

Article

Unpacking the Smart Mobility Concept in the Dutch Context Based on a Text Mining Approach

Tanja Manders ^{1,*} and Elke Klaassen ²¹ School of Innovation Sciences, Eindhoven University of Technology, PO Box 513, 5600MB Eindhoven, The Netherlands² Energy Unit, ICT Group, 5613 AM Eindhoven, The Netherlands; elke.klaassen@ict.nl

* Correspondence: t.n.manders@tue.nl

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Abstract: Existing mobility solutions are criticized for falling short of effectively addressing transport issues and sustainability challenges. In this light, smart mobility has received increasing attention. In the Netherlands, the smart mobility concept triggered various developments, leading to the uptake of initiatives for real-life experimentation, accompanied by an increase in media attention. While the concept is making its way through Dutch society, its meaning for practice remains unspecified. Therefore, this paper aims to unpack the meaning of the smart mobility concept, by analyzing Dutch news articles and initiatives' websites using text mining and qualitative content analysis. The analyses reveal some ambiguous meanings for the smart mobility concept, demonstrating on the one hand a focus on incremental technological innovations that bring forward car-based solutions for short-term fixes, while on the other hand promising to address car-related issues and fundamentally change the mobility system by taking long-term challenges into account. In general, smart mobility seems to be about optimizations and maintaining the status quo rather than challenging it, although there are a few deviating and more critical voices. The smart mobility concept mobilizes actors and resources, but considering the ambiguities, these developments should be critically evaluated when proposed as solutions to transport issues and sustainability challenges.

Keywords: smart mobility; sustainability; text mining; Netherlands

1. Introduction

Increasing congestion, incidents, and lack of parking space put current mobility systems under pressure. The mobility sector also faces severe sustainability related challenges to drastically reduce CO₂-emissions, improve air quality, and address livability concerns. Scholars criticize existing solutions for falling short of addressing these challenges and call for a fundamental shift in the way mobility systems are organized [1]. In this light, smart mobility has received increasing attention, both in academic research and in practice. The concept emerged around 2010 in relation to a variety of information and communication technology innovations in the mobility sector and more technologically advanced and user-centric traffic management innovations [2–6]. The concept has been brought forward as a possible solution to several urban transport issues, and is linked to the smart city debate [2–12]. In the discussions on transformative change, smart mobility is considered an alternative, more pragmatic, approach to the complex notion of sustainable mobility [6,10,11,13,14].

In the Netherlands, the smart mobility concept has led to great enthusiasm and triggered various developments. Since approximately 2013, the Dutch national government has been actively promoting the Netherlands as a frontrunner of smart mobility [15]. Several governmental programs have been initiated, e.g., [16–19], involving promises of more efficient and effective approaches to transport issues compared to traditional measures [14]. This resulted, among others, in a national smart mobility

program promoting innovation and real-life experimentation [14,20], and a smart mobility test center in the southern region of the country [21]. While at first the concept was used by specific circles within the traffic management field, the concept is now making its way through Dutch society as it is being introduced to the wider public. This uptake is a consequence of real-life experimentation and the ability to experience smart mobility possibilities in practice, accompanied by an increase in media attention. The number of news articles that mention the concept has been increasing since 2015. In addition, there is an increase in the number of initiatives that start to relate to smart mobility, thereby mobilizing the concept [14]. These initiatives range from traffic information services to multi-modal travel planners, and from communicating automated vehicles to car-sharing services.

The smart mobility concept comes in many different forms and shapes, and while it increases the interest of the wider public and triggers the uptake of several initiatives, it is still unclear what the concept entails and how it relates to the sustainability challenges of the mobility system as its meaning for practice remains unspecified. Therefore, in this paper, we are interested in the following research question:

What is the meaning of the smart mobility concept in the Dutch context?

We address this question by unpacking smart mobility for the Dutch case using two sources: news articles and websites of the initiatives. First, we use Dutch news articles as a source to capture the meaning of the concept for the communication to and growing awareness among the wider public. Second, we use Dutch initiatives' websites to capture how various initiatives mobilize the concept. For the analysis of both sources, we first perform an explorative data analysis for which we use a text mining method, which is a novel and recently introduced method in social sciences. This analysis provides insight in often occurring words as well as the relationship between words. Second, we perform a guided analysis, based on the exploratory analysis. For this, we use a qualitative approach where we contextualize and interpret the text mining results and cluster these into emerging themes. These are distinctive but related themes that provide meaning to the smart mobility concept. The themes are used to structure the results section. Last, we discuss the results by drawing on insights from academic literature about the meaning of the smart mobility concept and reflect on its implications for the mobility system, especially concerning sustainability. Summarizing, the paper is structured as following: Section 2 explains the used methodological approach in detail; Section 3 thematically describes the results of unpacking smart mobility for the case of the Netherlands; Section 4 discusses results and reflects on these with insights from academic literature; and Section 5 provides a conclusion.

2. Methods

To unpack the smart mobility concept in the Dutch context, we drew upon two sources, which are: news articles and websites of initiatives. For the news articles, we used Nexis Uni, which is a digital archive that has been developed specifically for academic research and educational purposes by the company LexisNexis [22] and it is widely used among Dutch universities. Compared to alternative digital archives that only cover specific regional news (e.g., municipal and provincial archives) or only contain historical newspapers (e.g., Delpher), Nexis Uni provides access to more than 75 Dutch news sources from the last 30 years, and contains an almost complete selection of the most popular national and regional Dutch newspapers and magazines [22]. Within the Nexis Uni archive, we searched for the English term “smart mobility” (used in Dutch as well), and the Dutch translation “slimme mobiliteit”. We conducted the search on 15 August 2019, without any restrictions for the start date or end date. The search results in 754 articles for “smart mobility”, and 450 articles for “slimme mobiliteit”. The concept smart mobility was first used in 2008 and continued to pop-up occasionally in articles. That is, until around 2015, when its use increased dramatically; see Figure A1 in Appendix A for an overview of the number of articles per year. Note that within the total of 1204 articles, there can be an overlap of articles containing the English as well as the Dutch version of the concept. This overlap was corrected for in the data preparation.

For the websites of Dutch initiatives, we used the peer-reviewed database of [14], who constructed a database of what they framed as Dutch smart mobility initiatives that started, ended, or were ongoing in the period of 2015 until 2016. The initiatives cover a variety of smart mobility innovations and services, including, among others: cooperative driving tests, driving assistance applications, real-time traffic information services, multi-modal trip planners, mobility-as-a-service applications, and car and ride sharing services. For more details about the type of initiatives, see [14]. There are a couple of initiatives ongoing around the early 2000s, but here, too, the number of initiatives increased around 2015; see Figure A2 in Appendix A for an overview of the number of initiatives per year. The database is not exclusive, and especially in later years, more initiatives were established. Furthermore, the database has a slight bias towards the car, as initiatives that solely focus on bicycles (e.g., bike sharing) or public transport were not taken into account. Nevertheless, for the exploratory purpose of this paper and the fact that the database has been verified by experts in the field [14], we consider the database with more than 100 initiatives to be a good proxy of Dutch initiatives in general. We drew upon the initiatives' websites as these form relevant 'communication channels' for such initiatives to attract the attention of the general public; see Table A1 for an alphabetic list of the initiatives with corresponding websites.

