries | | Show taxi's on a map (also in other countries) | Use data to count trucks etc. |

*Figure 22. Search areas; the result of a brainstorm to find intersections between trends and company characteristics.*

| Blockchain<br>O8 | Connectivity<br>O9, O10, O11, O13, T4 | MCD/FCD<br>O12 | Competitors<br>T1 | Shared economy<br>T3 | Quality controls<br>T5 |
|---|---|---|---|---|---|
| | Advice road operators about new technologies | Faster detection of new roads in maps by using FCD. | | Carpool functions Cooperate with BlablaCar | |
| | Stay up to date in the recent technologies | | Invest money in development, before competitors are in front of you. | | Improve quality by combining FCD and stationary data |
| | Research tech or react on interesting tech tenders | Acquire FCD related projects | Research into what tenders competitors react on | | |
| | Road sensors connected with in-car apps | | Focus on own strength (and market them) | | |
| | | | | | |
| | | Invest in tech that can detect the 'hidden' cars for FCD | Looking at competitors how they are doing their marketing | Cooperate with companies with a lot of marketing experience | Promote the good quality results |
| Research the possibilities with blockchain and ITS | | | | | |

during the brainstorm are mapped in the table. After the brainstorm the gathered data is analysed. The diversity within the ideas is broad. Some of the ideas were already put into practice at ARS T&TT, for example the idea to use the data to count trucks and to control vehicles inside an environmental zone. But there are also very new ideas, for example the idea to cooperate with companies like BlaBlaCar, a platform that connects people who wants to go to the same destination to drive together. The goal of the table is to find future directions to go for ARS T&TT. With that objective the search areas are categorized in different categories to find the most interesting search areas. This categorisation is done three times. Appendix E shows the three tables and explains the process. The last categorization was the most informative one, see Figure 23.

The third categorization focusses on future directions for ARS T&TT and a ranking was added to show the most urgent search areas. Three future directions were recognizable in the table. The first direction is the presence of automated vehicles on the road in the future and all technology that is attached to this disruptive development. The second future direction is the arrival of a sustainable city including the ideas that can improve the quality of the transport and traffic in the city. The development of automated vehicles and the rise of a more sustainable city can be combined as the 'smart city' of the future. The concept of the smart city already exists, but is very broad. Nam and Pardo (2011) has found seven different definition of a smart city in the literature. Therefore this concept is not combined into one direction, but split into the technological developments needed for the concept and the

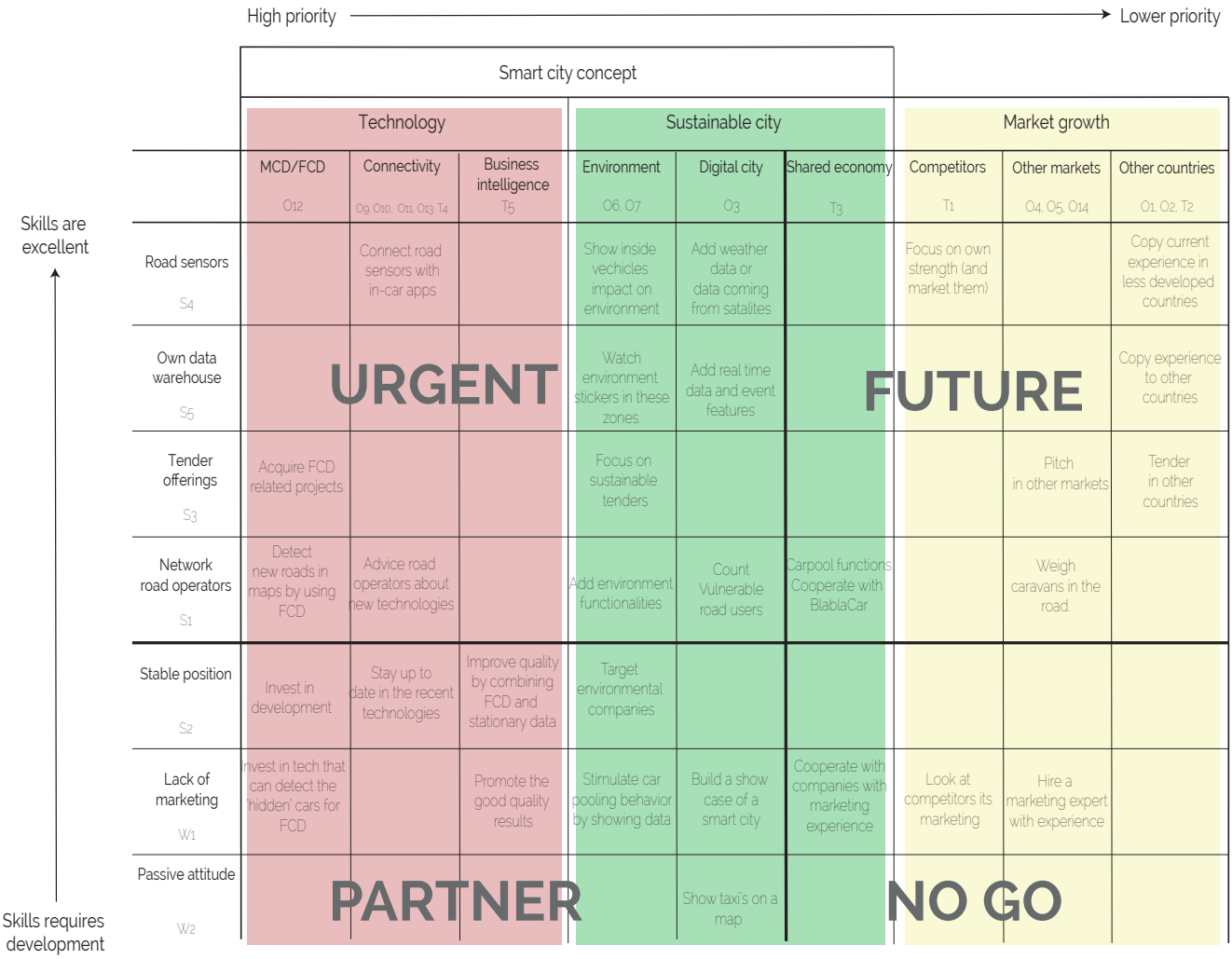



*Figure 23. Categorized table with search areas.*

sustainable needs rising from the major cities. The sustainable needs are not directly connected to the technological developments. Some of the needs can also be fulfilled with other solutions rather than a technological one. The last direction is market growth. This is possible in different directions, they are all gathered in this future direction.

Next to the emergence of three future directions the axes of the table are also ranked. The strengths and weaknesses are ordered from strongest to least strongest. At first, the ordering is done by different employers of ARS T&TT independently. Then the differences are discussed and so the final order is build. As shown in figure 23, the strongest characteristic of the company are in the top of the table and the least strongest in the bottom of the table. The opportunities are categorized earlier in the process. In this stadium the opportunities are also ordered from most impact to least impact. A trend that has a lot of impact is one where there is more certainty that it is going to happen in a short time range. This means the company can not ignore the development. Trends with less impact are the ones with more uncertainties. They are placed on the right side of the table. This does not mean that these trends are totally useless, but they are not so urgent as the trends with more impact.

After ranking the opportunities and strengths, four quarters has emerged in the table. The top left quarter contains search areas that have a lot of impact and is using top strengths of the company. These intersection points should be followed up in a short timespan, because they have a high chance for success. The right top quarter is also coming from strengths of the company, but the opportunities are some less urgent. So ARS T&TT has to make sure it is planning something for these intersection points for the future. ARS T&TT can already start working for these developments in the company or make sure it plan to do something with them in future. In the left bottom quarter the urgent opportunities are crossing weaknesses of the company. ARS T&TT should look outside its own company if they can partner up with other companies to fulfil these actions. It will be the best decision to start with this as soon as possible, because the trends have a high impact. Finally the right bottom quarter is a 'no-go' area. This quarter contains intersection points between weaknesses of the company and trends with less impact. Going in this area means taking high risks. Probably this will cost a lot of money and the uncertainties are substantial.

Chapter three investigates the three future directions (Technology, Sustainable city and Market growth) further to find out how those directions fits best in the roadmap to 2030 for ARS T&TT.

## INSIGHTS

There are three possible future directions emerged from the analysis so far. In the coming chapter the directions are explained to find out how these directions fits best in the roadmap to 2030.

The three directions are:

The emerge of automated vehicles on the road. These development includes an improved connectivity between vehicles and between a vehicle and other objects.

&

The growing use of data in smart cities. This also includes the increasing importance of environmental issues and the increasing number of people within cities.

&

In stead of developing in new products the current products can also has some value in new markets. For example in other countries in West-Europe or in Asia. But also other markets in the Netherlands are possibilities.

# 3. ROADMAP

## 3.1 FUTURE VISION

Designing a roadmap starts with the creation of a future product vision. This is an important step to choose the destination of the roadmap. In this chapter, the strategic roadmap is designed.

The strategic roadmap envisions why certain steps should be taken. It shows the pathways of product directions, market trends and technological developments. All paths are in parallel to each other. In the roadmap different trends or developments are linked across the pathways. This means that pathways are related to each other.

The completed roadmap helps ARS T&TT making tactical decisions. The roadmap is a guide for the department of DW&S. It shows the goal and the pathways to this goal visually. Tactical decisions can be about who to partner up with or if new employers should be attracted or not.

The target audience of the roadmap are the project team members of the department of DW&S and the management of this department. They all should be able to understand the bigger picture (strategic roadmap) to be able to work on the operational and tactical level of the department. Visualising the strategy helps to understand the bigger picture.

The future vision shows the destination of the context of the product. It helps a project team to focus on the same direction that will lead to an improved common motivation.
The vision can be based on spotted trends or identified opportunities, but also based on personal inspirations or intuition. A product vision is not the same as the corporate vision (framed in a mission or vision statement). The corporate vision has a larger, company wide scope (Simonse, 2017).

Important trends and opportunities that are taken into account when creating this future vision are:

- Developments in current technology of C-ITS and connectivity.
- An increasing use and applicability of the floating car data.
- Increasing availability of floating car data due to the development of connected cars, autonomous cars and smart cars.
- An increasing need to solve the traffic congestion in cities caused by urbanisation and misuse of infrastructure.

The main statement of the future vision of the ITS market is the following:

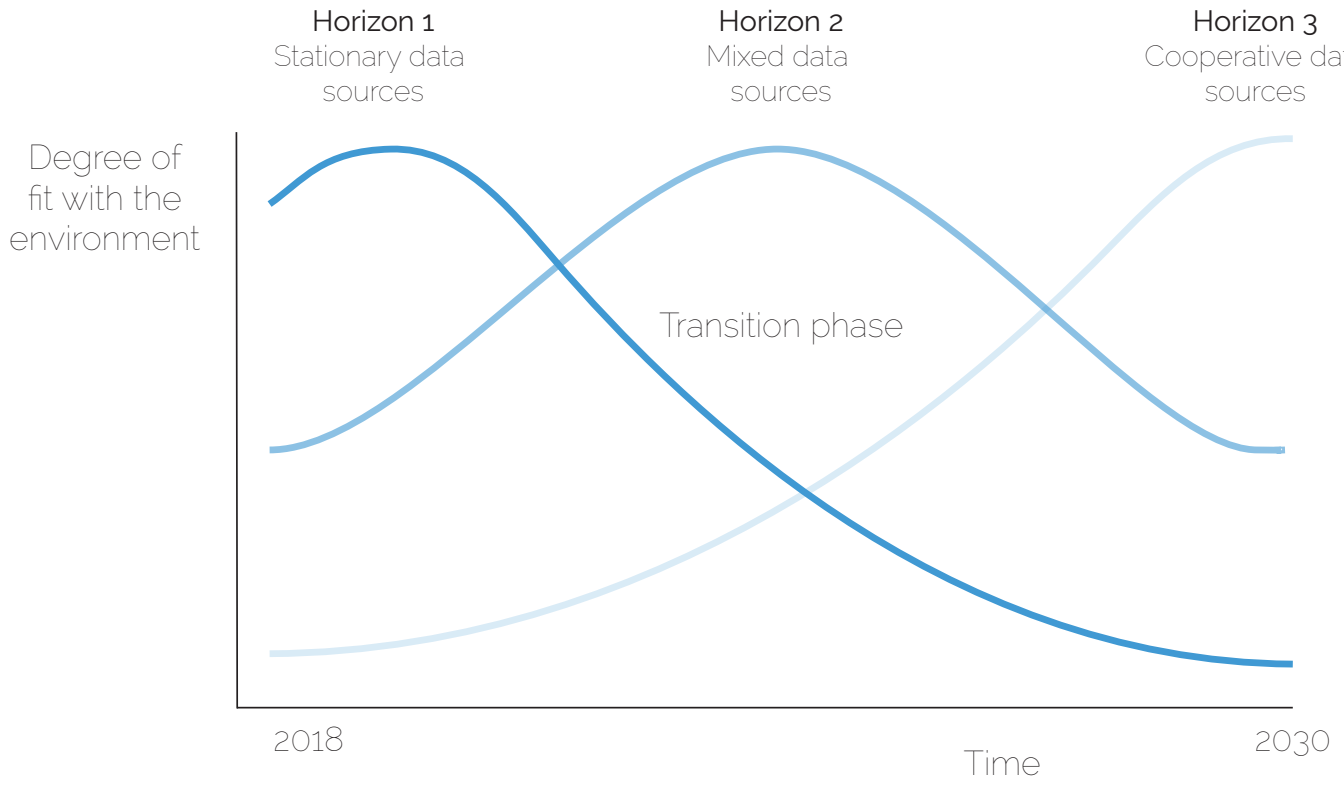



*Figure 24. Three Horizons about the source of traffic data.*

**The future of the city is smart. The smart city is a city which uses technology to improve the quality of life of the citizen.**

People move via autonomous vehicles through the city. The vehicles are connected with each other, traffic lights and the road, so the traffic managers can control the traffic more efficiently. Most of the data is coming from in-car sensors, but stationary systems is not disappearing.

Due to all the data coming from devices, the stationary sensors along and in the road are not able to be time and costs efficient anymore. Therefore ARS T&TT should take this vision very seriously and change the design direction regarding the data visualizer toward this vision.

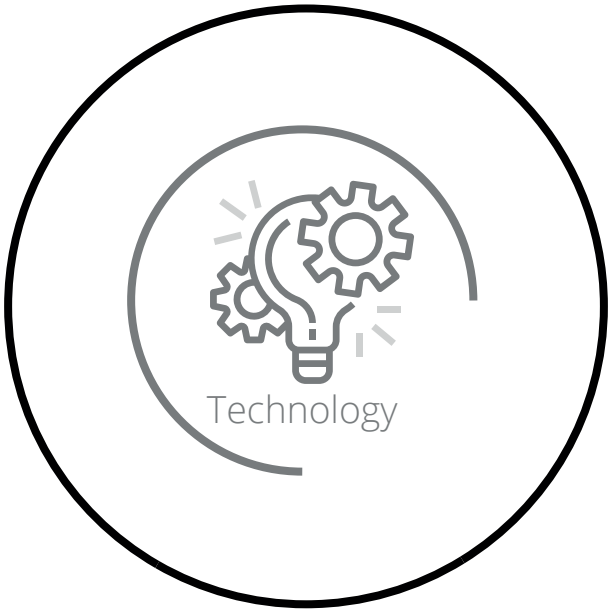
Figure 24 shows the three horizons to reach this future vision. In the first horizon well-deployed stationary sensor network all over the Netherlands is the main data source. Different types of governmental organisations uses the sensor data. ARS T&TT has good relationships with these organisations and the NDW. Operational control centres take care of traffic management from a distance.

To keep this strong position in the market ARS T&TT should change the direction of the company to be in a similar position during the third horizon as well. During the third horizon autonomous vehicles and smart cars are common on the road. This type of vehicles has many in-car sensor that gathers data and communicate in a cooperative way to drive the car safely. This data can be collected by external data warehouses to improve the management of the traffic in cities. For governmental organisations safety is still an important value.

To reach the third horizon described, there will be a transition period. This transition period is a phase with the biggest uncertainties. In this period technology is changing how data is getting collected from the infrastructure. Stationary sensor systems are decreasing, but not enough cars are gathering FCD. During the transition period the focus of ARS T&TT should be on the development of software that can merge both types of data.

In the following chapters (3.2, 3.3, and 3.4) the three development paths are explained; Technology mapping, market trends and the product time line. Chapter 3.5 presents the strategic roadmap with all paths visualised.

# 3.2 TECHNOLOGY




This chapter describes all mapped technologies shortly. The technologies are chosen because they have the most influence on how the vehicles on the road are going to change. These vehicles has direct influence on the intelligent transport systems that are relying on the data coming from the vehicles.

**Floating Car Data**
FCD is already used for data gathering broadly. For example Google Maps makes use of this technology to show the users where the traffic jams are. They count the smart phones in each region and calculate via smart algorithms how many cars are on certain locations and how fast they move. FCD has a lot of potential in the near future since more cars are connected to the internet as well and so not only the smart phones are the devices that are gathering data for FCD.

**DSRC (IEEE 802.11p), C-ITS and V2V communication**
Dedicated Short-Range Communication (DSRC) is a communication system considered only for the use of vehicles-based communication networks. IEEE 802.11p (also called WiFi-P) is the technology needed to communicate from vehicle to vehicle and from vehicle to infrastructure (for example traffic lights). DSRC changes ITS into C-ITS; Cooperative ITS. When vehicles share information with each other and with the infrastructure the road efficiency can be improved. For example at smart crossings a traffic light can stay a few seconds longer green for a heavy truck so it does not have to break. This increases the traffic stream and is better for the environment too. Pilots of C-ITS are already started. In coming years the features of this technology will grow (Beter Benutten, 2017). A vehicle with all these technologies included is called a connected car. This is a car with a lot of extra benefits for the driver in contrast to a normal car. The driver can get automatic notifications of crashes, speeds of surrounding vehicles and traffic congestions. On top of that the smart phone of the user is an important tool that can communicate with the car as well. The driver can unlock his car, check the status of the batteries of his electric car, find the location or activate the climate system. The smart car is making the car more user friendly and add convenience to the driver. A step in the same direction as automated driving. The market of the connected vehicles is tripled in 2018 regarding the market size in 2012, up to €39 billion (GSMA, 2013).

**AI / Machine learning**
Machine learning is one of the technologies that is part of the umbrella term Artificial Intelligence (AI). Machine learning means a computer can learn new steps without directly programming these steps into the machine. With the help of algorithms the machine learns things from new data. In the vehicle industry this technique is used in automated vehicles. Today there are multiple pilots from different companies that has fleets of automated vehicles moving around in certain areas to gather data of the context and learn more. This way the algorithms of the vehicles

are getting better and better and so closer to driving fully automated.

**5G**

Appendix F presents a deep dive into the technology of 5G and also automated vehicles. 5G internet is being tested by different Telecom providers in different countries. The developments are fast and 5G will probably be ready for usage in 2020. 5G still has to proof itself if it will work. For ITS purposes it can not happen that the connection will fail. For example when trucks are communicating with each other when they are driving in a train very close to each other (truck platooning) it will be disastrous when the connection fails. Because of this reason, it will take a while before 5G is really implemented in ITS solutions. Some people believe in a hybrid connection between IEEE 802.11p and 5G, like what is also happening when smart phones switches between WiFi connection and 3G or 4G.

**Automated vehicles**

A lot of companies are investing in autonomous vehicles, for example Google and Uber, but also car manufacturers. Today pilots are on the road, but in coming future the automated vehicles will be part of the traffic. The vehicles are much safer than human driving, but the perceived safety by the human is not that well yet. Next to the perceived safety also the data security, legal issues, ethical issues and economic aspects are still challenging in the process towards autonomous driving. Due to these challenges the technological development will not be ready for the market until 2030.

The technologies does not only develop on their own, some of them are depending on each other. Automated vehicles are depending on the development of connectivity such as 5G and DSRC. The technologies are plotted in the strategic roadmap in an chronological order. On the next page the result of an interview with an expert in the field of innovative technological developments is presented. Gert Blom has given examples of tests and pilots he is doing right now. This supports the developments in this chapter.

The technology developments are plotted in the strategic roadmap at the bottom line. They connect to the product time line when product developments are the result of a specific technological development.


# EXPERT POINT OF VIEW

*Name of the expert: Gert Blom*

*Organisation: Municipality of Helmond*

*Expertise: Coordinator smart mobility & chairman of the host committee of the ITS congress 2019 in the Netherlands.*

Gert Blom has become one of the most experienced people in the field of innovative solutions in the ITS market in the Netherlands. He has worked for 15 years at the municipality of Helmond, a city that has changed itself into mobility living lab in the last few years. Blom is working on different innovative projects together with organisations all over Europe. The focus for Helmond lays in up-scaling the C-ITS solutions and preparing the road on autonomous vehicles. Next to his function at the municipality of Helmond, Blom is also chairman of the host committee of the ITS congress in 2019, what will take place in Helmond and Eindhoven. This congress is a major opportunity for the Netherlands to show its expertise in this market.