The collected news articles and websites of initiatives were then prepared for further analysis. For the news articles, this included a categorization of the unstructured data set into categories of the news source, article title, publication date, and article content to be able to distinguish between separate articles and link attributes such as publication date to the article content. Additionally, we deleted duplicate articles that were from the same news source, and those that had the same article title, publication date, and content. We kept the duplicate articles that had the same content, but were published in different news sources; see Figure A1 in Appendix A for an overview of the number of (duplicate) articles per year. For the initiatives, some parts of the texts contained a different language than Dutch and needed to be deleted for the purpose of the analysis. In total, less than 10% of the initiatives were written in a different language. After preparation, we first performed an exploratory analysis to get a first impression of the general content of the articles and websites. Second, we performed a guided analysis for the contextualization and interpretation of the content.

We conducted an exploratory analysis by text mining the articles' and websites' content. Text mining is a rather novel method in social sciences, but it is promising, as it can structure large amounts of 'unstructured data' (e.g., large amounts of written texts) in a relatively short time and helps to process it. With visualization techniques, it can also help to get additional insights that would be difficult to obtain qualitatively [23]. Text mining combines mathematical, statistical, and pattern recognition techniques with linguistics. The text mining techniques can linguistically structure and categorize the data and extract information from it. The techniques range from basic statistical analyses to advanced modeling techniques, focusing, for example, on the autonomous writing of content to produce news articles. The most advanced techniques go beyond the purpose of this paper and we draw upon basic text mining techniques, such as word frequencies, for which we used the programming language R [24].

For text mining, we performed a linguistic categorization, which requires importing a library of Dutch words. The UDPipe library was used, which provides methods for language-agnostic tokenization, part-of-speech (POS) tagging, lemmatization, and dependency parsing of raw text. Different methods can be used, but we used the pre-trained UDPipe models (accessed via the UDPipe R package). The techniques to generate these models are described in detail in [25,26]. Of these methods, tokenization is used to break down the text into individual words, or so-called 'tokens'. Consequently, POS-tagging is used to categorize the words based on grammatical properties. This is done based on the context and definitions and it is essential for lemmatization, i.e., the process of linking words to their root form (the lemma). Dependency parsing is used to analyze the grammatical structure of the sentence to define the relationships between words. The example sentence shown in Figure 1 illustrates the POS-tagging and lemmatization process, as well as one example of dependency parsing.

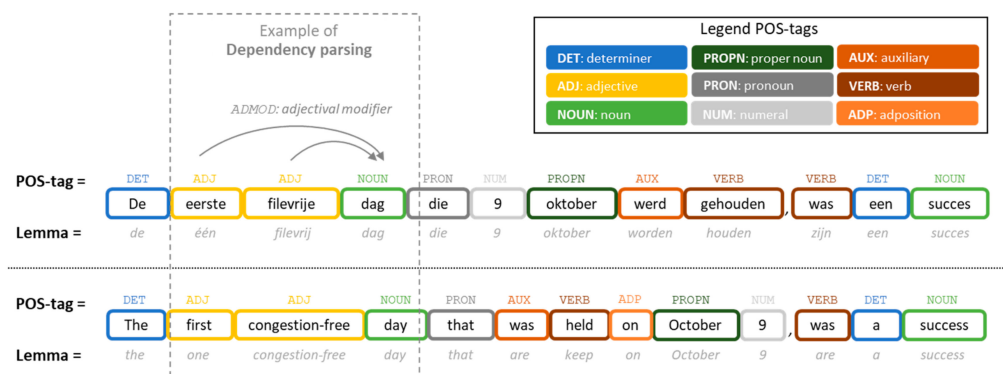


Figure 1. Example of part-of-speech (POS)-tagging and lemmatization for two example sentences. The Dutch example sentence is an original title from one of the news articles in the dataset. The English example sentence is based on a translation of the Dutch sentence. The POS-tags show the grammatical tag and the lemma shows the root of each word. The dependency parsing example indicates the relationship between the indicated words. Figure is made by the authors.

After applying these methods, we derived the most occurring nouns, adjectives, simple noun phrases, and proper nouns. The simple noun phrases were based on the combination of an adjective and noun, a pre/post position, an optional determiner, and another combination of an adjective and a noun. The pattern used to identify simple noun phrases is the following: $(A|N)^*N(P+D^*(A|N)^*N)^*$, where A stands for adjective, N stands for nouns, P stands for proper nouns, and D stands for determiner. We visualized all four types of the most occurring words and word combinations by using bar charts; see the figures in Appendix B.

On the basis of the exploratory analysis, we performed a qualitative content analysis to contextualize and interpret the results of the exploratory analysis. For this, we looked into the most occurring words and word combinations, and retrieved their textual context from the articles and websites. For example, the word “human” often occurred in the news articles. The word itself does not reveal that much information, but through scrutinizing the articles’ content, we were able to see that the word is often used to refer to human driving performance versus technological performance of automated vehicles. For all words resulting from the exploratory analysis, we scrutinized the textual context to attach meaning to them, identify relevant topics and categorize these into themes.

The results section, Section 3, thematically describes the meaning of the smart mobility concept in the Dutch context. To reflect on its meaning and discuss the implications, we furthermore draw upon insights from academic literature in the discussion section, Section 4. For this, we conducted an academic literature review on the concept “smart mobility” among the peer-reviewed literature. For the purpose of this paper, we selected those articles that made an attempt in unpacking the concept and discuss or relate to the societal context, meaning that articles that have a purely engineering focus were not included. Figure 2 provides a schematic overview of the research approach.

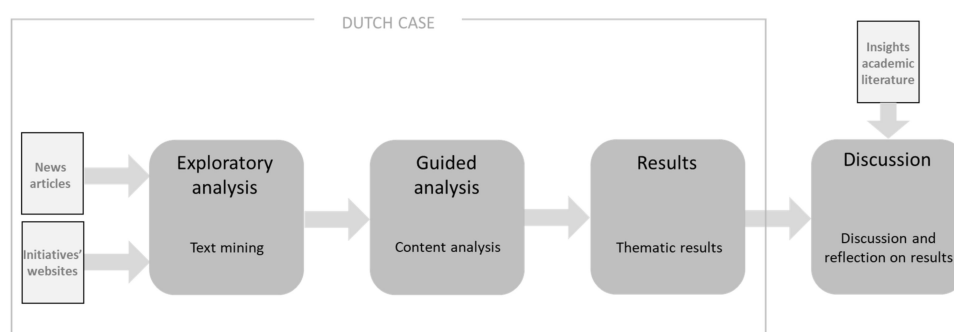


Figure 2. Schematic overview of the research approach for unpacking the smart mobility concept in the Netherlands. Figure is made by the authors.

3. Results

Here, we thematically present the results from the exploratory and guided analyses, which led to the identification of three emerging themes. This identification processes is visualized in Appendix B, which provides detailed graphs of the most occurring words and combination of words colored per theme. When referring to one of these most occurring words or combination of words within the text, brackets [...] are used with a reference to the Dutch word. The first theme concerns the commercial and technologically advanced innovations that the smart mobility concept constellates. The second theme is about the solutions for car-related transport issues that the smart mobility concept brings forward. The third theme is about the concept being related to incremental changes for a sustainability transition of the mobility system. Although closely related, the three themes reveal some distinctive aspects about the meaning of the smart mobility concept in the Dutch case.

3.1. Theme 1: Commercial and Technologically Advanced Innovations

Smart mobility seems to evoke enthusiasm in the societal debate. During the years, an increasing number of news articles have been published about smart mobility. In general, a positive and promising picture is portrayed. The same applies to the initiatives. For both, we find many adjectives with positive connotations, suggesting a generally positive attitude towards smart mobility. Although this can be expected from the initiatives promoting themselves positively and attract users, it is also found in the news articles. “Good” [goed] is, for example, the most occurring adjective in both. Furthermore, the news articles and initiatives talk about technologies and point towards these as “new” [nieuw] [ander], and “innovative” [innovatief] solutions, which are considered “relevant” [nodig] [belangrijk], as we find, for example, that: “smart solutions are necessary”. Within the initiatives information [informatie] is the most occurring noun, pointing towards various information services and systems, and the exchange of “data” [data]. In this regard, “personalized”, “real-time”, “traffic and travel”, “information” [actuele informatie] [persoonlijke reisinformatie] [verkeersinformatie], and “cooperative systems” [coöperatieve systemen] are especially often referred to. Some names of initiatives are also among the most occurring words, covering, among others: navigation services, multi-modal travel information and services, traffic management services, charging applications for electric vehicles, parking applications, and cooperative driving [mobile ninja] [mobility mix] [digitale wegbeheerder] [social charging] [ITS reisinformatie] [prettig parkeren] [talking traffic] [Brabant in-car] [praktijkproef Amsterdam] [truck platooning].

The technological and commercial character comes forward quite literally in the news articles and initiatives, as words related to “technology” [technologie] [techniek] [technisch], and “economy” [economisch] are among the most occurring nouns and adjectives. Furthermore, the financial newspaper [Financieel Dagblad] [FD.nl] published often about smart mobility; see Figure A3 in Appendix A. “Economy” is used in different ways in relation to smart mobility. One context is that of economic growth causing more traffic jams and congestions, for which smart mobility could provide a solution. A second context refers to the ability of the smart mobility solutions to improve accessibility and smoothen traffic flows, which are important for the economy to benefit the companies in the region and attract more companies, in a context like “accessibility is the key to economic growth”. A third use is in the context of traffic jams and congestion that lead to economic costs for which smart mobility solutions are necessary, and a fourth is pointing towards the interesting economic opportunities of smart mobility for companies. Related to this, “company” [bedrijf] and “private sector” [private partijen] come up as two of the most occurring words. The commercial interest of the technology sector is also accounted for by the former Minister of Transport, who is often mentioned in the context of smart mobility [Minister Melanie Schultz van Haagen]. The Minister has been actively promoting smart mobility and expressed the ambition for the Netherlands to become frontrunner in the field due to interesting economic opportunities for the Dutch private technology sector. The Ministry [ministerie van infrastructuur], including its executive body [Rijkswaterstaat], have been actively involved in

(inter-) national agenda setting, creating favorable conditions, and facilitating experimentation and promoting initiatives.

Many of these and other initiatives are located in the province of Brabant; see Figure A4 in Appendix A. Furthermore, most articles were published by the *Eindhovens Dagblad* and *Brabants Dagblad*, which are regional newspapers within the Province; see Figure A3 in Appendix A. The Province of Brabant receives much attention as the name of the Province [Brabant] and the deputy's name [van der Maat] are among the most occurring proper nouns and simple noun phrases. Moreover, a specific highway in Brabant [A67] is often mentioned in relation to the various tests that are conducted there. Brabant, and the Eindhoven region more specifically, are known for its high-tech industry, with a large automotive industry located around the Automotive Campus in Helmond, a nearby city to Eindhoven. The Automotive Campus provides home to companies, knowledge institutes, and education institutes, but also facilitating real-life research and tests. Both the municipalities of Eindhoven [Eindhoven] and Helmond [Helmond], as well as the "Automotive Campus", are mentioned regularly in the news articles [automotive campus]. "Brainport" [brainport] also appears often and is used to point to the economic collaboration in Eindhoven region between public authorities, private sector, and knowledge institutes. As part of the Brainport region, Eindhoven University of Technology is very present in the smart mobility news articles as the institute and two of its prominent employees are often mentioned [technische universiteit Eindhoven] [TU Eindhoven] [universiteit Eindhoven] [Carlo van de Weijer] [directeur smart mobility aan de TU Eindhoven] [Maarten Steinbuch]. This University has a strategic research area in which smart mobility research from various disciplines is represented. With its University of Technology, an Automotive Campus, and high-tech industry, the region has a strong technological and automotive focus and dominates the much of the smart mobility discourse.

The technological character also influences how the human factor is portrayed. "Human/people" [mens] is one of the most occurring nouns, both in the initiatives as well as news articles, suggesting an important role for humans and seemingly confirming the promise of a user-centric approach of smart mobility. However, a closer look shows that human factor is often used in relation to technology to point to the consumers of technology. Portraying a technology-centric image with users as rather passive adopters of technology that just need to accept or adapt to new technologies, corresponding to ideas of that the "Driver needs to let go of the steering wheel". While the articles occasionally mention that humans perform well in cars, and that smart mobility needs to mature before being able to take over, more often it is claimed that humans perform worse than technology, which is reflected in quotes such as: "90 percent of all [incident] cases caused by humans", "humans biggest risk", and "a human behind the steering wheel? Way too dangerous!". Furthermore, within the initiatives, problems of congestion and incidents are sometimes framed as inefficient traffic flows or unsafe traffic situations caused by human error. Solutions of connected cooperative and automated systems and vehicles link to this narrative and are proposed to bypass human error, smoothen traffic flows, and increase traffic safety.

3.2. Theme 2: Solutions to Solve Car-Related Transport Issues

Smart mobility is proposed as a solution to a variety of transport issues. Within the news articles, most attention goes to issues of "traffic jams" [file] and "busy" roads [druk] [vol]. Additionally, within the initiatives, the smart mobility innovations mostly target congestion [betere doorstroming] [doorstroming van het verkeer]. Although other initiatives often focus on congestion, many of the initiatives are situated in and around the Randstad, which is the most dense and urban area of the Netherlands, where such transport issues are experienced the most. This likely leads to a high number of initiatives in the Province of Noord-Holland, including the capital, Amsterdam; see Figure A4. Furthermore, the news articles often mention the cities of the Randstad region [Amsterdam] [Utrecht] [Rotterdam] [Den Haag]. Additionally, among the initiatives, safety issues receive much attention [(gevaarlijke) situatie op de weg] [incident] [veilig]. As mentioned in relation to the previous theme, to address issues of traffic flow and traffic safety technological solutions are proposed to eliminate

human influence in both news articles and among initiatives. To address such issues, the solutions also speak to the “individual (road) user” [individueel] [individuele weggebruikers] by providing information services as travel support; this reasoning is demonstrated in the following quote from the news articles: “There are about three-hundred cars that are equipped with boxes that provide information to the road user about the best lane and speed to improve the overall traffic flow.” “With this we would also like to solve phantom traffic jams” [. . .]. An estimated one-third of all traffic jams does not have a clear reason, but is being caused by brake-responses. “One driver brakes, and through a harmonica-effect a traffic jam occurs at the back””. Following this thought, several initiatives provide solutions for the informed “traveler” [reiziger], during different moments of the route: pre-trip, on-trip, and post-trip, in the form of “applications” and “services” [app(s)] [dienst]. This is demonstrated by the use of words related to the “trip” [rit] [route], “fastest and best routes” [je route] [snelste route] [beste route], “destination” [hun/jouw/uw bestemming], and “other travelers and vehicles” [andere reizigers] [andere voertuigen]. Better information for (road) users in the form of accurate, real-time, targeted, and personal information is expected to address congestion and safety issues by also speaking to the individual road user and providing individual benefits, such as faster travel and more convenience: “These apps give personal and actual in-car information for commuters and event visitors in Amsterdam. With these, the car driver can choose him or herself for the most suitable route and contribute to the prevention of traffic jams” (initiative: PPA In car). Users are therefore mainly targeted as potential consumers and are offered all kind of benefits of using the service, promoting that it is “easy” [(ge)makkelijk] and “reliable” [betrouwbaar], for example. Additionally, “sustainability” [duurzaam] receives attention in the news articles, but it is often used in a way that is still linked to technological solutions and as an incidental benefit rather than a prioritized aim, such as: “By supporting the behavior of car drivers with the use of technology, traffic jams can be reduced, and traffic safety, driving comfort, and sustainability will be improved”.