**Projects**
Below some projects that Blom is working on are highlighted.
**Fabolous** is a projects that is trying to start up an autonomous shuttle service between the train station of Helmond and the automotive campus in 2020 for half a year. The goal is that the shuttle will not have a driver nor a stuart, it is fully automotive, level 4. It is an ambitious project, because the technology is not proven yet.
**Maven** is a project that studies the cooperation between autonomous vehicles and the infrastructure. Blom does not believe in the Google autonomous vehicle, that is driving on its own. He thinks that there should be a traffic management system that take care of the overall management. The vehicle itself can only manage itself.
**C the difference** is up-scaling the C-ITS projects. Helmond already tested C-ITS in 10 trucks, but with this new project the technology is tested with 100 trucks. This will improve the ability to test if other vehicles also benefit from those 100 trucks.
**C-mobile** is a project that is also up-scaling the C-ITS project directly. In Helmond the C-ITS is focused on trucks in the first place, but C-mobile will also test what C-ITS can do with pedestrian streams.
**Coexist** is a project that add autonomous vehicles in current traffic modelling tools. Autonomous vehicles will behave different. For example, they will probably accelerate faster when a traffic light turns green. So this needs a different approach in modelling systems.
**Autopilot** is a project that searches for viable use-cases and services when combining autonomous driving with IoT. An example of such a new use-case is to check agendas and see where vehicles are required.

An important technology for all those projects is the communication technology. Helmond makes use of wifi-P and they proved it works. But other parties really believe in 5G, because this is cheaper if it works, because it connects with mobile phones where wifi-P needs a special device to connect with. Blom beliefs in the future their will be a kind of hybrid solution similar to how our mobile phones switch between Wifi and 3G/4G automatically.

The main insights of this expert point of view are the following:
- Autonomous driving will be part of the agenda for Helmond for the coming years.
- Infrastructure is definitely playing a role in traffic management, also when autonomous vehicles enter the road.
- Helmond does not only test the technical conditions for those technologies, but is also searching for business models.

*The expert point of view is based on a interview done with Gert Blom. The interview guide and a summary of the interview can be found in Appendix I.*

# 3.3 MARKET TRENDS


The market trends in the roadmap are divided into three directions; Traffic congestion, urbanisation and environmental requirements. Appendix F presents a deep dive into these market trends, more information can be found there. In this chapter the trends are described shortly and discussed why they have influence on the ITS market and the products ARS T&TT is developing.

Traffic congestion is caused by a growing number of people living in the Netherlands (and in Europe as well) and by a growing number of citizens that uses a car. Currently people are driving more when they are older, so that causes more drivers on the road. More vehicles on the road causes a higher need for intelligent transport systems.

Urbanization is the fact that more people are living in the cities in stead of the countryside. This also increases the number of passengers on the road (and the rails as well). According to predictions, in 2030 the number of people in the city increases by 15% (CBS, 2016). More passengers on the road will also lead to more traffic congestion.

Traffic congestion is a known problem for ages. Intelligent traffic systems tries to solve this problem for a long time now and still the systems are improving today. The congestion is a main driver for the ITS market to improve the quality and efficiency of the systems.

Environmental requirements is the last main driver in the roadmap to 2030. The European Union and the government in the Netherlands are both setting restrictions and goals for the amount of emissions. In 2030 the reduction goal of CO2 from vehicles is 30% regarding the amount of emission in 2021. These are serious reductions of the amount of emission so the Dutch government is already setting new measures to reach this goals. For example they are focusing on more sustainable projects. So more sustainable tenders will show up in the coming years, ARS T&TT should be prepared for that. Another measure of the Dutch government is to launch emission zones in the cities. The goal is to have these restricted zones in the 30 biggest cities in the Netherlands. Emission zones are zones in the city that do not allow vehicles that has an emission rate higher than a certain amount. This already exist in some cities in the Netherlands and also in other countries around the Netherlands. Data can help the cities to control the emission zones.

The market trends are plotted in the strategic roadmap on the line in the middle. They connect to the product time line when product developments are the result of a specific market trend.

# 3.4 PRODUCT TIME LINE


The product time line is constructed based on the market trends, the technology developments and the strengths and resources ARS T&TT already has. All insights from previous research are used to create the roadmap. In the roadmap connections are made between the market trends and the product steps and between the technology developments and the product steps. In the end two product phases emerged. The product in the second phase will change disruptively.

Another layer that is added to the product time line in the roadmap is the complexity level of the product. There are three levels of complexity derived; operational, tactical and strategical. In the operational level the product shows data directly coming from sensors. There are no data processing steps taken in between the data collection and the data visualisation. The features within this level has only operational purposes. For example a traffic controller can see how many cars are on the road or how fast they drive. No further conclusions can be made from the data visualized in this level. The second level of complexity is the tactical level. The tactical features answers the how-question, for example 'how did this traffic jam occurred?'. The data used in this level needs to be processed before this question can be answered. Data from different data sources should be combined so that the data visualiser can show where vehicles are coming from before ending up in the traffic congestion. The third level of complexity is the strategic level. In this level the what, where, when and why-questions can be answered. This needs more complex data processing steps. For example the question 'where do we expect traffic congestion at Tuesday morning?' can be asked. The data visualiser needs processed data from different time slots (all Tuesdays mornings) and different sources (vehicle intensity and speed, accidents information, weather information) to answer this question. Currently the data visualiser of TDWC has only features in the operational level of complexity.

This chapter describes the product developments planned in the roadmap. There are two products described.

**TDWC 1.0 - Visualized traffic management tool**

The first product developments fits the first horizon of the roadmap. The data visualiser needs improvements with FCD. At this moment ARS T&TT already acquired the company Route Radar that is active for a certain time in the mobility market. They have started collecting FCD with their consumer application. The task for ARS T&TT is to use this data in their data visualiser so that the quality of the current data increases. After that also real-time data should be added to the data visualiser in the first horizon. The data sensors of ARS T&TT already do send real time data to the customers, but this feature is not used yet in the data visualiser. The data in the platform is available 24 hours in delay.

So the customer can not see the last 24 hours in the platform. When real-time data is available in the platform the customers are able to react on situations happening at that moment. The last data source that is planned to add to the data visualiser in the first horizon is the data of vulnerable road users (VRU). VRUs are for example pedestrians and bicyclers. Adding those road users to the platform is the first step into the direction of the smart city traffic control centre, the platform envisioned to be. Knowing how many VRUs use the road is important for road operators to decide on a more tactical level. For example the bicyclers and pedestrian can be an important reason for many car accidents that happen. So it can help answering the question "how did this happen?"

In the second horizon the focus of the product development lean more towards the transition phase to the smart city with automated cars in it. In the smart city the operational tasks of the traffic management can be executed from inside the car (smart navigating, accident recognition). The road managers are more the managers at the tactical and strategical level.

The first product development in strategical level is to add weather data. This type of data is available at the internet, but not used yet in the product. Weather data helps road managers react on different situation. The situation on the road is very different when the sun shines, when it is cloudy or when it rains. Next to that the use of mixed data should be developed further. In the first horizon FCD was already added, but ARS T&TT should make themselves expert in the use of stationary car data combined with FCD so that the knowledge within the company increases and the company is ready for the third horizon. The last step in the second horizon is to create functionalities in the platform so that the platform can be used as an emission control centre. Features as calculating emission rates on certain roads and controlling vehicles entering emission zones are examples for this emission control centre. For future cities the emissions are an important value. Too much emissions in the city makes the city less comfortable to live in.

**TDWC 2.0 - In-car application**

In the third horizon a new product is introduced. As said before, the management of the traffic is probably shifting from control centres to in-car micromanagement centres. This means that the vehicles itself is going to decide which route they are going to take. So in stead of DRIPs above the road telling the driver there is a congestion 200 meter in front of the vehicle, this message is send to the car itself and a display shows the driver a congestion is coming (or the car is already starting to decrease the velocity). The traffic management software is not going to be designed by ARS T&TT probably, because car manufacturers and other navigation companies are also in this market. But, ARS T&TT should be able to assist this local traffic management systems with data coming from the infrastructure.

Because this horizon is quite far away the product developments in this part of the roadmap are predictions and based on assumptions. Therefore the developments are described concept based, not in detail. There are three levels of product developments in the roadmap: In-car application, level 3 and 4 features and features for fully self-driving vehicles. On the next page, Figure 25 shows several examples of functionalities for the in-car application. In the first launch of TDWC 2.0 the product is just a traffic management system for in-car use. But in the end the car is managing the traffic by themselves, so the driver does not have to notice it anymore. The in-car application is shifting towards a more informative display. So the driver can see what it wants to see, but does not have to make any

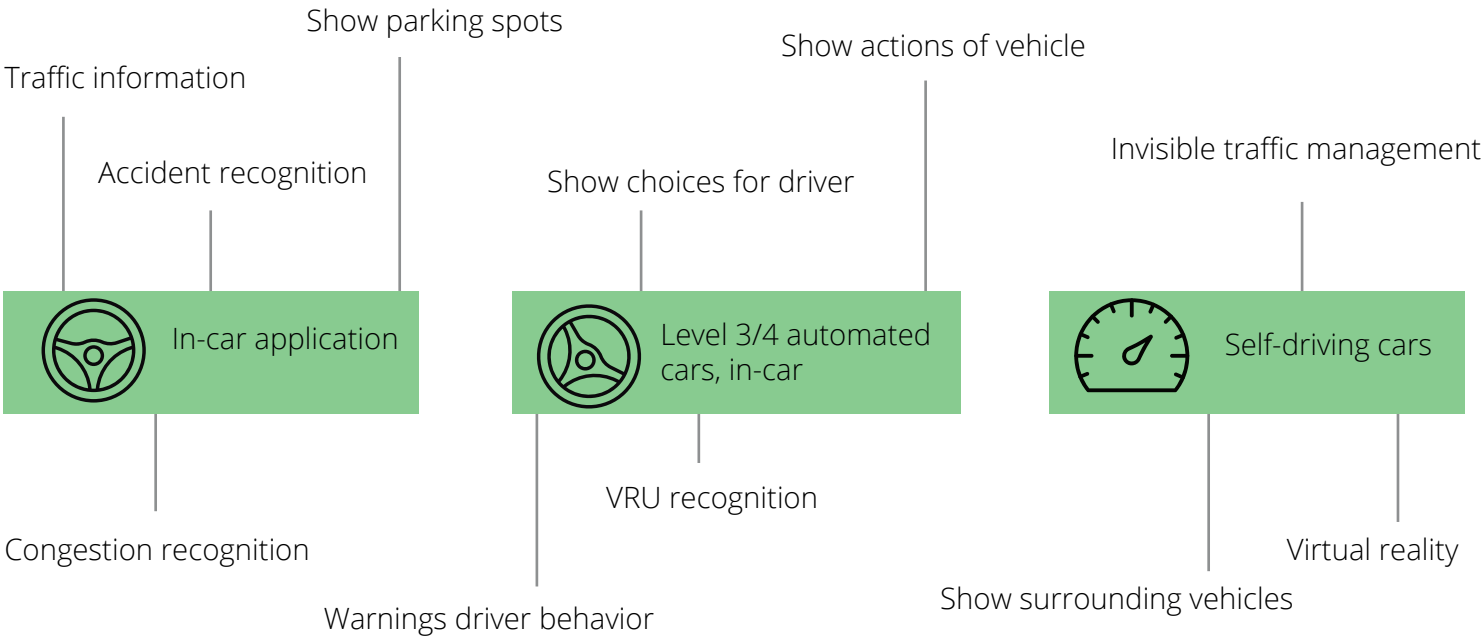



*Figure 25. Optional features of the second product line in the roadmap: TDWC 2.0, an in-car application.*

decisions based on the information he gets. In this last phase the role of the infrastructure is to navigate the vehicles even more efficient than the vehicle can do with only in-car data. For example green light zones (communication with traffic lights) are important. But also the redirection of the traffic after an accident can have some help of the infrastructure by choosing the fastest routes.

In short, TWDC 2.0 assists in-car traffic management systems to let autonomous vehicles drive more safely and efficient.

# 3.5 STRATEGIC ROADMAP

On the next two pages, Figure 6 shows the strategic roadmap. The top line presents the three horizons that has been described in Chapter 3.1. The vision that is also described in Chapter 3.1 is visualized on the right side of the roadmap. The bottom row of the roadmap (in red) are the technological developments described in Chapter 3.2. The middle row (in green/ grey) are the market trends that are described in Chapter 3.3. In between the market trends and the horizons the product time line described in Chapter 3.4 is shown. All together this presents the strategic roadmap of the DW&S department of ARS T&TT.

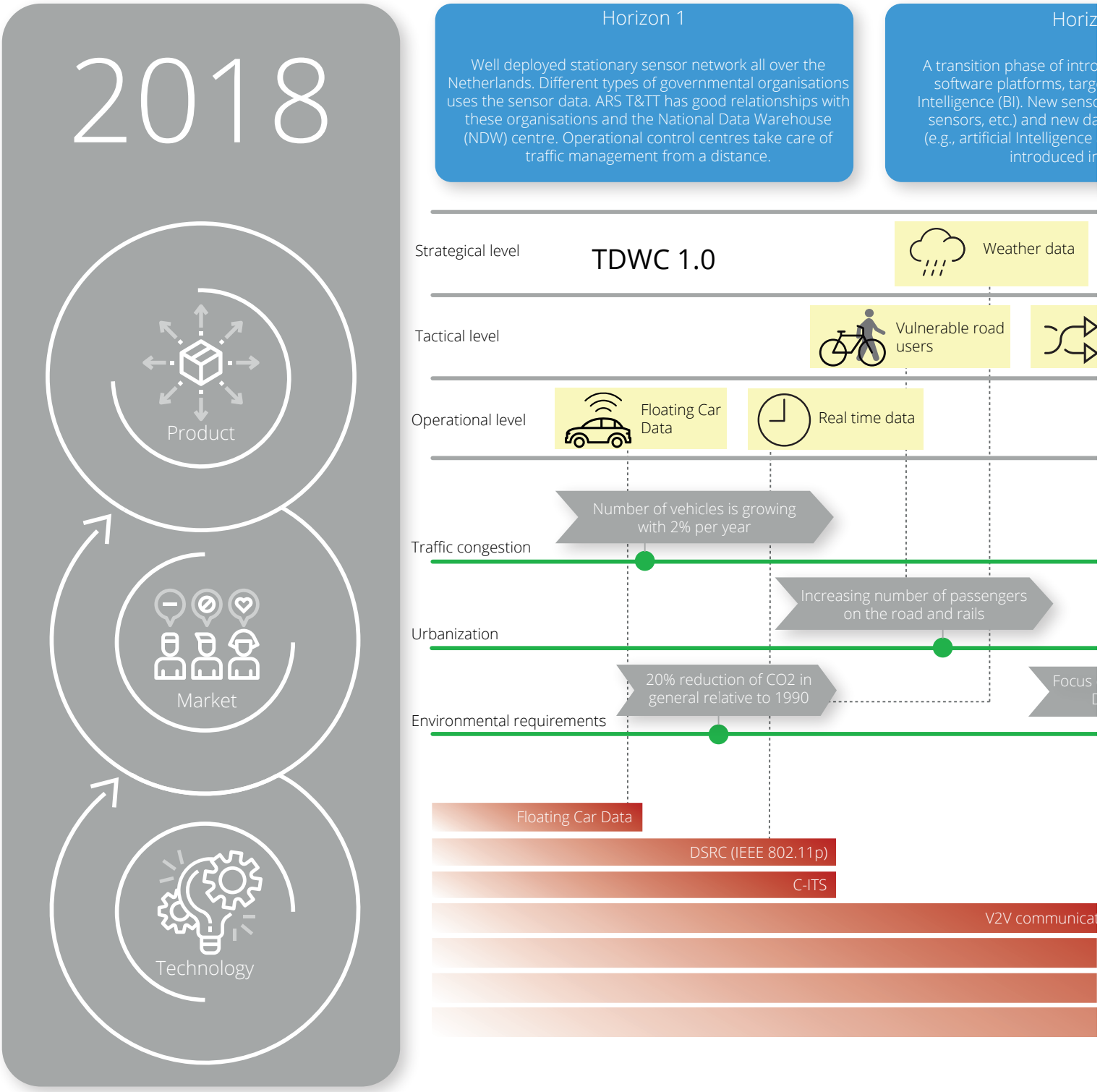


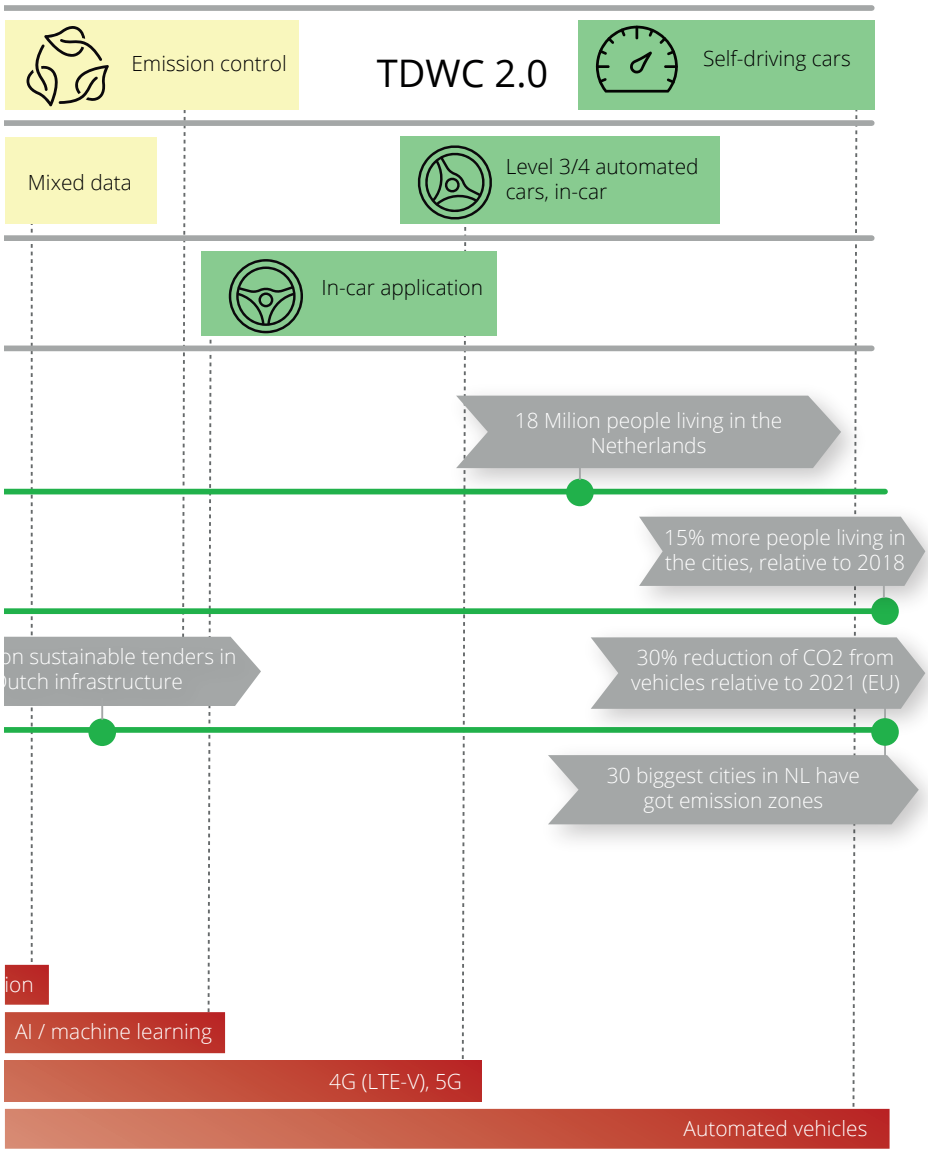

*Figure 26. Strategic roadmap of the department of DW&S of ARS T&TT from 2018 till 2030.*

on 2

ducing new hardware and
eting increased Business
r types (e.g., FCD, Airborne
ta processing techniques
and machine learning) are
the product.