With congestion and traffic safety, as with most of the mentioned problems, the type of problems that receive most attention are car-related. Moreover, the individual user that is being targeted by most initiatives is the individual road user. The most occurring nouns show that, by far, the noun “car” [auto] is mentioned the most in the news articles and often by the initiatives. Furthermore, we can find many words related to cars, such as “road” [weg], “traffic” [verkeer], “traffic jams” [file], and “vehicle” [voertuig]. Within the initiatives, we furthermore find words pointing towards the specific user that relate to the car, “road-user” [weggebruiker], “cardriver” [automobilist], “driver” [bestuurder], and lastly “traffic manager” [wegbeheerder]. Moreover, the companies and organizations that are among the most occurring words are mostly car-related [Uber] [Tesla] [Lightyear] [Ford] [TomTom]. In general, the negative externalities of automobility are currently addressed with smart mobility by proposing car-centric solutions, such as stimulating cooperative automated driving or supporting the driver better, articulated for example as: “Talking cars will beat the traffic jam”. Furthermore, as a solution to the unsustainability of vehicles, “electric vehicles” are often proposed as these are in both the initiatives and news articles among the often occurring words [elektrisch] [elektrische auto’s] [elektrische auto].

Although car-centric, the bicycle and public transport receive some attention as well. The “bicycle” [fiets] is among the 50 most occurring words in the news articles, with approximately 400 hits and “public transport” [openbaar vervoer] with around 300 hits. These are relatively often mentioned, but little compared to the word ‘car’, which has, on its own, a frequency of more than 2500. Both the bicycle and public transport are used either as part of the smart mobility mix of solutions, such as intelligent electric bicycles and multi-model travel planners, or as solutions additional to smart mobility, such as: “Not more asphalt, but smart mobility, public transport, and bicycles are good solutions. Then, traffic flows can be improved”. When mentioned, the bicycle, even in its traditional form, is always positively portrayed, and is furthermore especially mentioned as a solution for commuters to avoid or even prevent traffic jams during rush hours. However, public transport is sometimes also perceived to become obsolete due to smart mobility solutions, having smart mobility replacing it, such

as: “Soon, cars will become cleaner, safer, and cheaper mobility solutions than public transport, thanks to technology and sustainable energy”.

3.3. Theme 3: Incremental Steps for a Sustainability Transition of the Mobility System

The smart mobility concept is generally used in quite incremental terms by being framed as a next step compared to traditional measures. Within the news articles, smart mobility is often brought up as an alternative to the traditional solution of providing more asphalt by building new roads and extra lanes. Especially in the Brabant region, there is an ongoing discussion about an additional road to finalize a road network around the city of Eindhoven, named “de Ruit” [ruit] to improve traffic conditions. However, the road would also fragment villages and nature areas. Hence, it was decided to rely on smart mobility solutions instead of more asphalt. This politically contested decision led and still leads to much media attention and discussion about whether smart mobility is a good alternative to traditional traffic management solutions. The example of “de Ruit” is illustrative for the general tone in the news articles as there are only a few more radical, alternative arguments. Only sporadically, concepts like “electric shared vehicle” or “mobility-as-a-service” pop-up involving multiple modes, and putting livability and sustainability goals more central rather than as incidental side-effects of the efforts for congestions and traffic safety, such as in Eindhoven for example: “This is the reason that Eindhoven municipality wants to experiment with Mobility-as-a-Service (MaaS). She wants to organize a MaaS-project in which the focus lies on sustainable mobility without CO₂-emissions. Additionally, MaaS should play a role in the accessibility of the region”. These alternative voices also take a more critical stance against the current dominant role of the car, such as: “Amsterdam from car possession towards car use”, “Cars are not used for an average of 23 hours [a day]”. These arguments are, however, isolated voices and less visible from the other more dominant smart mobility discussions. Furthermore, although seemingly more radical, many of these kind of solutions still largely follow the same logic as the dominant debate in which the car, car-related issues, and the car driver still has a central role, although maybe in a different form, for example: “Other research showed that every shared car replaces 10–15 privately owned cars! Fewer cars in the city means less parking spaces and more room for green areas. And fewer cars on the road means less congestion! This is something we all benefit from; the environment, the economy and the car driver him/herself” (Initiative: Studentcar).

The news articles confirm that smart mobility solutions are still largely in an experimental stage as the articles communicate about various investments that are made, and the projects and programs that are being developed. Words related to programs, or projects, and costs or investments are among the most occurring words [project] [ontwikkeling] [plan] [miljoen] [euro] [geld] [onderzoek]. Throughout the years, smart mobility remains associated with the “future” [toekomst], which is one of the most occurring words. It is either used in a way to address the need to prepare for the future, to introduce futuristic technology, like “the car of the future”, or to generally describe “the future of mobility”. The news articles are largely optimistic and full of promises about the future impact and role of smart mobility, but in later years, a few critical notes emerge related to the disappointing impact of the once promising smart mobility concept, emphasizing the still immature development stage: “But in those years little has been done [in terms of smart mobility]”, “[...] smart mobility is still very immature”, and “smart solutions as part of the ‘smart mobility’ concept—a magic word for years—will also not be able to solve congestions in the following years.” Not many articles or initiatives make a link to more radical solutions or describe for example what it would mean to fundamentally change the mobility system.

4. Discussion and Reflection

The smart mobility concept has different meanings. Within the Netherlands, it seems to be mainly associated with technological novelties. Additionally, the concept is used to propose solutions for car-related transport issues, such as traffic jams. In general, it provides quite incremental changes, and little attention goes to the concept in light of fundamental change of the mobility system. Here,

we discuss the different meanings and reflect on the corresponding implications by comparing with insights from academic literature. The most relevant topics covered in the international academic debate show similarities to the topics covered in the news articles and on the initiatives' websites for the Dutch case, hence, we categorize them into the similar themes as introduced in the previous section. Table 1 provides an overview of the three themes linked to the most relevant topics covered in the news articles, initiatives' websites, and the academic literature.

Table 1. Thematic overview of the meaning of the smart mobility concept from Dutch news articles and initiatives, and the international academic debate. Table is made by the authors.

Smart Mobility	News Articles	Initiatives	Academic Debate
Commercial and technologically advanced innovations	Enthusiasm for the technological innovations. Technological and economic character due to commercial interest of technology sector, also stimulated by the Ministry. High involvement of Dutch high-tech region. Users considered to perform worse than technology.	Promoting the technological innovations. Technological innovations cover a range of smart mobility solutions. Many initiatives located in dense urban area and Dutch high-tech region. Technological innovations proposed to solve human errors in traffic.	Technological and economic character. Commercialization. Technology-push. Downplaying users to consumers. Short-term gains.
Solutions to solve car-related transport issues	Congestion, traffic management issues, and traffic safety receive most attention. Car-related aspects and issues receive most attention. Bicycle and public transport sometimes mentioned as part of smart mobility developments or as other solutions additional to smart mobility solutions. Public transport either part of solution or becoming obsolete due to smart mobility.	Congestion, traffic management issues, and traffic safety receive most attention. Car-related aspects and issues receive most attention. Issues being targeted by focusing on individual traveler and offering benefits such as more convenience and flexibility. Bicycle and public transport sometimes mentioned as part of smart mobility developments.	Congestion, traffic management issues, and traffic safety receive most attention. Car-centric solutions can lead to more mobility issues, and problems can become more severe. A need to focus on other modes and looking for solutions beyond the car.
Incremental steps for a sustainability transition of the mobility system	A next step compared to traditional traffic management solutions such as more asphalt. A more radical development of shared, sustainable, and multi-modal mobility, but less visible and more isolated.	Incremental innovations for optimizations. A more radical development of shared, sustainable, and multi-modal mobility, but less visible and more isolated.	Pragmatic approach to system change. Experimental, innovative, immature stage, thus not proven yet and likely to face many barriers when scaling up. Short-term focus on immediate problems rather than on long-term societal goals like sustainability.

In the academic literature the technological and commercial character is discussed as well, although there is less attention for the regional aspect, such as the impact of the Dutch high-tech region in the empirical case. In the literature, other transport modes do receive some attention, but there is also

a general focus on the car and car-related transport issues such as congestions. Moreover, while the Dutch case demonstrated that these issues are addressed by targeting the individual road users, the academic literature is less specific about the approach. Furthermore, the literature shares the view on the pragmatic and incremental character of smart mobility, but differs in the overall tone, which is more critical. In the literature, smart mobility is criticized for being too technocratic, promoting technological solutions for non-existing problems, driven by the commercial interests of market parties, resulting in a technology-push of these solutions rather than addressing mobility issues [3,6,9–11,27]. Furthermore, when targeting transport issues, the solutions tend to focus on keeping cars on the road and fail to look for solutions beyond cars, which might result in an opposite effect of increased mobility [3,4,6,11,27]. Finally, the solutions seem to focus on short-term fixes and immediate problems, rather than taking long-term issues, such as sustainability challenges, into account [3,6,9–11,27].

Summarizing the above insights, these themes reveal some seemingly contradictory meanings for the smart mobility concept. First, smart mobility is about technological innovations, but promises to address social aspects, such as user and societal needs. Second, smart mobility is about individualistic car-based solutions, but promises to address collective transport issues that are caused by cars. Lastly, smart mobility is about incremental innovations, focusing on short-term fixes, but promises to fundamentally change the mobility system and address long-term issues such as sustainability challenges. These ambiguous and seemingly contradictory meanings are discussed below in more detail.

4.1. Smart Mobility: Technology-Push to Address User and Societal Needs?

Smart mobility comes forward as a constellation of ICT-related innovations in the mobility sector with much attention for cooperative systems and real-time information services, which resembles academic literature [2–4,6,7,9–13,27,28]. As technologically advanced innovations, the smart mobility concept has a technological and commercial character in the Dutch case, and it is used in relation to economic interests, and to provide opportunities for the private sector. The dominance of a high-tech region in the Netherlands especially demonstrates the interest of the private sector and the technology and the automotive industry specifically. The danger of this technological character, however, is that it might result in a technology push [3,6,9–11,27] where technology is promoted for commercial reasons for the technology sector and where societal goals are downgraded to possible side-effects and users are seen as potential customers instead of users with specific user needs [10,11,27]. Indeed, the results show that although making a promise to be user-centric, the smart mobility concept is still rather technology-centric, framing issues in such a way that it becomes necessary to bypass human error with the use of technology. Broader social aspects, such as social equity and justice, receive little to no explicit attention, which leads to uncertainty in the relation of smart mobility towards social sustainability challenges [29]. When viewing technological development as an end rather than a means to an end [9,10], there is a danger of technological solutions “looking for a problem to be solved” rather than starting from the perspective of that problem [3,6].

4.2. Smart Mobility: Individualistic Car-Based Solutions to Address Collective Car-Related Transport Issues?

The smart mobility concept largely comes with promises about addressing traffic flow and traffic safety issues, which is in line with the academic literature, where most often promises are made about the reduction of congestions [4,12,13,28], improvement of traffic management [3,5,7,11,30], and contribution to increased traffic safety [12,13,28]. To address such collective issues, smart mobility solutions target the road user by providing travel support during different moments of the trip, as found in the Dutch case. The innovations focus on driving, such as providing the driver real-time traffic information, driving assistance advice, speed advice, fastest and/or most environmental friendly route navigation, and lane keep advice [3–5,8,10,27]. Next to on-trip services, pre-trip and post-trip information is also provided, such as route planning applications, or real-time parking information. To target road users, the individual benefits are promoted. Therefore, a large part of smart mobility innovations mainly focus on improving the travel comfort and convenience of the individual traveler,

by increasing travel quality and flexibility [11], improving transfer speed [12], [28], reducing costs, and taking user needs into account [7]. Sustainability receives some attention in the societal discourse, but mainly in the form of an incidental benefit rather than as a top-priority. Scholars also found that sustainability is often not a main concern, but mainly treated in terms of improving energy-efficiency, by reducing energy use of vehicle-distance travelled, and promoting the use of less energy-intensive modes [3].

In general, smart mobility solutions focus on car-related issues by targeting the individual road users, and the solutions aim to solve the negative externalities of automobility with car-centric solutions. Although cars receive the most attention, among the news articles and initiatives, some attention is also dedicated to public transport and biking, either as part of the smartification developments, or used as additional solutions next to smart mobility developments. While the bicycle in the Netherlands has only positive connotations and it is generally believed that it will continue to have an important position in future, the position of public transport is questionable as some believe it will become obsolete. Indeed, when smart mobility solutions are car-centric, there is a big chance that it will persuade people from public transport towards car use, keeping cars on the road [4]. Furthermore, due to improvements in the mobility system, such as a smoother traffic flow, a rebound effect could take place [3], and (car) demand and use will continue to increase, as it leads to more convenient travel and induced traffic [6,11]. Especially if trends that lead to extra mobility demand will continue to exist [4]. Smart mobility holds a paradoxal promise of on the one hand reducing mobility demand, while on the other fulfilling currently unmet demand and creating new demand [4,27], amplified by the involvement of the private sector, whose profits are still linked to more mobility (either in the form of products or services) [4]. Therefore, to really address congestion issues and sustainability concerns, it is argued that there is a need to look for solutions beyond the car, including public transport, walking, and cycling, in the mix of multiple modes to form an integrated solution for mobility needs [2,4].

4.3. Smart Mobility: Incremental Innovations and Short-Term Fixes to Trigger Transformative Change?

Smart mobility is currently mainly used as a next step compared to traditional traffic management solutions and thereby provides a rather incremental change. There are just a few more radical and alternative voices, involving ideas like shared and multi-modal forms of mobility where livability and sustainability goals are prioritized. Additionally, academic literature mentions these other innovations that concern the integration of multiple modes by providing real-time information, such as multi-modal travel planners, and sometimes also including the booking and payment of such modes [3,8,13,27,31]. These also include several new mobility services, such as ride sharing, ride hailing, forms of car sharing, bike sharing, and the integration of such forms, linking to the more traditional forms of public transport. There is also mention of the idea of offering mobility “as a service”, providing seamless multi-modal travel opportunities. Such initiatives take a much more critical stance against the car. However, in both the academic debate, but even more so in the case of the Netherlands, these other type of solutions are often isolated arguments, less visible and not well-connected to the more dominant debate. Additionally, although seemingly radical, many of these solutions still follow the same car-centric logic, aiming for efficiency-gains, although maybe in a different (shared) form of the car. Smart mobility is used as a pragmatic approach [4,6,11,27], but therefore, it tends to focus on solving immediate problems, and going after short-term (commercial) benefits, rather than addressing more comprehensive and long-term goals such as quality of life and sustainability [3,9,11,27]. With the assumption that such short-term technological fixes will also address broader societal goals, there is a danger that smart mobility solutions might even distract attention from these larger sustainability challenges, and postponing change or diverging from long-term solutions [6,10].