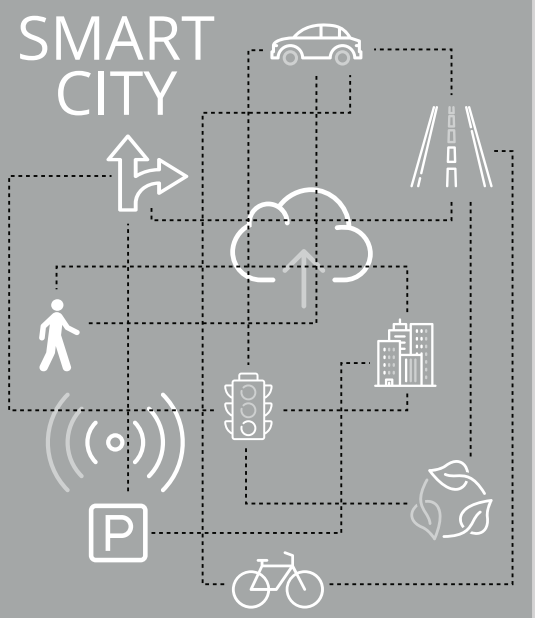
## Horizon 3

On the road autonomous vehicles and smart cars are common. This type of vehicles have many in-car sensors that gather data to drive the car safely. This data can be collected by external data warehouses to improve the management of the traffic in cities. For governmental organisations safety is still an very important value.




# 2030

*FUTURE VISION*




The smart city is a city which uses technology to improve the quality of life of the citizen. People move via autonomous vehicles through the city. The vehicles are connected with each other, traffic lights and the road, so the traffic managers can control the traffic more efficiently. Most of the data is coming from in-car sensors, but stationary systems are not totally removed.

# 3.6 CONCLUSION

In this roadmap the product development of ARS T&TT is aligned with the current market trends and technological developments. The roadmap shows the path till the emergence of autonomous vehicles in 2030, the biggest change in the upcoming decades. For the product time line a disruptive change for the product developers of ARS T&TT will occur in the third horizon. TWDC 2.0 will be launched by then. This product is an in-car feature, the biggest change in the product roadmap. Reason for this disruptive change in the product line is that the traffic management will slowly shift from traffic centres to the individual drivers. They need the information the traffic centres normally needed. ARS T&TT can provide them with this information, because they collect all the data. The road operators will still provide the drivers with this information, so they will probably stay as the customer of ARS T&TT, but the channels of how they distribute the information is changing.

The next questions that pop up when such a shift is happening are:
- What is the business model behind it?
- Who is going to pay for the product?
- Who are the most important competitors by then?

The product shift will take place around 2025. It is not easy to predict the market exactly in 7 years from now. In Chapter 4 a deeper dive into the business model of TDWC 2.0 is done. Different scenarios are described and suitable business models are presented.

# 4. VIABILITY

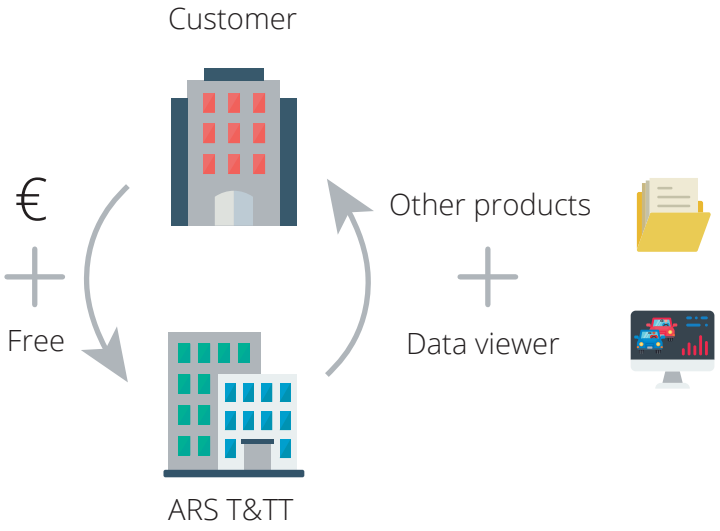
In this chapter, the viability of the roadmap is analyzed. The strategic roadmap introduced in Chapter 3 encompasses two product lines, TDWC 1.0 and TDWC 2.0. For both product lines business modeling is necessary. TDWC 1.0, the current product does not have a clear business model within ARS T&TT. TDWC 2.0 will exist in a future that is changing, so the business model may change as well.

We start with analyzing the current business models of TDWC 1.0 and continue with presenting a new business model. While taking into account different possible future scenarios, the future business models of TDWC 2.0 are generated. Ultimately, we propose a transition plan to change from the current business model to the generated future scenarios. This business model generation will help ARS T&TT to think about the role of the road operators in the future and also the way ARS T&TT can consult those road operators with a viable business model.

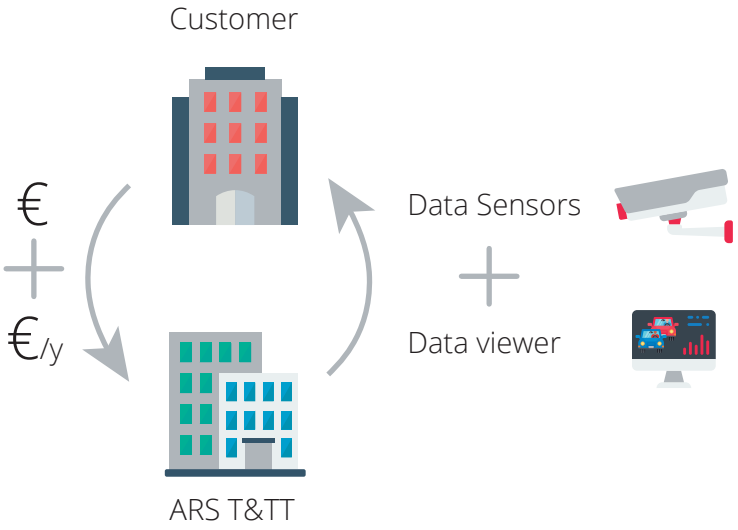
## 4.1 CURRENT BUSINESS MODEL

Currently, TDWC is offered to customers in two different ways. To most of the customers the data viewer is sold as a marketing tool. The data viewer is an extra product sold with a package of products. The other business model currently used is the razor blade model. Just like the razors and the blades the data viewer is sold in two parts. The first part is the hardware that is sold in the beginning of the project. The hardware consists of sensors that are build next to the road that measures the data. After that, the data viewer is sold against a yearly fee.

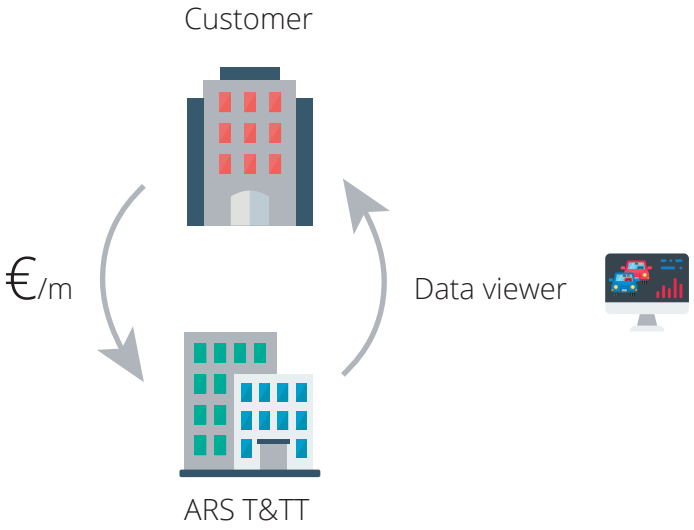
The proposed business model does not exist yet for the data viewer of ARS T&TT, but is an ideal model and the company can sell the product like this in short future, because no extra investments are required. The business model is subscription based, this means the customers pay a monthly fee and receive the data they want in return. This business model has a lot of potential value in the near future, because the model can be used for different customer segments (for example an event management agency or the police). Figure 27 shows the three business models. An explanation for each model is described next to the visuals.




**Marketing tool**
Most of the current customers got the data viewer for free in a combination with other products they order. This way the data viewer is an additional product, it is sold as marketing tool to sell other products.




**Razor blade model**
Some of the current customers pay yearly for the data viewer and the data included in the viewer. Before that they paid once, to get the data sensors that were needed to collect the data. The hardware is paid off in one time, but the data has a yearly fee (like a razor and blades).




**Subscription**
This is not one of the current models, but this model has a lot potential for new customers. A lot of sensors are already in the field, so the data coming from that sensor can be sold to new customers with a subscription model. Customers pay a monthly fee and get the data that they want. They can choose which sensor locations they want to get data from and what the time pacing is (every second or every minute for example).

*Figure 27. Business models of TDWC.*

# 4.2 FUTURE SCENARIOS

In order to propose a business model for an evolving product serving a dynamic market such as ITS, it is required to consider many facts and factors. For that reason a few scenarios are created. This creation started with a brainstorm about what could happen in the future. During the brainstorm a few questions were tried to be answered with multiple possibilities. The questions were:
- What business models are possibilities for future scenarios?
- Which stakeholders could have a (more) important role in the future?
- Which ambiguities are still there about the future?

Appendix G shows the result of this brainstorm. After the brainstorm the answers were analysed and combined to come up with three different scenarios predicting the future. This chapter describes those future scenarios. There is a time frame added in those scenarios. The first scenario is the one that is most likely to happen in the shortest time frame. The second one is most likely to happen in a time frame between the first and the third scenario. The third scenario is the most futuristic one, this is only happening after the large-scale deployment of the autonomous vehicle, probably in 2030. The scenarios are based on the trends and developments found earlier (Chapter 2.5). Following each scenario, a short list of corresponding trends and development directions is given.

**Scenario 1 - Sharing is caring.**
*What if all data for traffic purposes is open data?*
When all data for traffic purposes is freely accessible, the data itself has no added value anymore. This has huge impact on the current business model of ARS T&TT since they use the data as an important resource to sell to their customers. If customers can get the same data, but for free, ARS T&TT has a problem. Added value should come from data processing capabilities, this means that the open data that is processed into interesting information can have way more value than the raw data. In this scenario ARS T&TT should focus on how to make the raw data valuable again by processing it. ARS T&TT should invest in processing the data (for example with the data visualiser) in a way that people or organizations can benefit from it. This way the value that is being sold is not in a physical product, but the value is the service ARS T&TT can deliver with it.

This scenario is based on the shared economy trend mentioned in Chapter 2.3.

**Scenario 2 - Scared to death.**
*What if autonomous driving is not accepted by the drivers?*
The perceived safety of autonomous vehicles is way lower than the real safety in those vehicles. People do not trust the technology yet and rather drive themselves (although that is more dangerous compared to autonomous driving). According to Tom Dingus the risk perception for autonomous vehicles is 1000 times lower than normal, so autonomous vehicles should be 1000 times safer than driving by humans (Dingus, 2017). There are also examples from other industries that people do not trust technology, for example the autonomous pilot system in the airplane. The pilots in the plane can fly the machine almost without doing anything, but still they are present in the cockpit, because people feel more safe with a human behind the stick. Therefore, perceived risk/safety is an issue when it comes to technology. ARS T&TT can play a role in this by focusing on the safety perception for humans. If ARS T&TT can use data to make people feel more safe it is really valuable in this scenario.

This scenario is based on the fact that people are scared for technology. Just like the autonomous pilot in the airplane, it can take a while until the autonomous vehicle is really implemented.

**Scenario 3 - Google is watching you.**
*What if Google owns all data?*
Google is already a major player in the field of mobility. They are building their own autonomous car (Waymo project) and they have a free navigation system for mobile use including real-time travel information based on FCD. Next to that Google

owns a lot of non-traffic data due to the amount of Google-accounts installed at smart phones and the Google search tool. So, what if Google owns enough data to manage the traffic at the road itself? Google is able to predict peoples behaviour because it knows where people live and work and when they go to work. They also know the other people living in the same household and so Google can predict when people are going to be on the road. This way they can also steer the behaviour by giving notifications on which route to take that day or give advice if you have to leave your house half an hour earlier or later to improve the travel experience. In this scenario the autonomous cars can also drive only on data of Google. An important question in this is, what the role of ARS T&TT can be when this will happen.

For extreme situations it is still not possible to control the autonomous car with data from inside the car only. Due to the fact that the data from inside the car is almost all based on vision techniques. The appearance of the infrastructure is very different with the sun is low or when snow is covering road signs and traffic lights. Therefore ARS T&TT can play a role in this scenario by using the open data of Google and improving the data with stationary sensor data. These stationary sensors can recognise differences in extreme situations better than FCD can. So the quality of the data will become better and it is safer to drive in an autonomous car.

This scenario is based on the fact that the major IT companies can grow relatively fast in a different market, this way Google can be a competitive company in the ITS market.

The three scenarios described are not mutually exclusive. This means that there is a possibility that all scenarios will take place. The next chapter will explain and show the business models that fit with these three scenarios. Each scenario has a different model, because the customer values in the scenarios are subject to change.

# 4.3 BUSINESS MODEL GENERATION

A tool to come up with new business models, is the business model canvas from Osterwalder (2010). This canvas is used for the business model generation in this chapter. The canvas, showed in Figure 28, is filled in four steps for all three scenarios .
In what follows, we first introduce each field of the business canvas and subsequently, for each scenario we elaborate on all fields of the business canvas, concluding to potential business models.

1. Value proposition: What can be the added value ARS T&TT is offering to its customers?
The value proposition canvas created in Chapter 2.4 is a valuable source for this step. Some values of the current customers are not dependent over time. Values like safety and environmental concerns will be important in the future as well.

2. Customer segments: What are the future customer segments? How are they reached and how does ARS T&TT relate with these segments?

3. Key partners: Who is going to be an important partner? What are the resources ARS T&TT has itself and which activities are planned to offer the value to the customer?

4. Cost structure: Who is going to pay for what and what are the biggest costs.
This is an important step in the business model generation. Who is going to pay for what value is being answered here. This step is also an assumption since the answer is not validated with the (also assumed) customer segment. Validation should be the last step in the process.

The result of the three business model canvasses are explained on the next pages (63-65) for the three scenarios. Appendix H presents the business value canvasses created in this part of the project.

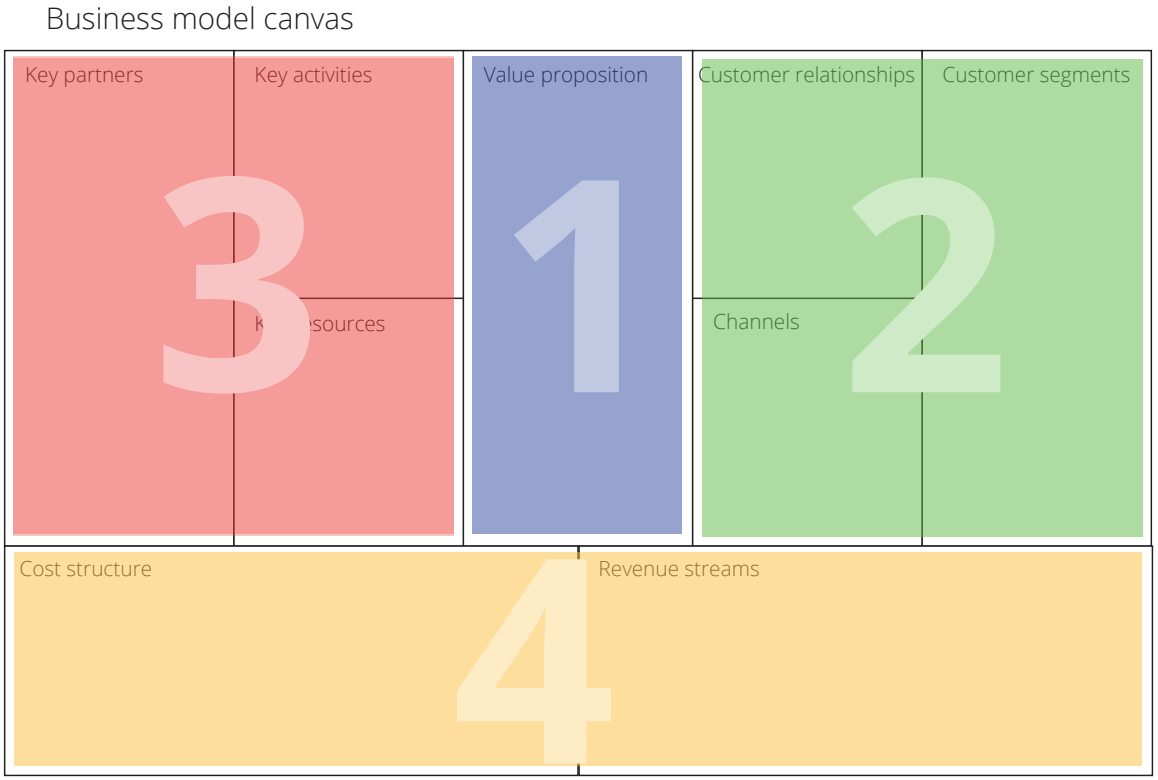
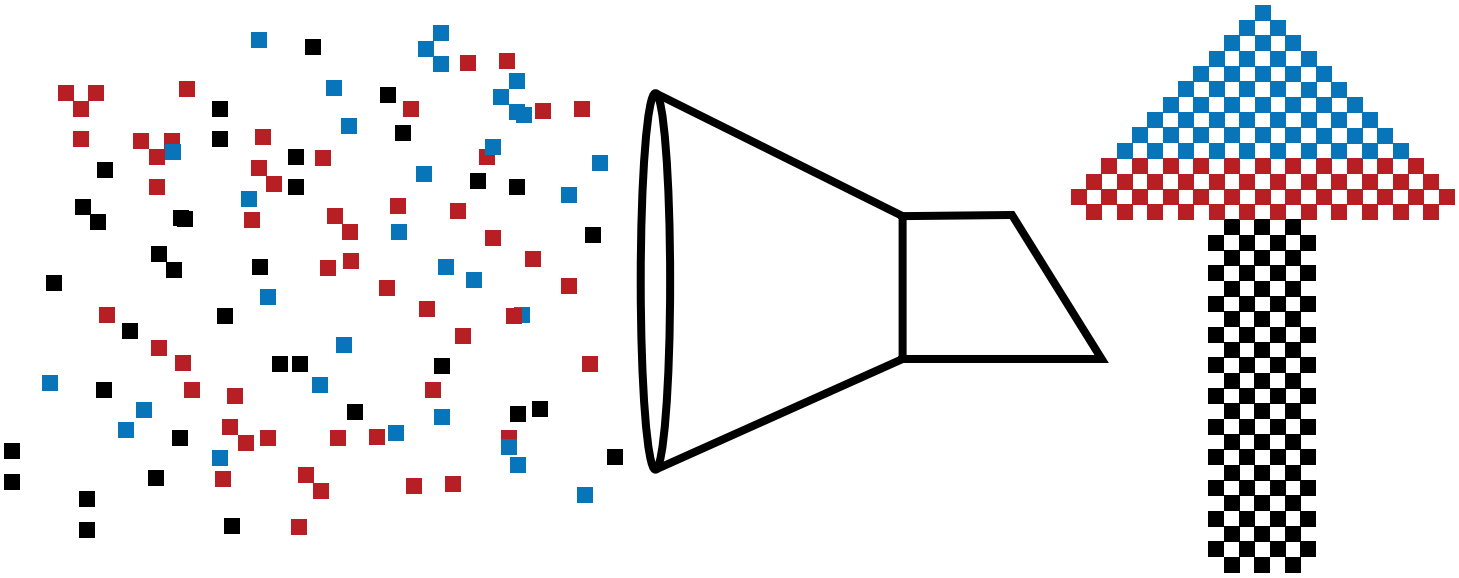



*Figure 28. Four steps that shows how the business model canvas is used.*

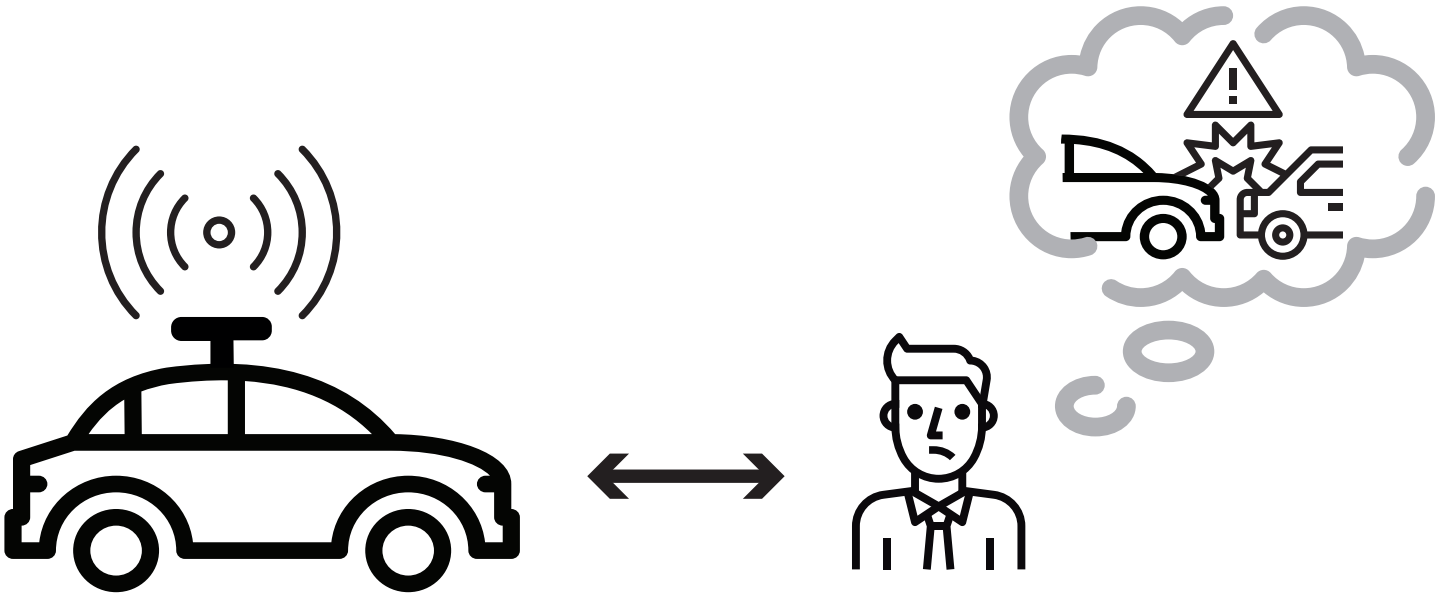


**Scenario 1 - Sharing is caring**

When data has no value anymore the value must be added by processing the data and change it into valuable information or knowledge. For example, the data that tells the speed and intensity of the cars on the road is interesting when the customer wants to know if there are congestions. This type of data is more often open and free because Google is giving the same information on Google maps while using FCD. However, when ARS T&TT can make good predictions with historical data out of the stationary sensors and data from external factors (weather or holiday days) the data is more valuable, because road operators can start acting to the information they have. They can choose to redirect the traffic before the traffic congestion has started, supported by prediction models.