Moreover, in the Dutch case, little evidence is found that smart mobility is brought into relation with a possible larger transformation of the mobility system and the smart mobility developments remain largely associated with an innovative and experimental stage. When aiming for system change, such developments still need to mature and scale-up [3,4,6–8,27,28,31], meaning that along with new technological options, it requires the co-evolution of the industry, infrastructures, business models, legislations, user behavior and preferences, and cultural norms and values [32]. It requires, for example, an infrastructural basis of a high-quality road network [3,7], and a physical high-quality ICT network [3,28]; it furthermore requires users' acceptance and willingness to adapt their behavior [3,4,7], and it asks for collaborative alignments and new forms of governance, involving multiple stakeholders and their diverse set of needs and interests [3,6,8,27]. This is a much more uncertain, complex, and long-term innovation process, likely to trigger much resistance, especially when solutions challenge the status quo and the current dominant role of the car. Somehow there exists a certain thought or hope that the proposed quite incremental innovations will trigger larger transformations. However, moving from the small-scale isolated initiatives that smart mobility currently entails towards such sustainability transitions means that many barriers are still to be overcome, which will possibly lead to many disappointments [33]. Currently, among news articles and initiatives, a picture of technology-optimism is portrayed. There are few arguments that challenge the dominant role of the car or critically reflect on the unsustainability of the existing mobility system. In the context of smart mobility, the larger societal and sustainability challenges of the current mobility system are rarely discussed, let-alone that the potential role of smart mobility innovations herein is critically examined.

5. Conclusions

Unpacking the smart mobility concept for the Dutch case and using insights from academic literature revealed some ambiguity in the meaning of the smart mobility concept, demonstrating on the one hand a focus on incremental technological innovations that bring forward car-based solutions for short-term fixes, while on the other hand promising to address car-related issues and fundamentally change the mobility system by taking long-term challenges into account. Therefore, our main conclusion is that considering the ambiguities and uncertainty in the meaning of smart mobility, smart mobility developments should be critically evaluated when proposed as solutions to transport issues and sustainability challenges.

For the Dutch case specifically, but applicable to other contexts as well, this leads to the following critical points for evaluation. First, generally speaking, smart mobility seems to be about optimizations of the existing mobility system and the solutions that it brings forward focus on maintaining the status quo rather than challenging it. Sustainability and other long-term societal challenges receive little attention, and these are often treated as positive side-effects rather than major concerns. Overall, the relation of smart mobility to sustainability remains largely unpacked as there is little debate about this. Second, although a wider public became more familiar with smart mobility, the concept is mainly used by a few specific types of (regional) actors that dominate the societal discourse and push smart mobility developments forward. These actors include, for example, the Ministry of transport, the automotive industry and technology sector, and the technological universities. More specifically, many of these actors are located in the Dutch high-tech region, which has hosted many initiatives and has often been mentioned in the news. Due to the strong technological and automotive focus of the region the smart mobility concept is mobilized and given substance to for these specific technological and commercial purposes with less attention to other goals and interests. Third, there are a few deviating and more radical and critical voices; for example, the focus on mobility-as-a-service that critically questions the dominance of the car and links more strongly to sustainability goals. However, these often isolated voices get less attention and are not well-connected to the larger smart mobility debate, which involves a risk of losing diversity.

The concept's ambiguous meaning leads to the critical remarks above, and while it constantly evolves, it adds to the uncertainty about the direction of developments, it also enables actors to link to and mobilize the concept for their own purposes. As demonstrated in the Dutch case, it has attracted actors and resources, stimulated experimentation, and drawn the attention of the wider public. Hence, the smart mobility concept has mobilized several developments, and although the majority of initiatives and developments have an incremental character, such initiatives can be seen as possible seeds of change. Whether or not still called 'smart mobility', their accumulative effect can, on the long-term, contribute to a fundamental change towards a sustainable mobility system. Therefore, it remains important to research such developments, although from a critical perspective.

Unpacking the meaning of the smart mobility concept was a useful step in exploring what such a concept entails and mobilizes in practices. For the exploratory purpose of this paper, the text mining approach proved to be a useful method. It is especially useful as a first step to explore the content of a large dataset of different sources, which were, in this case, over 1000 news articles and over 100 initiatives' webpages. The text mining results provided a solid base for the guided analyses. However, the method cannot stand on its own, as it requires some pre-knowledge of the topic to distinguish between results that are relevant for unpacking the smart mobility concept and more general text, not specifically relevant for this purpose. Some pre-knowledge also helps to recognize the names of, among others, cities, organizations, people, and the link between these. However, additional context is still needed; for example, the word "green" often occurred, which could be linked to "green" sustainability issues if the context is not properly studied. However, the content analysis revealed that it was mainly used to relate to traffic lights, pointing to the "green" light. Hence, it is useful to complement the text mining approach with a qualitative content analysis to contextualize and interpret the text mining results. Furthermore, future research can explore the application of more advanced text mining methods based on natural language processing insights. Specifically, a sentiment analysis would be of interest considering the emergence of small notions of criticism on smart mobility in later years, which might suggest a possible change in public opinion in the coming years.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Graphic overview of the number of news articles and initiatives per year, the names of the initiatives, and the article news sources and initiative locations.

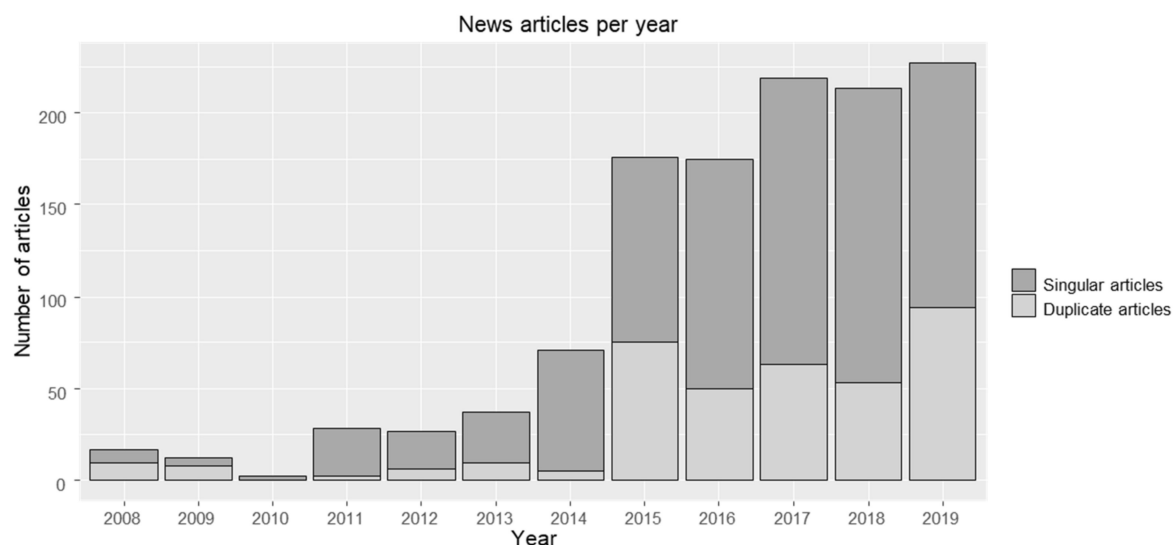


Figure A1. Graphic overview of the number of news articles per year discussing “smart mobility” or the Dutch translation “slimme mobiliteit”. The lighter grey part of the graph shows duplicates, meaning that the same article was published in multiple news sources. Note that the results for 2019 only cover the first 8 months of the year; thus, the number of articles for the full year is expected to be even more. Figure is made by the authors.