The business model for this scenario will not change that much from the current business models of ARS T&TT. The government will stay the customer of the product, but the product is more advanced. ARS T&TT should invest in data processing, because today the processing of the data is limited and therefore the data does not contain that much information for the customer. Data processing capabilities can also be acquired by investing in innovative start-up companies. Those start-ups may have great ideas how to process the data to make it knowledgeable. In return ARS T&TT can provide the start-ups with more data and so they can help each other.

The customer can still be reached via tender offerings, since that is the way the customer operates when setting up bigger investments projects. It is also a low-risk way to do business, because the customer will agree on paying for some investments before the investments are done.



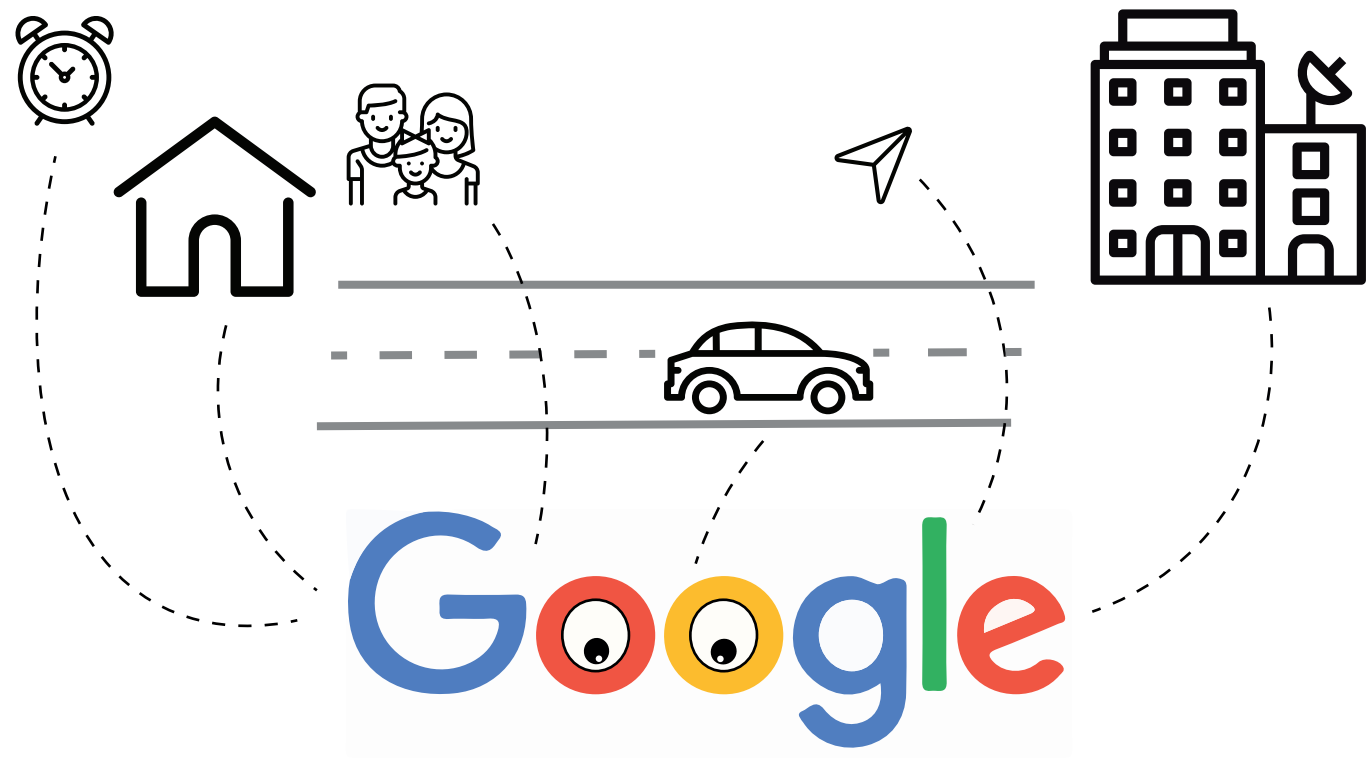
**Scenario 2 - Scared to death**

As mentioned before, there is a gap between the perceived safety and the real safety of autonomous vehicles. In this scenario the perceived safety of autonomous vehicles is that low that people do not dare to enter a vehicle without a driver that is responsible for the vehicle. If people are too scared to sit in the autonomous vehicles the vehicles will not be introduced to the public roads.

ARS T&TT can add value in this future scenario by focusing on the safety and trust values of the drivers. ARS T&TT has the strength that it is a smaller Dutch company. This encourages trust in contrary to the big companies like Google or Uber. Also the combination of the use of in-car data and data coming from infrastructure can increase the perceived safety of the driver. This way the safety is not only depending on the vehicle itself. To convey the feeling of safety to the end-driver it can help to set up great marketing campaigns that has impact on how the drivers will perceive the safety feelings.

In conclusion: the key activities ARS T&TT should be doing in this scenario are marketing activities and data fusion. A good example of a marketing activity fitting this scenario should be building a showcase of the future cities and start informing governmental organisations how the infrastructure is going to look like when autonomous vehicles are entering the road. This will build trust at these governmental organisations; ARS T&TT is ready for this future and has knowledge expertise in this area.

In this business model the customer is the end-user or the driver, though the direct customer for ARS T&TT should still be the government. The responsibility of the safety of the drivers lays also at the government in the Netherlands too. The government is also the party that can benefit for increasing the trust in the autonomous vehicles, since autonomous vehicles can increase the traffic flow and decrease the number of accidents on the road.




**Scenario 3 - Google is watching you.**

The added value ARS T&TT can represent in a world where Google owns such extent amount of data that it can drive the automated vehicles on the road itself is that the autonomous vehicles can use the road more effectively when it is also communicating with the infrastructure. For example, to provide the autonomous vehicles with real time information about which parts of the road are having all traffic lights on green when the vehicle is passing that road. This way the information the vehicle gets makes vehicles move faster through the city. This will have several advantages. When vehicles move faster through the city, less traffic congestion will take place. Furthermore, the city can partly control the vehicle stream in the cities by communicating with the automated vehicles in stead of letting the vehicles always decide themselves which road to take.

In this case a key partnership with Google is needed. ARS T&TT can provide the governments with the technology needed in the infrastructure. However, the government needs to cooperate with Google to ensure the communication between the infrastructure and the vehicles operates smoothly.

The government then, will also be the party that pays for the technologies for the infrastructure. The government values the traffic flow and the safety of the road a lot, so they are willing to pay to make it more efficient and more safe. Similar to how they do now.

# 4.4 BUSINESS MODEL TRANSITION

The transition phase between the current business models and the business models needed for future scenarios is different per scenario. Therefore all transitions are discussed in this chapter. In Chapter 4.3 the changes ARS T&TT should make in their activities are already described, so the focus of this chapter lays on the pricing model.

**Scenario 1 - Sharing is caring**
The business model for this scenario is the same as the current business models. No transition phase is needed. This scenario is therefore easily applicable for ARS T&TT. Open data is the scenario that is possible to be reached in very short time. Although the pricing model is not changing, the activities ARS T&TT is doing will change in order to realise this scenario. ARS T&TT can start processing the data into knowledge today.

**Scenario 2 - Scared to death**
For this scenario the business model should change, although the customer is the same. The product ARS T&TT is selling to the government is not only data or processed data, but also a service to decrease the gap between the perceived safety and the reality. The focus in the transition phase will lay on the marketing aspect. Via marketing ARS T&TT can tell the story about the safety in autonomous vehicles. Next to that, it is important to inform the customers (road operators) about the issues they will have in the future, so that they can start searching for a solution. Currently, ARS T&TT lacks a well-established marketing department and it is of high importance the on-time investment in marketing and all corresponding activities, as a means for successful product sale.

**Scenario 3 - Google is watching you**
In this scenario there is a major transition in the role the road operators are playing in the traffic management field. Because ARS T&TT is doing business with road operators it is important to advise them about how their role is going to change and what they should do to keep control of the traffic management. Google will have a lot of control of the traffic in this future scenario, but yet they can still work together with the road operators to improve it further. Google will have different motivations to redirect traffic than the road operators were used to, because the customer of Google is the individual driver, whether the customer of the road operators are all users of the road or city (pedestrians, bicycles, car drivers, trucks). During the transition phase to this future scenario ARS T&TT should advise the road operators by giving workshops or organise co-creation sessions. This way the road operators are involved in the transition phase and better prepared for the future.

Next to informing the road operators, ARS T&TT should also invest in data processing capabilities, so that they are ready for the future as well as the road operators and so ARS T&TT can supply the road operators with the ITS solutions needed for vehicles controlled by Google.

# 4.5 CONCLUSION

The major insight of this chapter is that the role of the road operator is changing in the future, but the road operator stays the customer of ARS T&TT. ARS T&TT should be connected very closely to the road operators and maybe change the relationship they have with them from supplier to advisor. The road operators are lacking information about how to change their traffic management role into a way they are ready for a future in which the mobility is changed so much caused by technology. Next to the role of the road operator it is also needed that ARS T&TT focuses on future activities. Raw data will lose its value, but the value of processed data (into knowledge) is growing in the future.

The next chapter will continue with a marketing strategy and plan for the coming two years for ARS T&TT. It all starts with a marketing goal that is set in the first section. The marketing goal is derived from all earlier research done in this report and conversations with managers of ARS T&TT.

# 5. MARKETING STRATEGY

## 5.1 MARKETING GOALS

This project was initiated due to an emerging need of ARS T&TT to gain marketing knowledge. ARS T&TT is an expert within the Dutch ITS market. As mentioned in the beginning of this report they are doing business with NDW, the organisation that gathers all traffic data in the Netherlands. NDW has started acquiring data from other sources (floating car data). This data is competitive with the data ARS T&TT is providing. Therefore, ARS T&TT has to find new value they can offer to NDW or to other customers. In the past the marketing strategy of ARS T&TT was passive. Due to the competitive market they want to change to a more active attitude. This chapter provides an advice to ARS T&TT about marketing strategy and activities.

Where branding is the invisible part of the iceberg, marketing activities are the visible tip of the iceberg, see Figure 29 (Brandfabric, 2018). The building blocks are changed in order to fit the scope of this project. The brand is containing the strategic building blocks for a marketing strategy. In this chapter the strategic building blocks for a marketing strategy for DW&S are created. The starting point for the marketing strategy is the marketing goal. Then the positioning in the market is described and after that the marketing strategy advised to ARS T&TT. Finally the marketing activities fitting the marketing strategy are presented in a tactical roadmap in a two years timespan. This advice is based on the analysis described in Chapter 3 of this report.

The goal of marketing activities answers the question "Why are we doing marketing?". The 'why-question' is the inner circle regarding Simon Sinek and is the very important starting point for a lot of activities (Sinek, 2010). Sinek does not believe that making profit is a valid reason for a company to exist. There should be a more valid "why" and every company should be able to describe there "why".

For this project the answer to the question "why are we doing a marketing program?" is the following:

*Positioning the products of the department of DW&S of ARS T&TT in the market will improve the story that the department is telling, so that:*

*1. International potential partners are getting aware of ARS T&TT as a company which will encourage market development.*

*2. Customers are considering ARS T&TT as a supplier of ITS solutions which increases the market penetration.*

Both goals are steps in the marketing funnel, see Figure 30. The first goal is about growing awareness, the first step to turn leads into customers. The second goal is to make potential customers consider your product. This is the second step in the marketing funnel. The other steps in the funnel are purchase, repeat and loyalty. All steps in the marketing funnel demand different marketing activities. The sales department is also playing a major role in the last steps of the marketing funnel. The funnel is adjusted a bit for this project. There

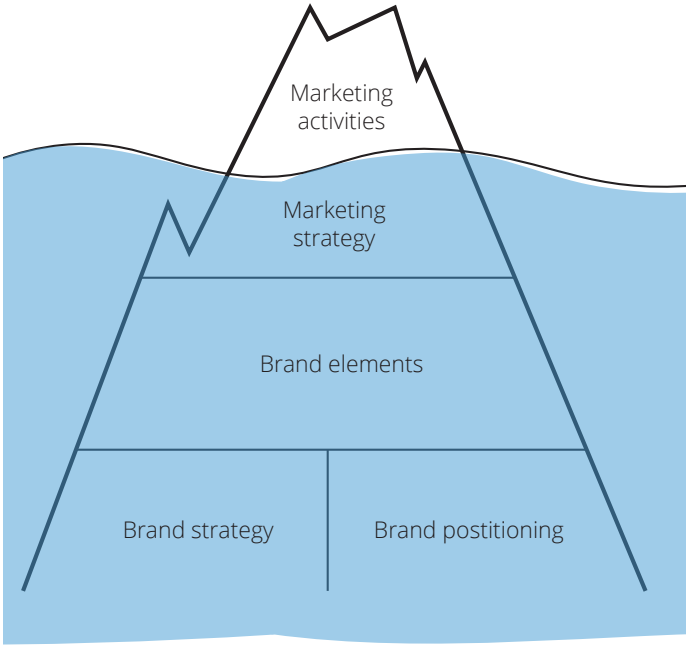



*Figure 29. The tip of the iceberg: Marketing activities and the brand building blocks (Brandfabric, 2018).*

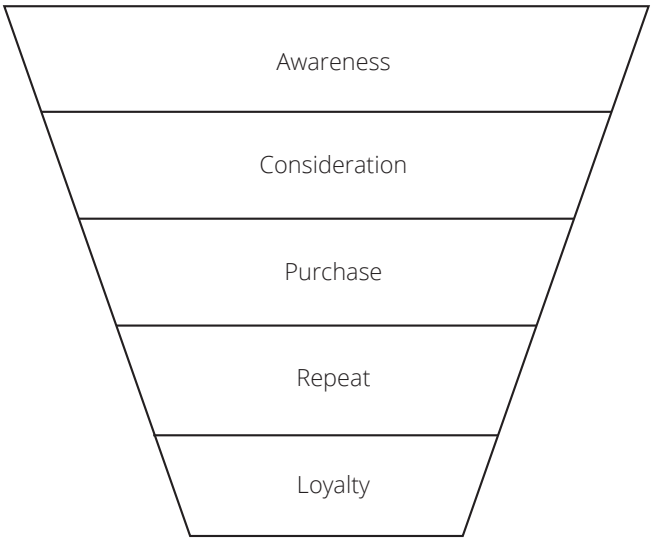



*Figure 30. Marketing funnel: turning leads into loyal customers (Finesilverdesign, 2018).*

are many different, but similar marketing and sales funnels. The inspiration for this funnel came from Finesilverdesign (Finesilverdesign, 2018).

**Target groups**

The marketing goals are divided in two parts, because they target different groups. The target group of the marketing strategy is therefore also divided into two groups: ***international partners and customers*** (see Figure 31).

***International partners*** are other companies in the ITS market in countries close to the Netherlands. These potential partners are key players in the other countries, with less developed ITS solutions as in the Netherlands.

***Customers*** of ARS T&TT are segmented in two segments for this marketing goal. Not all customers has the same benefits, therefore they should be targeted differently. The first segment are road operators, including central governmental organizations, local governmental organizations and municipalities. The second segment are the police. This segmentation is based on the customer value analysis presented in Chapter 2.4 (page 35).

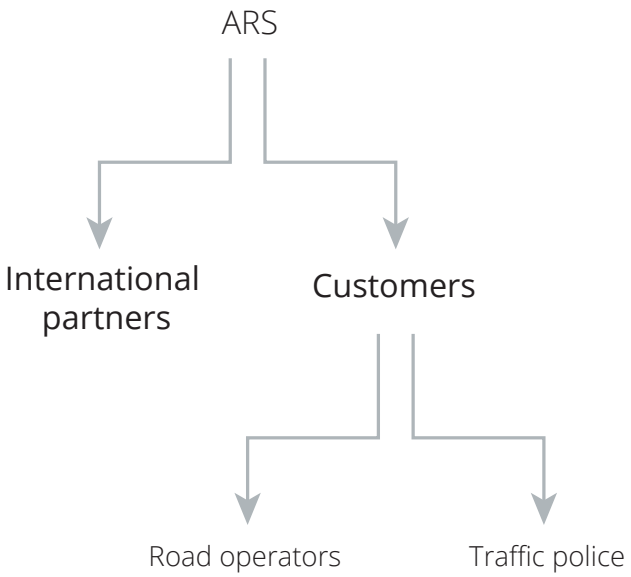



*Figure 31. Target groups for the marketing strategy of DW&S.*

## 5.2 BRAND POSITIONING

The positioning of the brand clarifies what the brand has to offer. Positioning a brand in the market is also telling the customer what the difference is between the brand and its competitors. A good brand positioning should contain the following elements (Aaker 1996):
- The target audience
- The product category in which it operates
- Product attributes
- Functional benefits
- Emotional benefits
- Self-expressive benefits

In what follows, we propose a brand positioning approach for the product portfolio of the department DW&S:
For **European road operators and enforcement,** DW&S offers end-to-end **ITS solutions** that are **tailor-made business cases**, delivers **excellent quality** and makes drivers **trust the road** and feel **in control.**

For the positioning of the products of DW&S there are two ***target audiences*** in the goals set in chapter 5.1: Potential partners and customers (road operators and the police). For the positioning the focus lays on the customers, because those customers will also be the customers of the potential partners, so the partners will be able to recognize themselves with this positioning.

The ***product category*** the traffic data warehouse fits in are ITS solutions. The ***product attribute*** highlighted in this positioning is the customization opportunities of the products. ARS T&TT is flexible in every project. The ***functional benefit*** they have is the quality they deliver with their products, this is the quality of the data. The ***emotional benefit*** in this positioning is new for ARS T&TT, but regarding the research done in this report not new for the market. Feeling trusted, the chosen emotional benefit, is important when technology is developing, due to a general distrust in technology. The last element is the ***self-expressive benefit*** ARS T&TT can serve to their customer. The driver should feel in control of the situation on the road. No matter if he is driving a normal vehicle or an autonomous vehicle, the feeling should not change.

## 5.3 BRAND STRATEGY

The strategy of a brand answers the question "Where are we going?" or "What do we believe in?". The branding strategy of this brand exist of the vision of the company and the core values fitting the brand. The vision is based on the internal and external analysis done in this project. Next to that it is important to create an absolute contradiction in the brand strategy. This means that the contradiction is measurable . An example of an absolute contradiction is trying to reach 'zero-accidents' in stead of 'increase safety'. 'Zero accidents' is clear and measurable, where increasing the safety is something that is hard to measure.

In this section, we propose a vision for ARS T&TT:

**We believe that the communication between vehicles and infrastructure is key to create a traffic environment with zero accidents.**

Right now, this brand strategy is not discussed with the members of the company. This is an important next step for the employees to believe and support the brand strategy. When communicating the brand strategy to the employees the strategy may change a bit to fit the values and beliefs of the employees. This is a cooperative process. The input of all members involved in this process is valuable and has influence on the vision of the company.

# 5.4 FURTHER BRAND RECOMMENDATIONS

Setting up a brand, requires more time than possible during this project. Therefore some recommendations for further brand developments are suggested for ARS T&TT.

The brand building blocks are important to build before starting marketing programs. In this chapter a positioning and a strategy is created. However, note that it is subject to further extension and elaboration, once decided on practical implementation. This can be done by organizing small workshops with the department of DW&S to align the vision and adjust it when the members of the workshop does not feel in line with this positioning and strategy. This way the positioning and the strategy are created with the company and so the employers are feeling the brand themselves.

When the positioning and the brand strategy are definitely, the next step to be taken is: Building the brand elements of the brand or adjusting current brand elements so that they fit the brand positioning and strategy. Examples of brand elements are: Brand name, logo, symbols, slogans or other characteristics that identifies the product and distinguishes it from others. For the data warehousing and sensoring department the brand elements do not really exist. The company has a name, but the products in general do not have a certain element. The data visualizer has a name (TDWC). The department should choose to keep this name or to improve it. The data visualizer is only one product of the products the department is delivering. Therefore ARS T&TT should rethink what their product portfolio exactly is and which products can fit in the same brand and which products should be branded differently. According to Keller (2013) in his book *"Strategic Brand Management"*, brand elements should have the following criteria:

- Memorable (easy recognized and recalled)
- Meaningful (descriptive and persuasive)
- Likable (interesting and aesthetically pleasing)
- Transferable (within and across product categories)
- Adaptable (flexible and updatable)
- Protectable (legally)

The brand elements represent the brand positioning and strategy. They are very clear in communicating the message of the brand and will be used in every marketing expression. Therefore this step should be taken before any marketing activity is launched.

Branding is not only used in consumer marketing products. Also B2B organizations use branding as a tool to communicate their products to other companies. Examples of B2B companies with a very clear brand are General Electric and IBM, see Figure 32. Branding helps them communicating their beliefs and so they will also hire new employees with the same beliefs and values. Next to that the value of the products and services they sell, increases value due to the brand. The brand value of Microsoft was 27% of the total market capitalization and for GE this was 19% (Keller, 2013).


*Figure 32. Two examples of B2B companies that use their brand elements to communicate their beliefs.*

# 5.5 MARKETING STRATEGY

The focus of this section is to create the marketing strategy. The strategy should always be in line with the marketing goals set in the beginning of this chapter. The marketing strategy is the pathway to reach the goals mentioned in Chapter 5.1. Figure 33 is a visual demonstration of the marketing strategy. The marketing strategy consists of three paths to reach the two marketing goals. The strategies are supported by activities ARS T&TT could carry out to reach the goals. First we describe each path, followed by the necessary activities to proceed in each path in Chapter 5.6.

**Increase visibility to potential partners**
ARS T&TT wants to expand their market in international directions. To let organizations, that could be potential partners, know ARS T&TT is existing, the company should improve their visibility to those organizations. This can be done in several ways. One of them is to seek for new channels to reach those potential partners. Channels to reach partners are business fairs, trade magazines, face to face communication, company website etc. ARS T&TT has a strong story, because they did very well in the Netherlands. Potential partners from foreign countries could be very willing to listen to this story and benefit from a partnership with ARS T&TT. The channels should be chosen carefully. Since it is better to enter the foreign markets one by one and considering them all apart from each other, ARS T&TT should dive deeper into each country so they can choose the channels how to reach the potential partners in those specific countries.

**Change the focus of the communication**
The core of the communications for marketing purpose, must be customer-focused. That is, to convince customers via simple terms and scenarios that the product can help them addressing their existing / emerging problems. This can be done by improving the building blocks of the brand. In this case the product the department of DW&S is selling is the data they has gathered with traffic sensors. this also includes the data viewer (TDWC).

As soon as the brand building blocks are made, ARS T&TT can communicate this brand and the values via their own website and other marketing materials

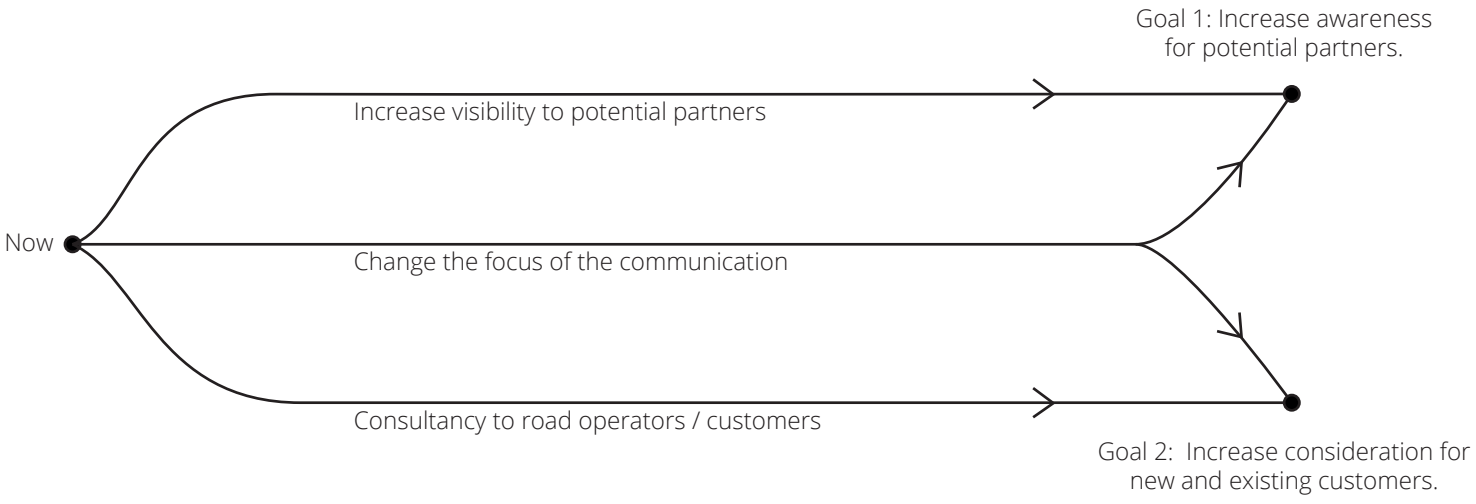



*Figure 33. Marketing strategy, the pathways to the marketing goals.*

# 5.6 MARKETING ACTIVITIES

and channels. Choosing the right communication material and medium is of critical importance to reach and influence the target audience. This communication is valuable in all marketing activities. It improves the story ARS T&TT is telling to the outside world. This pathway is helping to reach both the marketing goals. Telling a clear story will help ARS T&TT to convince partners they are a great party to work together with and it will also attract the customers, because they are the subject of the communication of ARS T&TT in stead of ARS T&TT itself.

**Consultant to road operators**
An important responsibility of ARS T&TT, is to advise the target audience on their ever-changing role in the ITS market. For instance, the role of road operators has been changing significantly over the last decade and will continue to change. However, prior knowledge to such changes are not necessarily known to the road operators. Hence, ARS T&TT can be an influential factor in envisioning their future role.

This brings opportunities to steer their idea of the future to an idea ARS T&TT likes. This helps them choose for ARS T&TT in the (near) future. An example of executing this is building a show case that shows the future city and all technological developments taking place in that futuristic city (For example, The Hague, choosing an existing city makes it easier to connect with the show case and furthermore an existing city is more complex than a imaginary city). This increases the possibility to invite customers over at the office and present them this future. The customer is learning from those meetings and the relation between ARS T&TT and the customer is improving as well.

Figure 34 shows a detailed overview of the marketing activities ARS T&TT can execute to reach the marketing goals. Activities are visualizes with the square dots on the lines of the themes. The dots has two sizes, the bigger dots are the most important. For example, the start of the blog is more important than writing a blog post. The writing part can be done next month as well (but preferably not). Those activities fits the three pathways mentioned in the strategy. Below the three paths are described.

**Visibility**
To improve the visibility of ARS T&TT to potential international partners, ARS T&TT can display itself better in trade magazines and at fairs. Figure 35 shows, in blue, the activities aligned with this strategy path. NM Magazine is the Dutch trade magazine for the ITS market. IEEE ITS magazine is an international magazine that publish papers. ARS T&TT can try to publish columns, advertisement or articles in those magazines to make companies in the market more aware of ARS T&TT. Next to that the company can also display itself at business fairs and symposiums. This activity should be combined with the activities in other paths of Figure 34. The new brands and core values can be used to improve the material ARS T&TT has on business fairs. Some business fairs are mentioned in the figure, but for foreign countries ARS T&TT should still choose the activities to go to.

**Focus**
To change the focus of the communication of the company their are three themes: Branding, communication and website. Figure 34 presents those themes in red. The brands of ARS T&TT should be defined more clearly. This starts with defining the core values of ARS T&TT itself and of the departments. After that the brand elements can be designed.

Furthermore, the focus of the communication can change to the benefits of the customers, in stead of the technological features of the products. It will take some time before all communication has changed.

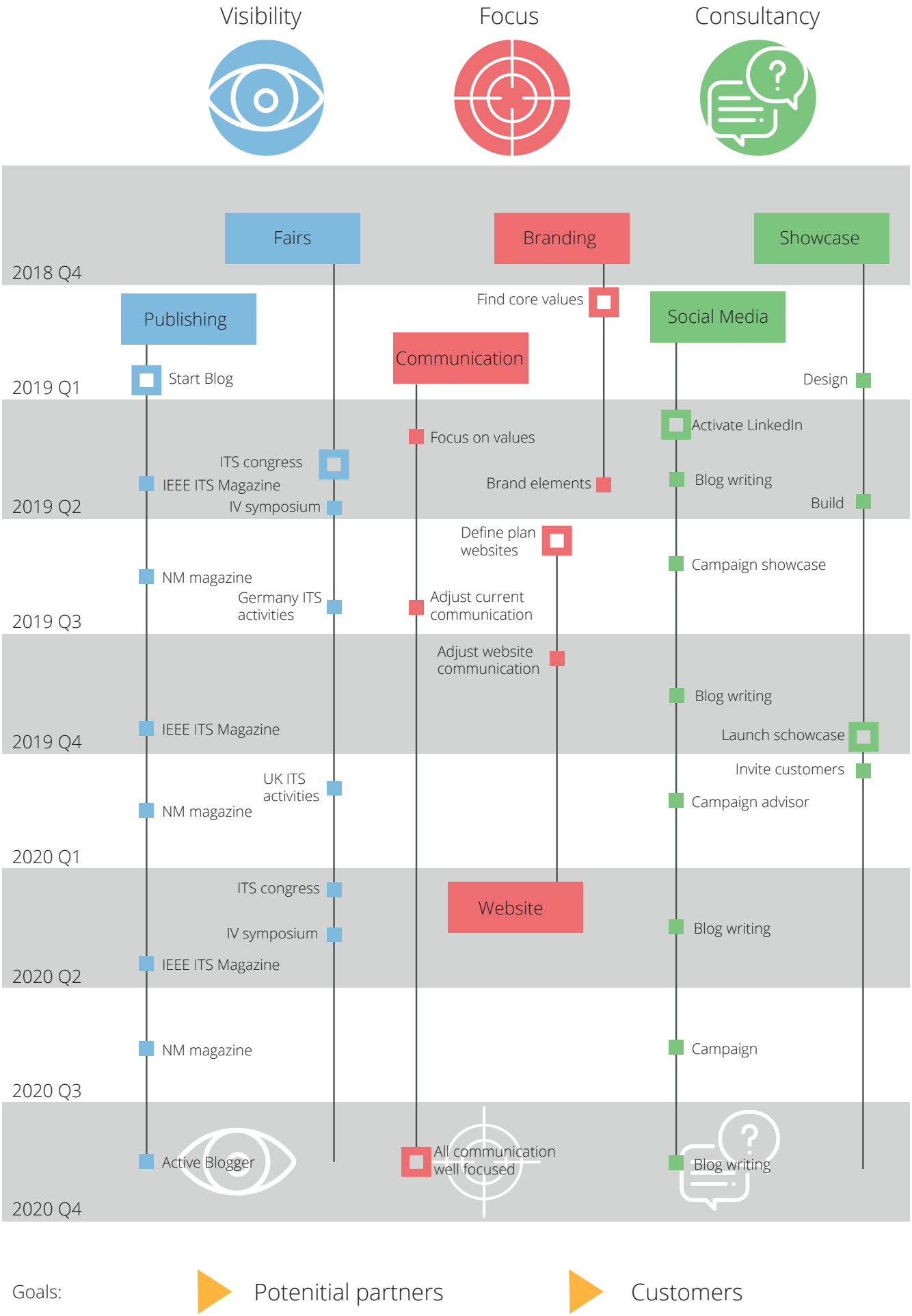



*Figure 34. Marketing activities, a tactical roadmap.*

However, this will be possible in a period of 2 years. This should also be applied at the corporate website of ARS T&TT. After the brand elements are build, there should be decided if some groups of products need their own website or not.

**Consultancy**
The last theme is to be take the role of consultant for customers of ARS T&TT. Figure 34 shows this path in green.

As mentioned earlier in this report an opportunity to connect more to customers is building a showcase of the smart city of the future. This way ARS T&TT can invite customers over to the office and show them how they see the future city and what the role of the road operator (the customer) will be in this vision. ARS T&TT can build trust and be more of an advisor to the governmental organizations.

ARS T&TT can also give advise to the customers via social media campaigns. This way they can tell their story via on line channels. A few examples of activities are: Activation of LinkedIn page, campaigns (about the showcase or new brands) and via blogs. Being visible to customers will improve the relationship.

# 5.7 CONCLUSION

The marketing strategy introduced in this chapter is an advice for DW&S. The strategy includes the marketing goals, brand positioning, brand strategy and the marketing strategy. The brand is the basis of the marketing activities. Without branding the marketing activities are missing direction and coherence. Therefore this advice also includes recommendation how ARS T&TT can improve the brand of the traffic data warehouse.

When the brand is created, the marketing activities can be set up. This chapter advises ARS T&TT to reach the marketing goals via three pathways. Those pathways will increase the visibility for the potential foreign partners, it will change the role ARS T&TT is playing from only supplier to also an advisor for the customers and the last pathway is that ARS T&TT improves the focus of the communication. Following these pathways will increase the awareness of potential partners and increase the number of considerations from new and existing customers. A tactical roadmap shows the activities fitting best to the strategic paths chosen to reach the marketing goals.

The research and analysis done in this project serves as the input for the marketing strategy. The analysis highlighted the areas DW&S requires improvement. For example, the lack of marketing within the company or the opportunities to grow in an international market direction. The marketing goals are based on those opportunities. The marketing strategy merges the whole project together into a final advice.

# 6. DISCUSSION

## 6.1 EVALUATION

In this chapter we evaluate the project according to the problem defined in Chapter 1.2. By doing this research the problem of the assignment became more clear. The market is changing due to technological developments. ARS T&TT is an expert in stationary sensor data, but with the technological developments these sensors might be out-dated. This thesis formulates an advice about how to change the value proposition of the department responsible for the stationary sensor data to be ready for the future.

**Analysis**
The analysis part of the project provides insights in the company, the competitors, the context and the customer. All components of the ITS markets are mentioned in this analysis. The analysis is executed thoroughly. This supported the creation of the strategic roadmap and the marketing strategy. However, at customer level the analysis was lacking a bit. The current customers were analysed very good, but the future customers could be analysed more as a design thinker. It was not manageable to have contact with the customers themselves, what makes it hard to find what they really want in the future. Therefore, some assumptions were made in this part of the analysis. Nevertheless this analysis contributed to a clear view of the context of the project. Due to that, the problem itself was more clear and so it is easier to find a solution for the problem in the form of a strategic roadmap and a advice for the marketing strategy and activities.

**Strategic Roadmap**
The roadmap illustrates the strategic path to 2030. It visualises the technological developments, market trends and product time line of DW&S. The product line is created in the last phase of the strategic roadmap creation. Due to that, the roadmap takes into account that the market is going to change and the products of ARS T&TT should be changing as well. The roadmap is constructed based on the analysis in this project. Beneficial to that is the roadmap is constructed unbiased. However, it could be insightful to include the opinions of the employers of ARS T&TT and especially of the department of DW&S as well. A cooperative process would have increased the likely-hood that the roadmap fits the employers and that they adopt it.

**Marketing strategy**
The last Chapter of this report advices a marketing strategy for ARS T&TT. The marketing strategy includes brand building blocks and a roadmap for

marketing activities for the coming two years. The marketing strategy is aligned with the analysis and the product roadmap and it is also based on the initial problem stated in the beginning of the project. Increasing the marketing capabilities of ARS T&TT will increase the awareness of customers of ARS T&TT. IT will also expand the market share of the company.

In this chapter some recommendations are done about the brand building blocks of DW&S. Initially the brand of the products was not part of the project, but without any brand, the marketing strategy has no basis to build further on. However, the brand building blocks are only explored minimally. And next to that they are not created together with the employees of ARS T&TT.

In the end of the Chapter 5, a roadmap is created with a detailed planning of marketing activities in the coming two years. This roadmap is more tactical and will support ARS T&TT in the further steps in marketing. Unfortunately, some of the activities are still not so detailed as required for this roadmap. An example are the business fairs in foreign countries. Those activities are planned to execute in a year from now, but the fairs are not planned yet.

Over all, the process in this project is evaluated very well. The proposed planning in the beginning of the project is followed well. This supported the decision-making processes during the project, because the next phase was going to start so decision-making was necessary. In general, the project should contain the three innovation domains: human, business and technology. The human factor is somewhat lacking, because ARS T&TT is a business to business company and the user was not researched that well. But the other two domains are analysed quite intensively.

# 6.2 RECOMMENDATIONS

Throughout the report advice is given on how ARS T&TT can approach the market more actively. This chapter provides recommendations for improving the marketing and strategy of the company.

**Strategy in general**
For a company it is important to know their own direction. If a clear strategy is communicated through all layers of the company, all employees know where the company is heading to. This also encourages taking responsibility, because members of the company are more confident about the decisions they have to make.

Within ARS T&TT the strategy is not clear. The strategy is not communicated well through the company nor to the external parties, via the website for example. This can be improved by communicating the strategy via e-mail or the website to the employers.

**Marketing department**
This project was started, because of the lacking marketing expertise in the company. Hiring interns to help ARS T&TT with the marketing activities is a good starting point to start up a department like this. However, I recommend to start building the marketing at company level. The company consist of different departments that all operates in the ITS market, but at very different sections (public transport, roads, parking, enforcement etc.). Marketing at company level will help positioning the company in the market, so it is known in every section of the ITS market.

After that I recommend ARS T&TT to start building their own brand portfolio, so they can position the different departments in the market separately. And after that, marketing activities can be set up for individual products or services. A more experienced marketing manager would help setting up this department. The department can consist of people who operates in different other departments as well, if at least one manager organise it.

**Brand TDW**
Chapter 5.4 presents some further recommendations for the development of the brand TDW within the department of DW&S. Keeping the previous recommendation about the marketing department in mind, it is important to build a strong marketing strategy company-wide and after that build the brand for the traffic data warehouse.

**Data processing**
One important insight of this research is that the capability to process data will be very important in the near future. Data becomes more open and easier accessible, so the data looses its value. Therefore I recommend ARS T&TT strongly to invest in their own data processing capabilities or invest in start-ups that are doing so. The report mentions earlier that ARS T&TT can work together with start-ups to exchange the data they have for processing tools of the start-ups. Investing in data capabilities means that ARS T&TT should hire new employees with those skills or educate the current employees to acquire the skills needed for data processing and merging. It will be a strong resource to have, because the amount of data we are producing has not stopped growing, so data will stay very relevant for a longer period.

# 6.3 REFLECTION

This graduation project combines a lot from what I have learned during my studies, Strategic Product Design. I combined product and marketing strategy into one project, the two things I loved the most during my Master.

Setting up a graduation project like this, was not easily done. In the beginning I felt a bit drowned in everything that needed to be arranged. I had set requirements for myself to find a project that suits me and my skills. I preferred being within a company to gain experience in the business field. Because of those requirements I had to arrange a project, a company and a supervising team at the same moment. But after all, it went very well and within ARS T&TT I found a project that suited me and the supervisory team I found. During the project I got more used to being in the lead of the project and the meetings regarding the project. Of course, this is not so surprisingly, because I was the expert of this project. It also meant that I had to merge what I wanted myself, what the company wanted and what my supervisors wanted. I listened carefully to all stakeholders and tried to make my own decisions in the end. This way the steps I took were chosen carefully and with all stakeholders in mind.