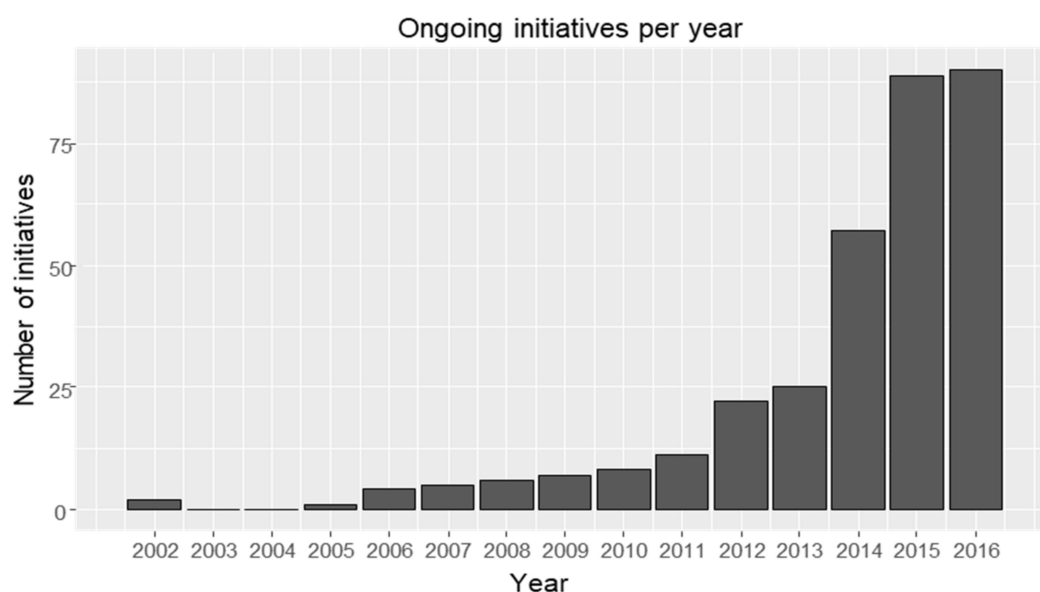


Figure A2. Graphic overview of the number of ongoing smart mobility initiatives per year, based on the database of [14]. Note that the database is limited to initiatives that started before 2017. Nevertheless, many of these initiatives are currently still ongoing. Figure is made by the authors.

Table A1. List of analyzed initiatives in alphabetic order, including a link to the website. Table is made by the authors.

A2 test	http://www.aon.com/netherlands/persberichten/2016/nationale-platooning.jsp
ADAM	http://www.amsterdammobiel.nl/
Amsterdam Arena Events	http://www.autoweek.nl/nieuws/vanuit-de-auto-communiseren-met-het-stoplicht/
Andes	http://demo.andes.nl/reisplanner/

Table A1. Cont.

ANWB Onderweg	http://www.anwb.nl/mobiel/onderweg-app
BEAMRZ	http://www.beamrz.com/
BeepBeep	http://www.beepbeeparking.com/
BikeScout	http://www.heijmans.nl/nl/bikescout/
Blabla car	https://www.blablacar.nl/
Blikr	http://www.technolution.eu/nl/mobiliteit/77-blikr-dynamische-rijstrookbegeleiding.html
Bliksem	http://www.beterbenutten.nl/assets/upload/files/Flyer%20A4-MMRI-21-11-HR.pdf
Brabant in-car III	http://www.beterbenutten.nl/brabant-in-car-iii
B-Riders	http://www.briders.nl/
Buurauto	http://www.buurauto.nl/
Calendar42	http://site.calendar42.com/
Car2Go	https://www.car2go.com/NL/en/
CHARM PCP	http://itsoverzicht.connectingmobility.nl/projecten/5TJyQxZxjzaT4yjGp
C-ITS	http://www.beterbenutten.nl/c-its
C-ITS Corridor	https://itscorridor.mett.nl/default.aspx
Communicating traffic light Crossing Delft	http://www.proeftuinendelft.nl/en/proeftuin/never-drive-through-a-red-light-again/49
Compass4D	http://www.compass4d.eu/en/about/over-compass4d/
Connectcar	http://www.connectcar.nl/
DAVI	http://davi.connekt.nl/contact/
De Digitale Wegbeheerder	http://www.smartdatacity.org/amsterdam-de-digitale-wegbeheerder-app/
ecoDriver	http://www.ecodriver-project.eu/
EcoTwin-demonstration	http://itsoverzicht.connectingmobility.nl/projecten/YczRqaceNAghmFt7e
Energy Efficiency Intersection	http://www.compass4d.eu/en/about/energy_efficient_intersection_service.htm
European truck platooning challenge	https://www.eutruckplatooning.com/default.aspx
EVA	http://www.amsterdammobiel.nl/
Evenementen	http://www.beterbenutten.nl/its-evenementen
Filejeppen	https://filejeppen.nl/#/home
Flip en Klaar	http://www.rivierenlandinverbinding.nl/projecten/vervoerexperiment-tiel/
Flister	http://flister.nl/
Flitsmeister	https://www.flitsmeister.nl/
Floating Car Data	http://www.ndw.nu/nieuws/bekijk/224/pilot_met_floating_car_data_in_de_innovatiecentrale/
FlowPatrol	https://filejeppen.nl/flowpatrol/#/home
GCDC 2016	http://www.gcdc.net/en/
Go About	https://goabout.com/
Google Maps	https://www.google.nl/intl/nl/maps/about/
Greenwheels	https://www.greenwheels.com/nl
Here	https://company.here.com/here/
Ijburg Streetwise App	http://www.smartdatacity.org/amsterdam-de-digitale-wegbeheerder-app/
IkbenHopper	http://www.ikbenhopper.nl/
IMeX	https://www.parkeer24.nl/slim-samenwerken-loont-bij-incident-management
Incident management	http://www.smartdatacity.org/amsterdam-de-digitale-wegbeheerder-app/
Incidenten	http://www.beterbenutten.nl/incidenten

Table A1. Cont.