When I started this project the focus lay on the data visualizer ARS T&TT had started developing. However, after a few weeks I found out that the market was so interesting and changing, that not only the data visualizer was important to look at, but the whole product portfolio of the department of data warehousing and sensoring needed to be the focus. This was one of the most important insights I had for the direction of the project. It also made the project more fun, because the challenge was more clear. I could use my strategic skills better when focusing on the whole market in stead of only one product.

Before starting the graduation project I was a bit scared, because the project is individual. The fear was not unjustified; the whole project I was the only person that had to make the next step. Of course, people helped me during the project, but in the end the decisions and execution of the steps I had to make and do myself. It feels satisfying that I ended this project successfully, but in the future I prefer working in teams again. When I look back on my studies (both my Bachelor as my Master) I really enjoyed the teamwork. I can not remember teams I did not like during this years. In the future I hope I can work with teams like that again.

Report writing is not one of my best developed skills. During my Master studies I tried to improve it by taking a writing course and exercise in other courses. But writing a Master thesis is very different from the smaller reports I have written those years. I am glad my supervisory team (both from ARS T&TT and the TU Delft) supported me in this process. I think there is still much room for improvement, but I am satisfied with the progress I made this half a year.

Over all, I am satisfied with the result I presented in this thesis report. I am grateful to ARS T&TT to have me in its company.

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# 8. APPENDICES

# B. Description competitors

Vialis
Vialis has 100 years of experience in infrastructure and mobility. The company is part of VolkerWesselsStevin. They offer advice, fysical products and digital products (software). Vialis introduced Verkeer.nu, a platform where road authorities can monitor road difficulties.

Dynniq
Dynniq emerged from PEEK Imtech. They are active in three different markets; energy, mobility and parking. Dynniq has 1800 employers all over the world with their headquarters in Amersfoort, the Netherlands.

Siemens
Siemens is operating in a lot of different markets. One of them is the mobility market. 2600 people are working within the ITS department. They offer different products/services in the mobility industry, including a traffic control center, which is a modular platform for the most diverse urban scenarios. Siemens is founded in Gemany in 1847 therefore the head quarters are still in Germany.

Swarco
Swarco is founded in Austria, but operating in different countries including the Netherlands today. They are specialized in the transport and traffic market. Swarco doesn't have a product that is similar to a data viewer. They do have some products that shows information to the consumers. 2800 employers are working at Swarco.

Royal HaskoningDHV
Operating in several markets: Buildings, infrastructure, aviation, energy, maritime, water etc. They developed a data visualizer together with Path2mobility (called Datack). The platform shows real-time and historical data. They use data coming from NDW and KNMI. 120 advisors are working at the department of transport and planning in the Netherlands.

Sweco/Grontmij
Sweco wants to build the cities of the future, so they are specialized in different markets regarding future cities; mobility and infrastructure, buildings and real estate, energy, water, industry and area development. The data visualizer they have is similar to what ARS T&TT is developing. They do differ in the business model of the product. Sweco sells the visualizer as addition to the consultancy work they do. This means that a consultant is working with the visualizer for the client.

Oranjewoud/Antea Group
In 2013 Oranjewoud is taken over by Antea Group. Antea group is delivering a lot of different services, including ITS. Some reference projects are available on their website, no one looks like a data visualization platform. In 2014 Antea group had 3200 employers worldwide. A small part of them worked for ITS purposes.

Logica/CGI
CGI is active in the ITS market (largest in Saudi Arabia). Has several reference projects in other countries regarding to ITS. Logica is adopted by CGI in 2012. I assume the ITS department is not so big.

Technolution
Mobility is one of the four markets Technolution is working in. They have 200 employers in charge.

Technolution does have a product that visualizes data, Moby Maestro. Technolution is active in the dutch market.

CAPGemini
CAPGemini is specialized in a lot of different IT market, including a small part of transportation. In the Netherlands CAP Gemini has around 5500 employers, but not all of them work in the transportation market.

Here
In 1985, Here began with the simple goal to digitize mapping and pioneer in-car navigation systems. Over the next three decades, as NAVTEQ and Nokia, They have built a legacy in mapping technology. Today, they are creating living three-dimensional maps that grow upwards, breathing with layers of information and insights. They have 8000 employers over 200 countries. Here does have a Visualization platform. HERE Traffic Analytics helps enterprise and government customers make informed decisions about future traffic flow management by using historical road traffic data.

Be-Mobile
Be-Mobile is a world leader in smart mobility, enabling public authorities, road operators, car manufacturers and private companies to lead the way for travelers towards seamless travelling. They are headquartered in Gent, Belgium, but active in Europe in the smart mobility market. Be-Mobile developed a traffic platform, called Flowcheck. The platform is based on Floating Car Data only. Be-Mobile has 90 employers.

Hig
Hig is active in the field of building solutions and traffic systems. They are working in the Netherlands only and they also have their headquarters in the Netherlands. They react on tenders as well as ARS is doing. It seems that they don't have a data visualizing platform. IBM has 380.000 employers all over the world. Not all of them are directly working for the transportation market.

IBM
IBM is an organization active in a lot of (technical) industries, including Infrastructure and citizen services. For example they did a project for the local government of Eindhoven. They used existing FCD and sensor data to optimize the traffic in the region. IBM is selling a weather and location data package to companies. It seems that IBM builds the analytics engine around data, but they don't gather data themselves.

# C. Interview guide Proposition Canvas

**Main questions interview**

What are the values of the current customers?
What is (dis)satisfying the current customers?
Can we segment the current customer-database?

**Introduction into the project**

- Market analysis for the TDWC
- Low level of experience in active commercial projects
- Focus on customer to get to know them better
- Introduction into the Value proposition Canvas
- Goal of this meeting: Find out values, (dis)satisfaction, right segmentation

**Customer segmentation**

I segmented the current customers in 5 main groups. NDW is not one of them, because I want to focus on the end-customer for this project. This are the five groups:

- Police
- City government
- Province government
- Rijkswaterstaat
- Ministry infra, water and environment

Do you agree with this segmentation?
Did I missed important customer segments? Shall we add them?
What do you know about Havenbedrijf Rotterdam? Should we add it?

**Value Proposition Canvas**

I want to fill the right side of the canvas for each segment. It is all about the customer so lets try to forget the product and focus on what the customer values.

JOBS
What functional job is ARS helping this client to get done?
What basic needs is ARS helping the client to satisfy?
How important is each job? Can we scale them?

Probes:
What is the role of the client in these jobs?
Why, why, why?

PAINS
What is too costly for the customer?
What makes them feel disappointed?
How are the current solutions underperforming for the customer?

What are the main difficulties and challenges they encounter to get their jobs done?
What risks do they fear?
What barriers are keeping them from adopting solutions ARS is offering?
How extreme is each pain? Can we scale them from 1 (no pain) to five (lot of pain)?

Probes:
Why?

GAINS
What outcome does the customer expect and what would go beyond their expectations?
What will make the jobs easier?
How do current solutions delight the customer?
What is the customer looking for?
How do they measure success and failure?
What would increase the likelihood that the client adopt solutions of ARS?
How essential is each gain? Can we scale them from 1 (not essential) to five (very essential)?

Probes:
Why?

**Future customers**

I explored some new ideas of customers we can reach in the future. For example:

- Environmental organisations
- Gas stations
- Event agencies
- Logistic companies (harbor)
- Public transportation or taxi's
- Media companies (bill boards along the road)

Do you have any ideas for new customers for TDWC?

Why this one?

Thanks for helping! The next step I prefer to do is interviewing the customers to check if you are right or that they value other things. Do you think this is possible and can you help me to get in contact with the customers?

# D. Brainstorm Search areas

To gather fresh ideas for interesting search areas a brainstorm workshop is organised with students of the industrial design faculty. These participants are chosen because they are unfamiliar with the topic and so they have a unbiased view on the subject. Two participants took part in the brainstorm workshop and the moderator of the workshop also joined the creative parts.
The workshop is set up to gather more search areas. Search areas are the intersections of trends in the market with strengths and weaknesses of the company. These trends, strengths and weaknesses are the insights from the analysis earlier in the project. A table is made with all intersection points visualized as boxes. These boxes are filled with 'search area'- ideas, written on post-its.

**Workshop flow**

First the participants of the workshop are introduced to the topic by the moderator. The introduction includes some company background, an explanation of the department data warehousing and sensoring, the assignment for the project and the goal of the workshop. After the introduction some rules for the brainstorm are explained:
- Filling in the boxes
- Own tempo and structure, you can start wherever you want in the table
- Not all boxes need to be filled in the end
- All ideas or thoughts are aloud. Even when it has a negative influence for the company
- Ask questions if needed
- The moderator is joining as well

After the introduction the brainstorm started. For the participants it felt a bit difficult to start. So it took some minutes before the first post-its were on the table. But after the start it became easier to fill the table. After around 20 minutes a short break was scheduled. When ready again the brainstorm went on for a few more minutes.

After the creative part all post-its in the boxes were discussed together so that more explanation about the ideas could be added when the ideas were not clear. Almost half the table was filled at this moment. A lot of new ideas were gathered which made the brainstorm workshop successful.

# E. Categorized search area tables

**Search areas for ARS T&TT in the ITS market**

| | Other countries<br>O1, O2, T2 | Smart city<br>O3 | Other markets<br>O4, O5, O14 | Environment<br>O6, O7 | Blockchain<br>O8 | Connectivity<br>O9, O10, O11, O13, T4 | MCD/FCD<br>O12 | Competitors<br>T1 | Shared economy<br>T3 | Quality controls<br>T5 |
|---|---|---|---|---|---|---|---|---|---|---|
| Network road operators<br>S1 | | Counting pedestrians, bikers and scooters etc. | Weight of caravans in the road | Road operators also care about the environment | | Advice road operators about new technologies | Faster detection of new roads in maps by using FCD | | Carpool functions<br>Cooperate with BlablaCar | |
| Stable position<br>S2 | Copy good things to other countries | | | | | Stay up to date in the recent technologies | | Invest money in development before competitors are in front of you | | Improve quality by combining FCD and stationary data |
| Tender offerings<br>S3 | React on tenders in other countries | | Pitching ideas in other markets then ITS | Focus on tenders with an sustainable direction | | Research tech or react on interesting tech tenders | Acquire FCD related projects | Research into what tenders competitors react on | | |
| Road sensors<br>S4 | | Weather data or data coming from satalites | | Vechicles receive information about their impact on environment | | Road sensors connected with in-car apps | | Focus on own strength (and market them) | | |
| Own data warehouse<br>S5 | | | | Watch environment stickers in these zones | | | | | | |
| Lack of marketing<br>W1 | | Build a show case of a smart city | Hiring a marketing expert with experience in similar cases | Stimulate car pooling behavior by showing data | | | Invest in tech that can detect the 'hidden' cars for FCD | Looking at competitors how they are doing their marketing | Cooperate with companies with a lot of marketing experience | Promote the good quality results |
| Passive attitude<br>W2 | Copy current experience in less developed countries | | Show taxi's on a map (also in other countries) | Use data to count trucks etc. | Research the possibilities with blockchain and ITS | | | | | |

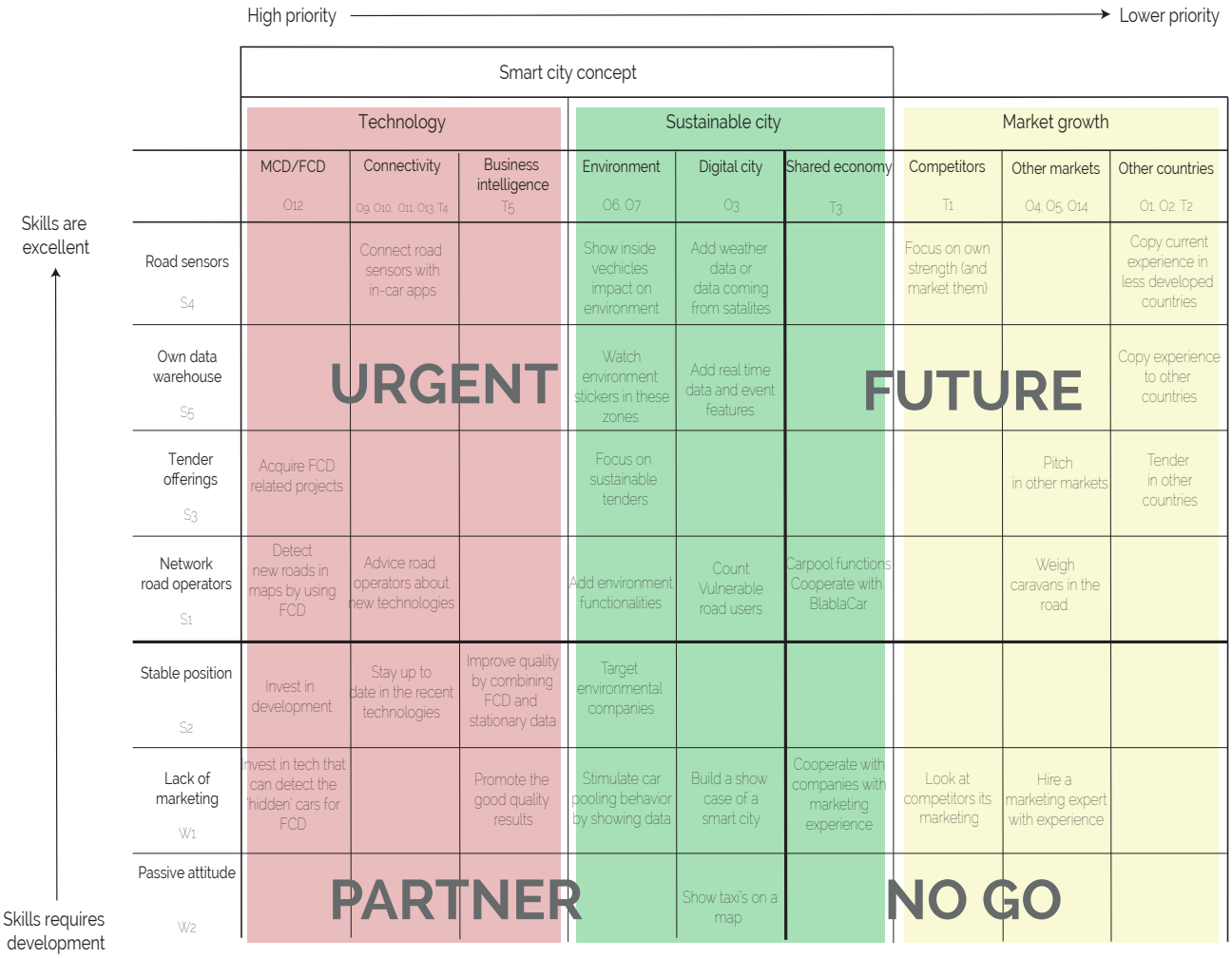
Data visualiser
Traffic data
Transport solutions
IT services

**Intersections between ARS T&TT and the market**

| | Other countries<br>O1, O2, T2 | Smart city<br>O3 | Other markets<br>O4, O5, O14 | Environment<br>O6, O7 | Blockchain<br>O8 | Connectivity<br>O9, O10, O11, O13, T4 | MCD/FCD<br>O12 | Competitors<br>T1 | Shared economy<br>T3 | Quality controls<br>T5 |
|---|---|---|---|---|---|---|---|---|---|---|
| Network road operators<br>S1 | | Counting pedestrians, bikers and scooters etc. | Weight of caravans in the road | Road operators also care about the environment | | Advice road operators about new technologies | Faster detection of new roads in maps by using FCD | | Carpool functions<br>Cooperate with BlablaCar | |
| Stable position<br>S2 | Copy good things to other countries | | | | | Stay up to date in the recent technologies | | Invest money in development before competitors are in front of you | | Improve quality by combining FCD and stationary data |
| Tender offerings<br>S3 | React on tenders in other countries | | Pitching ideas in other markets then ITS | Focus on tenders with an sustainable direction | | Research tech or react on interesting tech tenders | Acquire FCD related projects | Research into what tenders competitors react on | | |
| Road sensors<br>S4 | | Weather data or data coming from satalites | | Vechicles receive information about their impact on environment | | Road sensors connected with in-car apps | | Focus on own strength (and market them) | | |
| Own data warehouse<br>S5 | | | | Watch environment stickers in these zones | | | | | | |
| Lack of marketing<br>W1 | | Build a show case of a smart city | Hiring a marketing expert with experience in similar cases | Stimulate car pooling behavior by showing data | | | Invest in tech that can detect the 'hidden' cars for FCD | Looking at competitors how they are doing their marketing | Cooperate with companies with a lot of marketing experience | Promote the good quality results |
| Passive attitude<br>W2 | Copy current experience in less developed countries | | Show taxi's on a map (also in other countries) | Use data to count trucks etc. | Research the possibilities with blockchain and ITS | | | | | |

Highly relevant
Relevant
Consumer focused
Future opportunities

**Intersections between ARS T&TT and the market**




First the table is categorized in the levels of the scope. The most inner circle of the scope is the Data visualizer. After that the traffic data is a category, then the transport solutions and the last category is the IT solutions. After categorizing the search areas the conclusion was that a lot of ideas could be placed in different categories, so it was not easy to draw conclusions from this type of categorization.
During the second iteration in this process the search areas is categorized according to the relevance of the ideas. The most relevant ideas were dark green, than a bit less relevant ideas got a light green color. The ideas that were more consumer focused were yellow and the more futuristic (so less relevant at this moment) ideas are red. The hardest thing of this type of categorization was who is deciding what is more relevant and what not. Therefore it was not easy to draw conclusions from such a subjective categorization.
The third categorization focusses on future directions for ARS T&TT. Three future directions are recognized in this table. The first one is the presence of automated vehicles on the road in the future and everything that is attached to this important development. The second future direction is the arrival of the sustainable city and all the ideas that can improve the quality of the environment regarding transport and traffic in the city. The third future direction are the ideas that has something to do with market growth/ expansion. This is a combination of market growth in other countries, other markets or relative to other companies.

In this table the strengths, weaknesses and opportunities are ranked so that more urgent ideas became visible. More about this is explained in the report.
The future directions visualised in this table are used in the project to find out which direction is most reliable for ARS T&TT to go to.

# F. Deep dive future directions

The previous chapter concluded that there are three interesting future directions ARS T&TT can tap into. The three directions are:
1. Market growth
2. A sustainable city
3. Technological developments

This chapter describes and validates these three future directions more elaborately. The validation means that there is checked on what is the current state of the future direction and how certain is it that the trends in this direction are really going to happen. For all three future direction this validation is done differently, because these directions are different by themselves.

In the end of the chapter a set of validated directions are structured so that the search areas from chapter 2 can be filled in the strategic roadmap for ARS T&TT.

## 1. MARKET GROWTH

ARS T&TT is able to expand the market in three possible market directions, without changing the product itself. These possible directions are other countries in Europe, other countries outside Europe and other market in the Netherlands. The opportunities in the other countries are undoubtedly present. Congestion across the US, UK and Germany cost almost $461 billion in 2017 or $975 per capita (Inrix, 2018). These costs are calculated by hours that are lost in traffic jams and costs of extra gas during the time the cars are in the congestions. Intelligent traffic systems and data are able to reduce these costs.

ARS T&TT is already doing business in other countries, but not so much and strong as they are present in the Netherlands. In this chapter the focus will be on the countries in Europe. These countries are most similar to the market in the Netherlands. This chapter discusses several entry strategies to enter the foreign markets in Europe. Two different models are described and discussed.

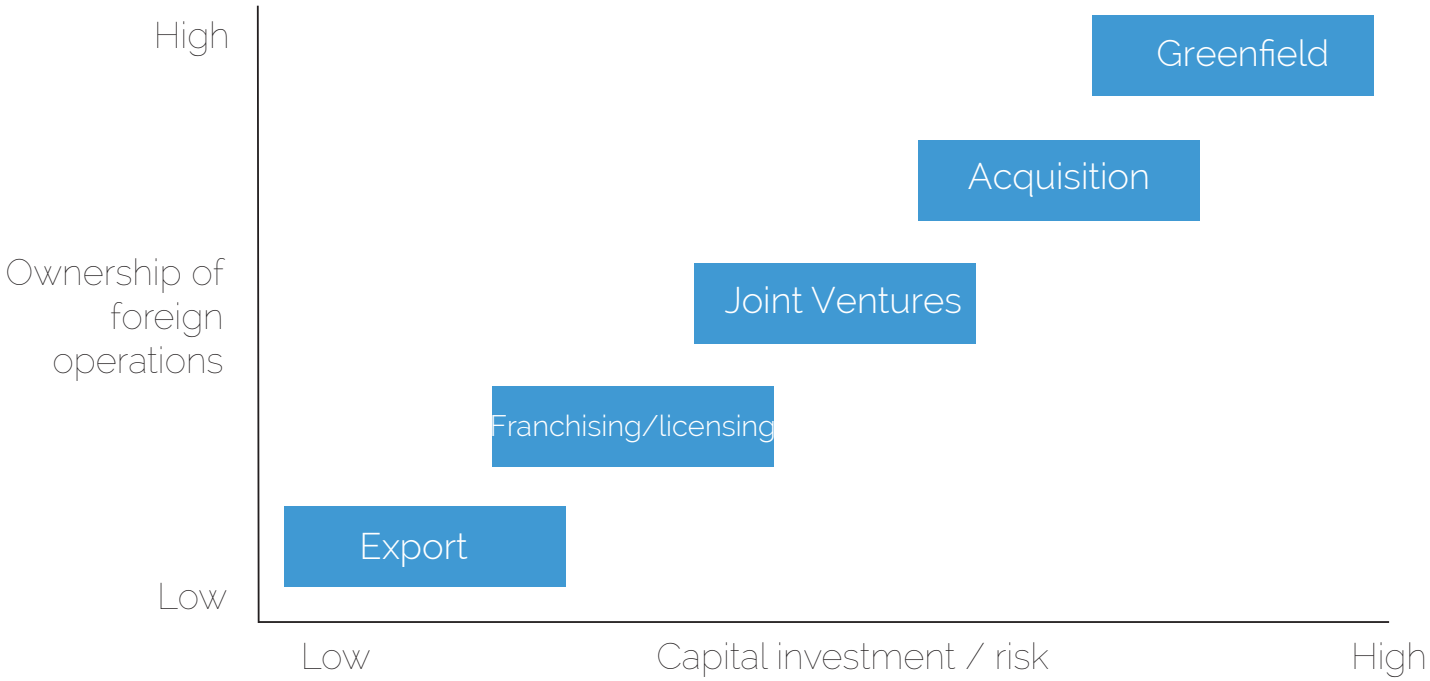



*Figure 22. Entry strategies ordered on risks and ownership.*

**Entering an international market: Strategy**
The literature identifies several entry strategies. These strategies differ from each other in the ownership of the entering company and the risk the entering company should take (Kumar & Subramaniam, 1997; Blomstermo, 2006). The strategies described in this chapter are the following: exporting, franchising or licensing, joint ventures acquisition, and greenfield (see Figure 22).

Exporting means that a company sells goods or services to customers in foreign countries. They can use a distributor in that specific country for it, but that is not necessary. Exporting is a cost efficient way of entering a foreign market. Therefore the exporting company is able to enter a lot of markets at the same time. But on the other side, the exporting company is dependent on foreign distributors or buyers. It is hard to control the new market.

Franchising or licensing are both methods where the entering company set up some kind of agreement with a third party in the foreign country. The third party is allowed to sell or use the brand name of the company and the company get royalties in exchange, depending on what the agreement says. This strategy is especially valuable when the local party has a strong position in the market that is going to be entered.

Joint venturing means that the company partners up with a company in the foreign market. The infrastructure and local expertise of the partner is very useful for the entering company. A third company is created together with the partners to step into the new business. The entering company is more involved in the new business than for example when licensing or franchising the business.

Acquisition means that the company buys a whole other company (for example a competitor, a supplier or a distributor), so it can has access to all resources very fast. This strategy is more expensive, but it also gives all control to the entering company.

The last entry strategy mentioned is the greenfield strategy. This means that the entering company is starting a new company itself in the foreign country. It is the most expensive strategy, but will also gives full control to the company.

There are four factors that has influence on which entry strategy fits best to a situation; Industry specific, company specific, product specific and

country specific (Kumar & Subramaniam, 1997). Since the product ARS T&TT offers includes a large part of software, the greenfield strategy is not so realistic. ARS T&TT do not have to build a whole new distribution centre in foreign countries to offer their product over there. The other strategies are still available keeping the first three factors in mind (industry, company and product).

Next to the type of entry strategies there are also two different types of entering new markets in another perspective than the one discussed here. The waterfall strategy and the sprinkler strategy (Kalish et al, 1995). The sprinkler strategy is about entering a lot of foreign market at the same time. The waterfall strategy is entering the foreign markets one by one. According to the resources, assets and experience ARS T&TT has it seems more viable to use the waterfall strategy, because entering many markets at the same time will keep a major marketing department busy and that is not one of the resources of ARS T&TT. According to the paper of Kalish (1995) a waterfall strategy is also more effective when the product that is being introduced has a long life cycle, which is the case with the data sensors.

The conclusion of this chapter is that ARS T&TT should enter the foreign countries one by one and that ARS T&TT should choose for each country a fitting entry strategy. The fitting strategy can be chosen by considering the industry, the company and the product. Depending on the strategy to enter the market, the partner companies can be chosen.

# 2. SUSTAINABLE CITY

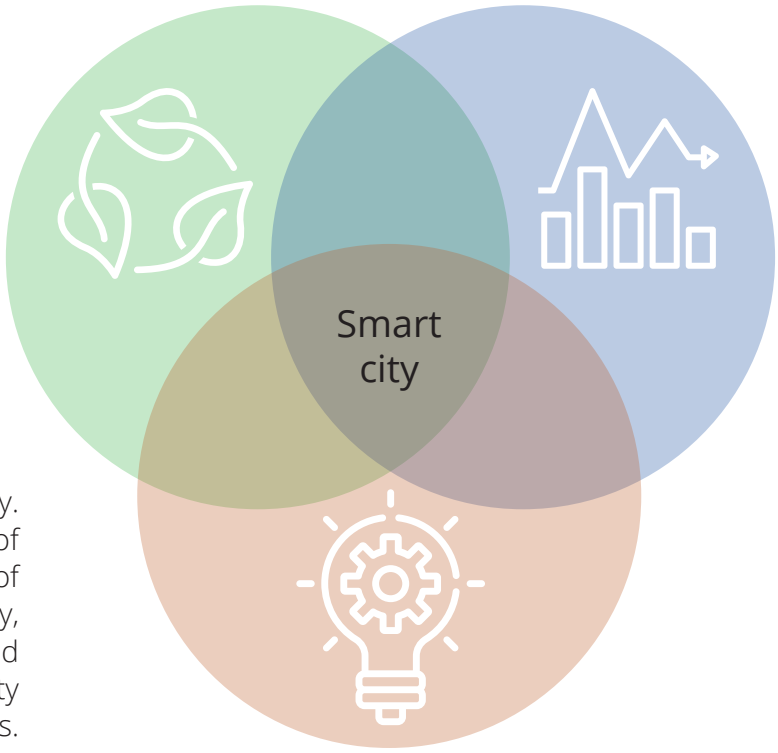



*Figure 23. The smart city concept: Technology, environment and economic and social developments.*

The sustainable city is a part of the smart city. The literature identifies different definitions of the smart city. Overlapping characteristics of the concept are innovation and technology, environmental requirements and economic and social developments, see Figure 23. Smart city is in the middle of these three developments. According to the systematic literature review in smart cities of Cocchia (2014), most smart city projects are technology driven. For that reason the smart city is often the result of small initiatives in the city in stead of a well conceived strategy from the government. Only later smart city implementations show the top-down path, where the government is taking a leading role in defining and driving the comprehensive vision about the smart city programs. Today the biggest cities in the Netherlands do have programs to enable the smart city concept, for example the Institution for Future of Living in The Hague, Amersfoort, Amsterdam, Rotterdam, Eindhoven and Utrecht (Institute for Future of Living, 2018). These programs are not only focused on the technology driver, but also the environmental, economical and social drivers of the concept are playing a major role. Therefore the smart city concept is split into two directions. One is the most important driver: technology. And the other direction is the sustainable city, that includes the environmental requirements and the economic and social developments.

**Environmental requirements**

In 2015 the European Union has made direct agreements about the climate change. 195 countries has signed a contract to decrease the greenhouse gasses and to reduce global warming. The objectives for 2030 are the following:

- 40% less CO2 emissions relative to 1990.
- 30% reduce of energy uses relative to 1990 and a reduction of energy use of 1,5% per year.
- 27% of the total amount of energy is generated by durable sources.
- 30% reduction of CO2 emissions coming from vehicles and trucks relative to 2021 (Europa-nu, 2018).

These objectives has a lot of impact on the Netherlands in general, but also on the cities in the country. The Dutch policy developed their own climate agreement to reach the objectives of the European Union. The proposal of this climate agreement is published recently. The agreement is separated in five main lines; Electricity, buildings, industry, agriculture and mobility (Ministerie van Economische Zaken en Klimaat, 2018). Within the scope of this project mobility is the most important subject of this climate agreement. In terms of mobility the Dutch government wants to reduce 7,3 Mton of CO2 emissions in 2030. Today the mobility market produces 32 Mton CO2 emissions, so the reduction is 22%.

To act according to this reduction of emissions the Netherlands divided the mobility market into four divisions: The physical infrastructure, the traffic services, the transport services and mobility services. For each division different measures are going to be taken. The environmental requirements are taken very seriously in the Netherlands. In all four divisions

the measures will be visible in the cities in the coming years. Examples of the measures in each division are given below:

In layer 1, the physical infrastructure ,the government will focus on more sustainable purchases and tenders.
In layer 2, traffic services, in the 30 biggest cities in the Netherlands low-emission zones will exist in 2030. No trucks or vans are allowed in the cities which has a declining impact on the CO2 emission level.
In layer 3, transport services, subsidy programs will come to encourage electrical vehicles in the consumer and business market.
In layer 4, mobility services, programs are going to be launched to stimulate behaviour that leads to individuals driving more economically.

To see how these measures are going to work out in the cities in the Netherlands a small case study is done. The chosen city for this case study is The Hague, the home city for ARS T&TT.

The Hague is one of the five biggest cities in the Netherlands. They have taken serious steps in the past period to make The Hague smarter. The goal of the 'smarter' The Hague is to improve the city. In cooperation with CBS, The Hague wants to improve the use of existing data to create policy more efficiently. The Hague also cooperates with Eneco and Eurofiber in 'Living Lab Scheveningen' to experiment with Smart City projects in public space (GOV, 2018). Some examples of experimental (environment) projects in The Hague are:

*Smart lighting*
During this project the lampposts in Scheveningen are replaced by smart, more durable lampposts. The lights can be combined with other features like WiFi, traffic cameras, charging point or sensors to measure air quality of noise disturbance.

*City Performance Tool*
This dashboard presents public data of the city to citizens in The Hague. The goal of the tool is to improve the decision making process by giving insights in multiple data sources, like CO2 emissions rate.

*Stop & Shop*
Via sensor based parking spots shop-owners can help to pay the parking fee for their clients. The goal is to connect the blue parking zones with economical activity. Next to that searching time for a parking spot will be reduced (Den Haag, 2015).

The city The Hague also mentioned the environmental requirements in their vision of 2030. They want to use the CO2 ambitions as a driver for urban development. This ambition is to be energy neutral in 2040 and this is way more ambitious than the requirements of the central government and European Union (Den Haag, 2017).

In different levels of policy (Europe, the Netherlands and the city) the environmental concerns are taken into account while making policy. This shows the environmental requirements are getting more important.

**Social and economical developments**
In 2030 the growth of major cities in the Netherlands is expected to be 15%. This is more than the average growth of the population in the Netherlands, which is predicted at only 5% (CBS, 2016). This growing urbanisation will bring new issues in the crowded urban areas. For example, housing for all people is one of the major problems, but also watering (risks of flooding) inside the densely built cities can be a problem.

For this project the most interesting problem that occurs when urbanisation is growing is the traffic congestion in the city. With more people in the city more people wants to transport within, to and out of the city. Therefore the pressure on the infrastructures is increasing. Next to the extra pressure on the road due to urbanization the number of vehicles on the road is also still increasing with 2% per year (CBS, 2018). Solving this problem is not as easy as building new roads and more lanes. To release the pressure

on the roads in the city a lot of factors come along. For example the behaviour of people is important. People can choose how to go to their work, by car or by train. If the road is congested they would choose easier for the train option. But if the traffic jams are decreased due to a new road or more lanes at an existing road, people will choose for the car again. According to Prorail (2018) also the train is having problems coping with all the passengers in the Netherlands, this can be a very serious problem. Behaviour and decision making is part of the problem as well. A more complex solution is needed for the traffic congestion issue.

According to the environmental requirements and the urbanisation the sustainable city will definitely be a growing concept and a more important item on the agenda of city governments the coming years. Data may be playing a big role in supporting the sustainable city. For ARS T&TT this is a major opportunity, because they already have the knowledge of data and the strong network with the Dutch governments that are going to develop the sustainable city.

# 3. TECHNOLOGICAL DEVELOPMENTS

Two key technological developments in the coming years for the ITS market are the connectivity between vehicles via 5G internet and the emergence of automated vehicles on the road. These two developments already started. In this chapter the two key technologies are explained and discussed about what the status of the development is at this moment.

**5G Internet**

5G is the next generation of internet after the well-known 3G internet and the current 4G internet. 5G will be 45 times faster that 4G. Currently there are five types of technological developments that are improving the Internet for this 5G Internet. The technologies are the following:

Millimetre waves; Today the frequency of the internet is between 3 kHz and 6 gHz. In the future the frequency between 6 gHz and 300 gHz will also be used. This means that there is more bandwidth for everybody and all connective devices. But, one disadvantage of this frequency is that it has problems with going through buildings or other obstacles. Therefore another technology is needed.

Small cell network; In stead of one big broadcast signal from one station. 5G will work with a lot of smaller stations that broadcast the signal. This is very useful in cities.

Massive MIMO; MIMO stands for Multiple Input, Multiple Output. 4G stations has 12 ports to process the signals. 5G will have 100 ports to process the signals. This means that the capacity of the Internet will increase 22 times.

Beam forming; Devices and stations send the data in all directions. Beam forming will work like a traffic system for cellular signals. They send the data only in the direction where it has to go to. This increases efficiency in the data streams and by that also the capacity of the Internet will increase.

Full Duplex; The last technology is about the use of a frequency. Normally a frequency can only carry data in one direction. So to send data in two opposite direction, two frequencies are needed. With full duplex the frequencies will make use of transistors that reroute the data when it goes in two direction on the same frequency. Therefore one frequency can carry data in both directions.

All these five technologies are still in a developing phase. Likely more technological developments are needed to implement 5G successfully (IEEE Spectrum, 2017). Telecom companies are testing the 5G internet all over the world with pilots. Also in the Netherlands these pilots are starting. KPN, the biggest Telecom provide in the Netherlands is testing the 5G network on different locations with different purposes. At the Amsterdam Arena they are testing the massive MIMO technology to make sure all people can stay connected at crowded places. In Helmond KPN is testing the short reaction time from the 5G network. This is important for the

communication between autonomous vehicles in the future (KPN, 2018).

5G Internet is a key technology to provide C-V2X (continuous vehicle to X) communication. This communication is needed to let automated vehicles safely on the road (Qualcomm, 2017). According to Qualcomm, the company that brought 3G and 4G to the world, C-V2X will be able to transform the in-car experience and pave the road to autonomous vehicles.

**Automated vehicles**

The automation of vehicles on the road will have a great impact on how people live and how the infrastructure is organised within cities. There are several reasons why especially automated vehicles will cause this change:

- Automated cars are connected with each other and therefore they can communicate and cooperate. Due to this technology the road can be used more efficiently, because cars can drive closer to each other or react earlier on each other.
- Parking is less needed within the city, because automated vehicles can park themselves somewhere else where more space is for parking. When parking spots within the city are not needed that much anymore the space can be used for other purposes.
- The automated vehicles has a lot of sensors on them that all collects data. This is a new way of data collection that is not done before. They know exactly where all other cars, trucks, bicycles and pedestrians around them are positioned. This data can be valuable for traffic management as well.
- Automated vehicles can solve part of the congestion problems in the city by driving more efficient on the road.

However, automated vehicles are not reality yet. There are some barriers that still has to get solved before the automated vehicle is driving on the road. For example the safety issue is very important. People are a bit scared of transferring the responsibility in the car to the technology. Therefore every single accident that happens with the automated vehicles is highlighted in the media. Although the technology is much safer than human driving already, the automated vehicles are not received as safe yet. Furthermore the technology is not far enough developed yet to implement the autonomous driving. One example is the communication between cars, which will improve a lot when 5G is being implemented. Data security is another hurdle that should be taken care of before the implementation of automated vehicles. If the software inside the vehicles are not secured, the vehicles can be hacked and programmed differently than initiated, for example to cause accidents or for terrorist purposes. Next to the safety challenges and the technological challenges also ethical issues appear. Questions like 'who is responsible for the vehicle' and 'what decision is the vehicle making when it is involved in an accident but has to decide how to make as little damage as possible' are popping up and there is not a good answer yet.

There are 5 levels of automation within automated vehicles shown in Figure 24. At each level the car is taking over more of the control. The first two levels are already reality for commercially available vehicles. Cruise control and lane-keeping are examples of level one driver assistance and these two examples combined are features that are more complex and is within the second level of the ladder of automation (Schladover, 2016).

A lot of major private car manufacturers and other type of companies are investing in automated vehicles. Google started their self-driving car project Waymo in 2009. These self-driving cars has no human behind the steering wheel, so they are level five in the automation scale. Waymo claims that its fleet has already driven 13 million km on their own in the streets of cities at different locations in America, to improve the machine-learning software (Waymo, 2018). Waymo does not build its own car, but they focused on the software needed for a self-driving car.

Next to Google also car manufacturers invest a lot of money in autonomous vehicles. Ford will invest

4 billion dollar building out an autonomous vehicle business through 2023 (Korosec, 2018). Volkswagen also plans to invest 15 billion Euro in electric and autonomous vehicles by 2022 (Government Europa, 2018). These investments confirm the popular autonomous vehicle trend and also validate the fact that the autonomous vehicles are emerging very soon, they may be on the road by 2023. Next to investments also a lot of rumours about autonomous vehicles are spreading through the news. Unknown autonomous vehicles are seen that seems to come from Apple. Apple itself does not say a lot about their autonomous car projects.

There is a lot of interest from important software companies and car manufacturers in the autonomous vehicles market. This is validated by the investment they put into this market. The forecast of when the vehicles are reality is very different, but that they are coming is unanimously predicted. For ARS T&TT this development is very key. Data is becoming more important when autonomous vehicles enter the road. The safety of the cars and the people is dependent on data coming from sensors in the car and outside the car.

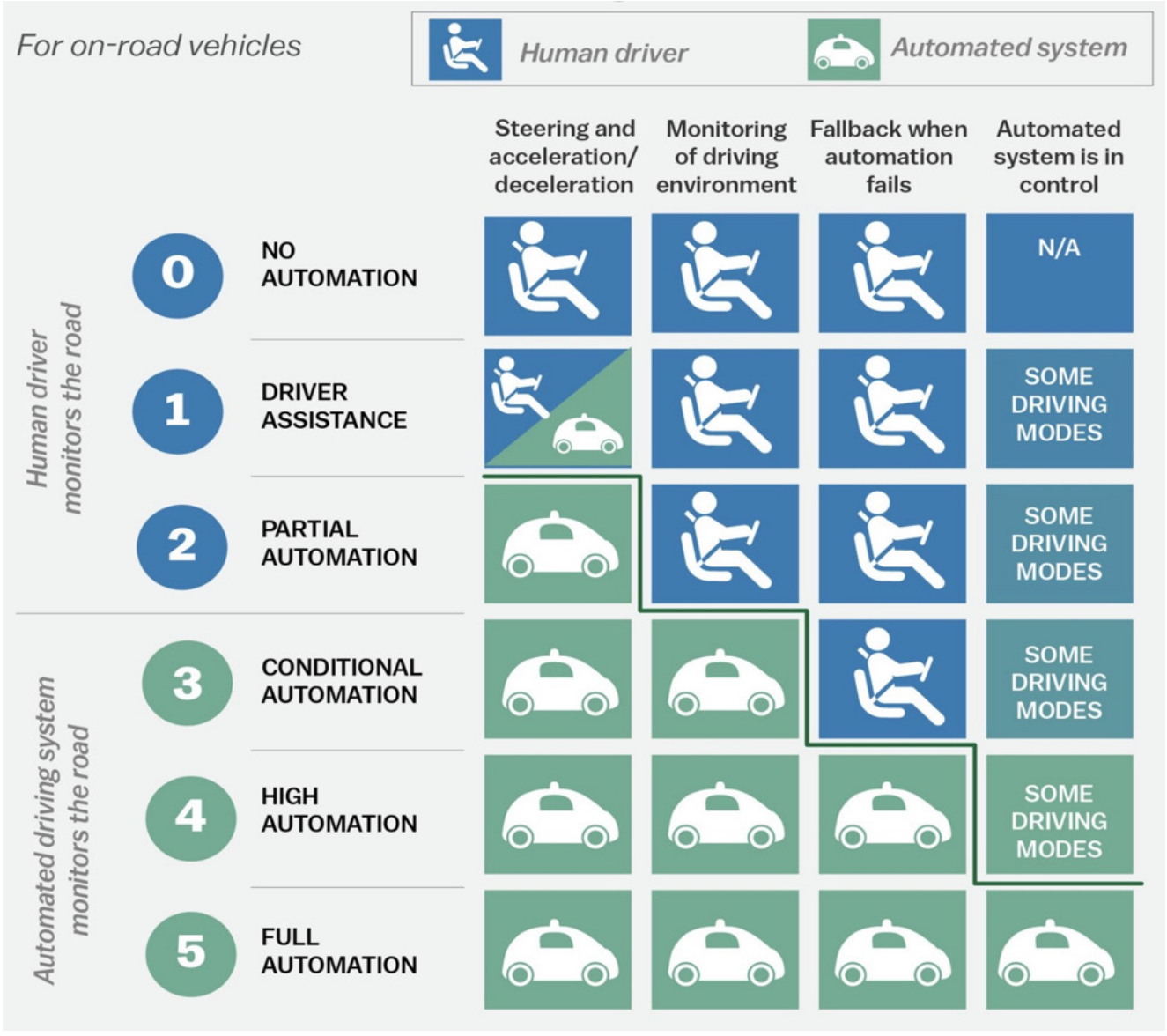



*Figure 24. The ladder of automation for on-road vehicles (Schladover, 2016).*

# 5. CONCLUSION

In this chapter three future directions are described and validated.

ARS T&TT is operating in the Dutch market mainly, but also in other countries. In the future they want to grow their market share in foreign countries. Therefore they can make use of multiple strategies described in this chapter. Partners are necessary to gain resources that are needed to reach the customer or to gain knowledge about foreign countries. Market growth is important, but will not influence the roadmap directly. The roadmap does not focus it self on the Netherlands only. It is focusing on market trends and technology developments outside the Netherlands as well.

Future policy requirements and predicted social and economical trends point both in the direction to a more sustainable city. Data is playing a major role in this futuristic city.

5G internet is currently being tested by several Telecom providers in the Netherlands and in other countries all over the world. This new development in Internet communication is a key technology that will support the up-scale of V2V communication. V2V communication is an enabler of automated vehicles so these technologies are connected to each other. Different types of companies invest in automated vehicles and other developments that are needed for self-driving cars. An expert in the field of ITS also agreed on those developments. Autonomous driving will be part of the infrastructure in the coming years, the infrastructure will also play a role in this development and business modelling is an important agenda item of those technologies.

In the next chapter these directions are projected in the roadmap for ARS T&TT from today till 2030. The technical and market developments discussed in this chapter are the basis for the roadmap, taken into account that these directions are the most probable directions the market will move to.

# G. Brainstorm future scenarios

## Stakeholders

Car manufacturers
Car drivers
Traffic Police
Road operators
Cities
Politicians
Google
Ministry of Transport
NDW
European Union
Citizens
ARS T&TT

## Business models

Freemium model
Subscription model
Market tool / free
Lease model
Open data / free
Direct sales
Pay-per-use
Advertisements
Licensing
Franchising
Razor blade model
Crowd funding

## What if... ?

**What if Google owns all data?**
**What if all data is open data?**
What if stationary sensor data no longer exist?
What if it is impossible to manage the traffic without stationary sensor data?
What if the car driver himself is going to pay for the data?
**What if autonomous driving is not accepted by the drivers?**
What if traffic management is done by vehicles itself?

*The 'what if..'in bold are the ones chosen to work out some more. These what ifs are chosen because they are different from each other and they need different solutions. Besides the others can fit into the three chosen scenarios.*

# Business model canvas

## Scenario 1 - Google is watching you

### Key partners

Google

Car manufacturers

### Key activities

Combining data Google and own data

### Key resources

Being Dutch/small

Data processing

Own data

### Value proposition

Being a small Dutch company gives trust to some parties

Add value by increasing the data quality of the data coming from Google

### Customer relationships

Personal assistance (like now).

### Channels

Via car manufacturer

via smart-car system (apple store)

### Customer segments

Key: End-user / driver

Police

Government

### Cost structure

Own resources (data-processing) are the biggest costs

### Revenue streams

Google may willing to pay for improved data quality

Government may willing to pay for increased road safety

Car manufacturers may willing to pay to serve the end-user

Pricing model: Google should subscribe to buy the data. For governmental use, a one pay model is fitting.

# Business model canvas

# Scenario 2 - Scared to death

## Key partners

Government

## Key activities

Marketing, to make sure the customer really trust the product

## Key resources

Being Dutch/small

Own data

## Value proposition

Provide safety to the end-user / driver

Let companies trust you

Traffic management

Lower environmental impact

## Customer relationships

Automated services via Apple smart-car platform

## Channels

Via car manufacturer

via smart-car system (apple store)

## Customer segments

Key: End-user / driver

## Cost structure

Own resources (data-processing) are the biggest costs

Marketing

## Revenue streams

The government may willing to pay if it creates value for the end-user. Governments stays responsible for traffic management and safety.

Pricing model: subsidy based, free for end-user

# Business model canvas

# Scenario 3 - Sharing is caring

## Key partners

Start-ups with intelligent data processing ideas

## Key activities

Writing tender offerings

## Key resources

Data processing

## Value proposition

Add value by processing the raw data

Valuable information in stead of data

Insights

## Customer relationships

Personal assistance (like now).

## Channels

Via tender offerings

At business fairs

Active sales

## Customer segments

Key: Government & police

End-user / driver

## Cost structure

Own resources (data-processing) are the biggest costs

## Revenue streams

Government may willing to pay if the information is valuable for them.

Police is also willing to pay if they can enforce violaters.

Price model: Subscription for data, monthly paid

# I. Interview expert Gert Blom

**Onderzoeksvraag:**
Hoe ziet de toekomst van de ITS markt eruit?

**Introductie**
• Mijn afstudeerproject gaat over de ITS markt van de toekomst.
• Ik ben al een heel eind, dus ik heb al wat ideeën.
• Ik ben dus ook geïnteresseerd in andere perspectieve (zoals die van u) en ook in internationale activiteiten in de ITS markt.
• Is het goed als ik het interview opneem?

• Kunt u uzelf introduceren? Wat zijn de grootste projecten op dit moment?
• Wat is uw rol internationaal?
• Het ITS congres van 2019 komt naar Nederland, wat is uw rol hier in?
• Ik heb gelezen over het living lab hier in Helmond. Hoe gaat dat precies in zijn werk? Kunnen verschillende bedrijven zich aanmelden met test projecten? Wie is hier de investeerder? Is dit het enige living lab in Europa?

**Huidige ITS pilots**
• Heeft u voorbeelden van huidige projecten in het living lab?
• Wat is de huidige status van de projecten, gaan deze bijna doorgevoerd worden?
• Welke gaan er op korte termijn, geïmplementeerd worden op de echte weg?
• Is er in Helmond al iets gedaan met Data logger in auto's? Wat is het business model achter deze techniek?
• Wat zal de rol zijn van sensoren/data langs de wegkant in toekomstige ITS oplossingen?
• Er zijn veel verschillende manieren van data verzamelen, zijn er op dit moment initiatieven om data te verzamelen? (bijvoorbeeld data van sensoren uit de auto?)

**Autonoom rijden**
• Wat zijn de grootste hobbels?
• Wanneer zal autonoom rijden echt doorbreken in Europa, volgens u? (level 4/5)
• Wat is de rol van de infrastructuur en de wegbeheerders met autonoom rijden?
• Hoe groot zal de rol van Google worden?
• Zal data openbaar worden in de toekomst?
• Hoe zit het met de beveiliging van de data?

**Nederland vergeleken met andere landen**
• Hoe staat Nederland ervoor vergeleken met Europa?
• Wat zijn de verschillen tussen ITS in Nederland en bijvoorbeeld Duitsland, of Groot-Brittannië?
• En is het nog anders vergeleken met Amerika?

Samenvatting interview Gert Blom

LZ: Ik ben eigenlijk ten eerste benieuwd naar wie u bent en wat u doet in de ITS markt, ik weet het al een klein beetje maar eh.

GB: Oorsprong in niet-overheid.  Afgestudeerd in planologie/vervoerseconomie. Gespecialiseerd tijdens mijn opleiding in de logistieke kant. Ik heb een jaar of 20 in het bedrijfsleven gewerkt (logistieke sector). Automotive sector het langst, verantwoordelijk voor leverancier logistieke dienstverlener. Vestigingen door heel Europa. Het voordeel daarvan is dat ik de automotive sector ken. De logistieke keten is interessant. Doorlooptijd van de auto is lang. Nieuwe systemen/types duurt 10 jaar. Software aan boord gaat veel sneller. Verschillende ontwikkeltermijnen. Uiteindelijk in 2003 bij de gemeente Helmond begonnen. Ik was gefuseerd met mijn bedrijf en stond op straat. Helmond zocht iemand die juist niet uit de overheid kwam. Is inmiddels al 15 jaar zo. Begonnen als hoofd verkeer en vervoer (leidinggevende). We hebben veel met beleid gedaan. Mobiliteitsvisie voor Helmond. Verschrikkelijke opgave, ik was nooit bezig met beleidsvisies. Heeft achteraf heel erg geholpen, nu nog. Mijn streven was het heel kort en bondig op te schrijven (er was al landelijk beleid), dus alleen waar Helmond uniek in is. Er stonden een aantal dingen in, we gaan ons niet richten op nieuwe infrastructuren, maar technologische oplossingen. We gaan onze stad echt als living lab openstellen, en daar heb ik veel plezier van gehad. Het is toen besloten en daarna heb ik heel veel daar op terug kunnen koppelen. Het heeft me geleerd dat ook in een politieke omgeving een visie te hebben en dat te laten accorderen door de gemeente raad (zoals in bedrijfsleden bij raad van commissarissen). We hebben in Helmond vooral ook veel in de praktijk gedaan. Wegen afsluiten voor testen. Om zo in een min of meer realistische omgeving dingen te kunnen testen. Dat is onze rol (Helmond). We zijn goed in het faciliteren van het tussenstadium voor dat een oplossing echt naar de markt gaat. ITS congres volgend jaar helpt hier ook heel erg bij. Mijn huidige functie is coödinator smart mobility en wij doen hiermee heel veel Europese projecten. Ik geloof heel erg in Europese projecten. Een aantal projecten zijn platforms, dit is voor het netwerk, maar ik werk heel graag in projecten. De projecten hebben een begin en een eind door funding. Privaat en publiek samen. We hebben op dit moment 10 projecten. Eigenlijk veel te veel met te weinig mensen. We proberen in de producten focus aan te brengen. We kunnen niet alles. De focus ligt op autonoom rijden en c-its. Voertuig-voertuig communicatie en voertuig-wegkant communicatie.
We hebben een project gedaan met chauffeurs van een vrachtwagen die snelheidsadvies geven en een bepaald level van prioriteit bij stoplichten. We hebben aangetoond dat in deze technologie een business case zou zitten. Het is niet alleen de research kant, maar ook business. Als je c-its op de goede manier aanpakt kan er ook echt business zijn. Een transportbedrijf bespaarde 15% brandstof. Met communicatie (onboard unit) aan boord. We hebben twee functies getest; time-to green en speed limit. Vrachtwagens hoeven hierdoor minder op te trekken en de vrachtwagens krijgen prioriteit. De communicatie gaat twee kanten op. In Helmond werkte dit. We moeten nu gaan opschalen. Focus is opschalen van C-its. En tweede is hoe bereiden we ons voor op automatisch rijden. Er zijn hier heel verschillende visies in, ik geloof er zeker in. Sommige use-cases zullen eerder komen dan anderen. Wij proberen ons op te stellen dat we hier in mee kunnen doen. De wereld met half automatisch rijden en automatisch en niet door elkaar is heel spannend voor ons. Het heeft impact op van alles (zorg, landelijke gebieden, parkeergarages…) Dit proberen we nu via een aantal projecten te onderzoeken. 1 van de projecten die interessant is is dat we in 2020 een automatische shuttle gaan laten rijden voor 6 maanden. Een zelfrijdend klein busje, tussen de automotive campus en het station. Zonder chauffeur en zonder Stuart, iemand die noodknoppen kan bedienen. Met stuart is er geen business case. Het project heet Fabulous. Er moeten nog partners zich aanmelden.  Navya, VDL, easy mal, mercedes. Is het haalbaar? Ja we zijn vanaf 1 januari 2018 gestart. We hebben onze plannen gepresenteerd aan de markt. We willen een auto die zelf rijdt en alleen vanaf een afstand eventueel nog ingegrepen kan worden. De markt vindt het ook ambitieus (en voor weinig geld).

Via precommercial procurement bieden we dit aan. We doen prototype maken en testen met partijen die hier mee kunnen doen. We beginnen met misschien 14 partijen en trechteren naar 3 misschien. Als echt niemand het aan kan bieden gaan we misschien onze eisen bijstellen.
We hebben eerder met een automatisch autootje gewerkt, maar die rijden helemaal niet, ze gaan al maar 10 km/u maar met voetgangers staan ze bijna stil. Het gaat uiteindelijk om level 4 autonomy, level 5 zou overal moeten kunnen rijden en dat is niet zo. We vinden wel dat ze met elkaar en met de wegkant moeten kunnen communiceren. Geen van de andere steden hadden dit erin gedaan. We geloven niet helemaal in het Google concept. Wij denken dat een voertuig om de hoek moet kunnen kijken en onderdeel moet zijn van het verkeersmanagement systeem. Ook weten of een stoplicht groen/rood is, ipv dit alleen zien. Maven is een project dat veel doet met verkeersmanagement. Dunniq, DLA, Hyundai. We gaan ook hier met praktische testen onderzoeken. De koppeling tussen verkeersmanagement en autonoom rijden is heel erg interessant.

Living lab en deze projecten lopen door elkaar. Living lab Helmond betekent waar wij kunnen faciliteren, faciliteren wij. Een weg afsluiten kunnen wij voor testen. De assets in de infrastructuur zijn van ons.
We stellen die ter beschikking aan de bedrijven of partijen die dit willen gebruiken voor testen. In 2011 hebben we een Europese award gekregen voor de goede koppeling tussen beleid en praktijk en het ook echt doen. De combinatie is uniek. We schrijven het op en besluiten het en doen er iets mee. Dit is uniek in Europa. Er zijn wel veel regio's/landen/steden die zich living lab noemen, maar niet op deze praktische manier. Het unieke is ook dat het living lab niet is gebaseerd op een project, we laten het gewoon staan. Anders wordt het weggehaald als het project is afgelopen. Soms is het lastig dat niemand weet van wie het living lab is. Ik ben bezig geweest een organisatie op te richten om een eigenaar te krijgen van het living lab, maar dat is niet geslaagd. Er zijn organisaties, zoals Tass die niets anders doet dan living labs faciliteren. Dit is lastig, want het werkt al dus niemand wil investeren.

Nog even over het congres. Het format is van Ertico. Dit is een ledenorganisatie voor de hele verkeers industrie. Hun cahscow is het congres. Je kan als stad/steden dit evenement hosten. Van te voren wordt bepaald, een aantal activiteiten doet Ertico. De demo's de organisatie, doet het gastland. Nu ben ik voorzitter van het landelijke host-comité. We hebben vanuit Nederland een aantal werkgroepen. Een werkgroep demo's is heel interessant.  Uniek tussen nu en Kopenhagen is dat we op zondag al beginnen om ITS voor het grote publiek zichtbaar te maken. Grote uitdaging, maar heel leuk. We hebben ongeveer 7 topics die volgend jaar aan bod komen. Onze eigen focus komt er ook zeker in voor. Wat we als Nederland ook hebben aangebracht is the next generation ITS Professional. De mensen die net van de universiteit komen.

Kun je nog wat voorbeelden geven van huidige projecten?

C-mobile is een project dat gaat over C-its opschaling. Opschalen van services. Nu hebben we ons vooral gericht op vrachtwagens. C-mobile richt zich op voetgangers begeleiden.

C the difference doen we samen met Bordeaux. Dit gebruiken wij om meer gebruikers te krijgen. Vanuit vorige projecten werkten we veel met plaatselijke transport bedrijven. Met C the difference kunnen we opschalen naar 100 vrachtwagens. Dit gaat ook op netwerk niveau impact hebben. Op voertuig niveau hadden we het al aangetoond dat het werkt. En nu proberen we op netwerk niveau iets te laten zien.  In Helmond kunnen de vrachtwagens overal communiceren met de wegkant. En de brandweer ook.  De brandweer gebruikt het ook echt operationeel dit gaan wij niet meer van ze afpakken. De resultaten van C the difference is nog niet helemaal duidelijk.

Maven  is wat ik al zei.

Co-exxist is een heel concreet project om te kijken of je verkeersmodellen kan modelleren dat het rekening houdt met autonome voertuigen. Momenteel wordt er nog geen rekening gehouden met de control logic van autonoom rijden, ze zullen sneller optrekken bij stoplichten enz. We proberen dus rekening te houden met verschillende graden van autonome rijden.

Auto-pilot is een project waarbij automatisch rijden in combinatie met IOT tot nieuwe services kunnen leiden. Voor bijvoorbeeld automatisch parkeren. Of in agenda's kijken waar auto's nodig zijn. Dit zijn toepassingen.

Cekredas is een project met NXP in de lead (chip fabrikant). Hoe kun je een platform inrichtingen voor automatische voertuigen. Open platform maar wel cyber secure.

Cellular en wifi-p staan tegenover elkaar qua technieken. Politici in Nederland worden nerveus want hebben we nu verkeerde investeringen gedaan? 5G moet zich nog bewijzen. Platooning bijvoorbeeld moet zeker zijn dat de communicatie er is. Wij willen het hybride benaderen. Dus beide technologieën onderzoeken. De brandweer hier rijdt op wifi-p en het werkt. 5g is er nog niet. Wifi-p vraagt investeringen en 5g is gewoon mobiel. Er gaan voertuigen volgend jaar met Wifi-p erin komen (volkswagen bijvoorbeeld). Ik denk een hybride oplossing net als op je telefoon. Soms wifi, en soms 3g/4g.

Talking Traffic doet ook veel aan de wegkant. 15.000 verkeerslichten in Nederland worden uitgerust met wat wij hier in Helmond hebben. Talking traffic is een onderdeel van het beter benutten programma in Nederland.

Als eerste autonoom rijden gaat openbaar vervoer zijn, shuttles. Hier is de eerste business case voor. De hobbels voor personenauto's die overal moeten gaan rijden dan is mixed traffic een grote uitdaging. Hoe gaan autonome voertuigen zich bewegen. Ze moeten coöperatief gemaakt worden zodat ze kunnen gaan bewegen. Er zijn teveel obstakels op de weg in NL. Hij zal niet botsen, maar wel voor opstoppingen zorgen. Ik denk dat er altijd een overkoepelend orgaan zal zijn dat verkeer zal leiden. Op voertuig niveau zullen voertuigen zelf ervoor kunnen zorgen dat ze niet botsen, maar opstoppingen voor komen zit niet op voertuig-niveau maar hoger, dit moet geregeld worden door verkeersmanagement. Ik zie als kansen in intelligent speed systems. Systemen in auto's die zelf niet harder kunnen dan de snelheid op de weg. Dit bestaat al, maar wordt nog niet geaccepteerd. ISA (Nederlands Belgisch systeem). We kunnen dit versnellen naar de markt. Het systeem staat altijd aan, maar je krijgt tegendruk op het gaspedaal. De data voor de auto is een combinatie van visueel lezen van verkeersborden en een digitale kaart die weet hoe hard je overal mag. Mensen zijn bang om gelimiteerd te worden op hun gedrag in de auto. We noemen het nu bewust intelligent speed assistant. Als vrachtwagens zich aan de snelheid houden is het moeilijker dat het andere verkeerd volgt. Vrachtwagens chauffeur zijn enthousiast over het systeem, zij betalen zelf boetes als zij die krijgen en dat willen ze niet. Afspraak met chauffeurs was als ze te hard rijden, krijgen ze geen groen meer bij het stoplicht.

Drie jaar geleden had ik gezegd dat Nederland echt voorop loopt in de intelligent systemen, maar tegenwoordig roep ik dat niet meer zo hard. Engeland geeft veel geld uit momenteel aan allerlei systemen en living labs op het gebied van automated driving. Ook Spanje zegt dat, dit is na Duitsland het tweede automotive land in Europa. NL scoort hoog in allerlei monitors, maar we zijn maar een klein landje. We

moeten goed blijven samenwerken en niet op eilandjes werken. ITS 2019 is ook in Nederland, en niet in Helmond qua communicatie. Leuk idee in NL is het rijbewijs voor de zelfrijdende auto. De auto krijgt dan het rijbewijs. Het voertuig moet testen doen en onverwachte situaties kunnen gaan handelen.