Intelligent crossings	http://www.autoweek.nl/nieuws/vanuit-de-auto-communiseren-met-het-stoplicht/
Intelligente fiets TNO	https://www.tno.nl/nl/aandachtsgebieden/leefomgeving/mobility-logistics/veilige-mobiliteit/fietsen-auto-s-en-kruispunten-intelligent-maken/
INTERCOR	http://www.itsinternational.com/event-news/intertraffic/2016/news/necessity-is-the-mother-of-invention/
Intersection Safety	http://www.vruits.eu/?q=node/45
Lochem adopt EV	https://www.lochemenergie.net/producten/adopteer-elektrische-auto
Marktplaats voor Mobiliteit	http://www.verkeersonderneming.nl/home/anti_filediensten
Marktplaats voor Mobiliteit	http://marktplaatsvoordata.nl/
MAXS	http://www.maxs.nl/
MOBI	http://www.van5naar4.nl/nl-nl/
MobielSchadeMelden app	https://www.mobielschademelden.nl/#/landingspagina
Mobile Ninja	http://www.mobileninja.nl/#/map
Mobility mixx	http://www.mobilitymixx.nl/
Mobilitylabel	http://www.mobilitylabel.nl/Office-Location-Optimizer/
Mobinet	http://www.mobinet.eu/?q=content/pilot-helmond
Mobypark	https://www.mobypark.com/nl/hoer-werkt-het
Multimodale reisinformatie	http://www.beterbenutten.nl/mmri
MyOrder	https://myorder.nl/
MyWheels	https://mywheels.nl/
Open parkeerdata	http://www.beterbenutten.nl/open-parkeerdata
P33	https://e52.nl/athlon-car-lease-in-zee-met-eindhoven-startup-p33-voor-innovatief-autogebruik/
Parckr	http://www.parckr.com/nl/
Parkbee	http://parkbee.com/
ParkFlyRent	https://www.parkflyrent.nl/
Parkmobile	http://www.parkmobile.nl/
Parquery	http://parquery.com/
PickThisUp	http://pickthisup.nl/index.php?lang=en
Plannerstack	http://www.plannerstack.org/
PPA In car	http://www.praktijkproefamsterdam.nl/PPA-projecten/Fase+1/default.aspx
PPA Noord	http://www.praktijkproefamsterdam.nl/PPA-projecten/Fase+2/default.aspx
PPA wegkant	http://www.praktijkproefamsterdam.nl/PPA-projecten/Fase+1/default.aspx
PPA West	http://www.praktijkproefamsterdam.nl/PPA-projecten/Fase+2/default.aspx
PPA Zuidoost	http://www.praktijkproefamsterdam.nl/PPA-projecten/Fase+2/default.aspx
Praktijkproef Amsterdam	http://www.praktijkproefamsterdam.nl/default.aspx
Prettig Parkeren	https://www.prettigparkeren.nl/
Probe Vehicle Data	https://itscorridor.mett.nl/Projectinformatie2/Cooperatieve+diensten/Sensordata+uit+voertuigen/default.aspx
Red Light Violation Warning	http://www.compass4d.eu/en/about/red_light_violation_warning.htm

Table A1. Cont.

Reisinformatiediensten	http://www.beterbenutten.nl/informatiediensten
Reisinformatiediensten	http://www.beterbenutten.nl/reisinformatiediensten
Road Hazard Warning	http://www.compass4d.eu/en/about/road_hazard_warning.htm
Road Works Warning	https://itscorridor.mett.nl/Projectinformatie2/Cooperatieve+diensten/Waarschuwing+bij+wegwerkzaamheden/default.aspx
Roudle	http://www.roudle.com/
Route 66 Navigatie	https://www.route66app.com/
Routeradar	http://www.routeradar.nl/
SAA-corridor	http://www.beterbenutten.nl/nieuws/647/its-reisinformatiediensten-helpen-bij-wegwerkzaamheden
Shared parking Amersfoort	http://fiware-lab.nl/nieuws.php#28
Slim Rijden Kosten Vermijden	http://onlineedewageningen.nl/kick-off-pilot-slim-rijden-kosten-vermijden/
Slimmer naar Scheveningen	http://denhaag.com/nl/scheveningen-bereikbaarheid
Slotmanagement	http://www.smartdatacity.org/amsterdam-de-digitale-wegbeheerder-app/
SMART	https://www.smartintwente.nl/
Smart Solar Charging	http://www.lomboxnet.nl/smart-solar-charging
SnappCar	https://www.snappcar.nl/
Social charging	http://www.social-charging.com/
Social media in traffic management	http://innovatiecentrale.nl/nl/social-media-als-databron
SPARC	http://gosparc.com/
SpitsLive	http://www.ditcm.eu/innovations/application-projects/102-spitslive
Spookfiles	http://www.spookfiles.nl/
Studentcar	http://www.studentcar.nl/
Supermarktlogistiek	http://www.beterbenutten.nl/supermarktlogistiek
Superroute	https://www.amsterdamonderweg.nl/pages/index.php?pageid=76
Superticket	https://www.amsterdamonderweg.nl/pages/index.php?pageid=76
Switchpark	https://www.switchpark.nl/#!/howitworks
Tesla Autopilot 1.01	http://www.ditcm.eu/news/8-news/414-tesla-autopilot-about-to-get-fleet-learning-update
TimesUpp	https://timesupp.com/nl/
TomTom Traffic	https://www.tomtom.com/nl_nl/drive/tomtom-traffic/
Uber	https://www.uber.com/nl/cities/amsterdam/
Verkeersinformatiedienst	http://www.vid.nl/app
Waze	https://www.waze.com/nl/
WeGo	http://wego.nu/
WEpods	http://wepods.nl/
XXImo	https://www.xximo.nl/
Yellowbrick	https://www.yellowbrick.nl/
ZOOF	http://www.zoof.nu/home.html

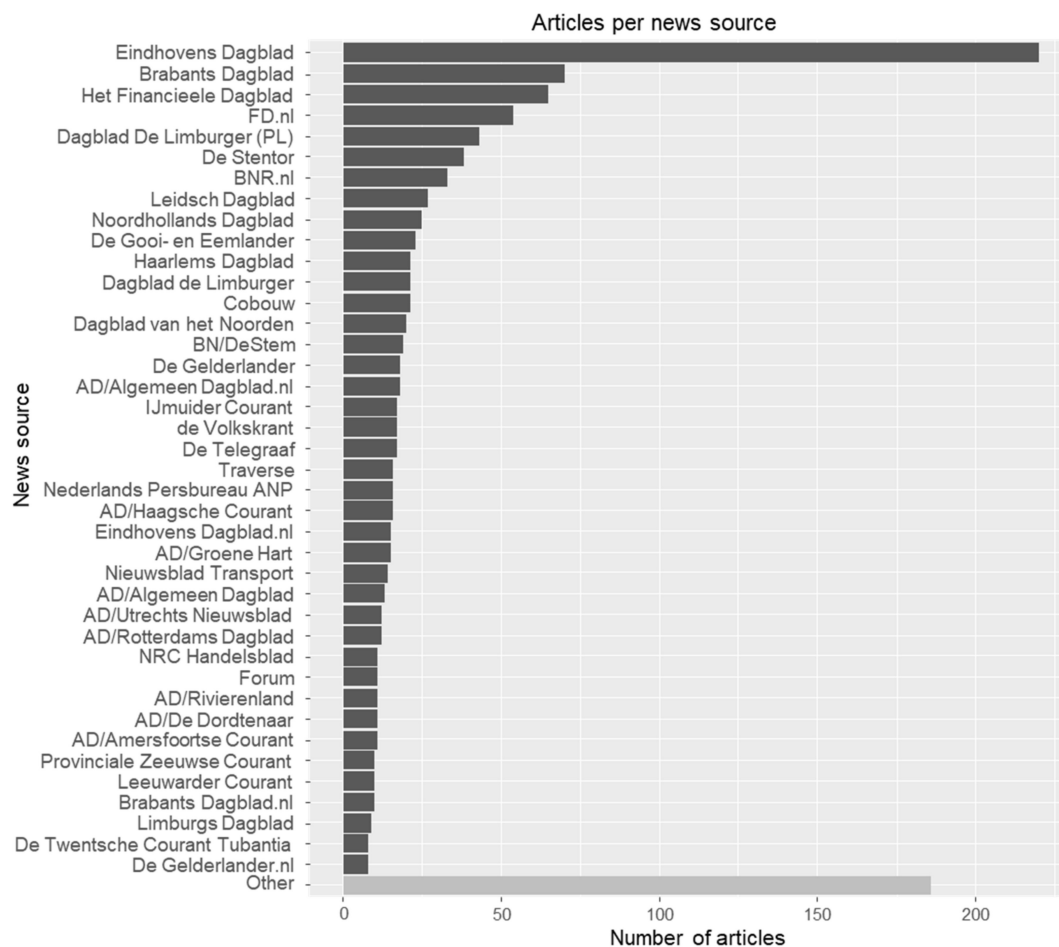


Figure A3. Graphic overview of the number of Dutch news articles about smart mobility per news source. Figure is made by the authors.

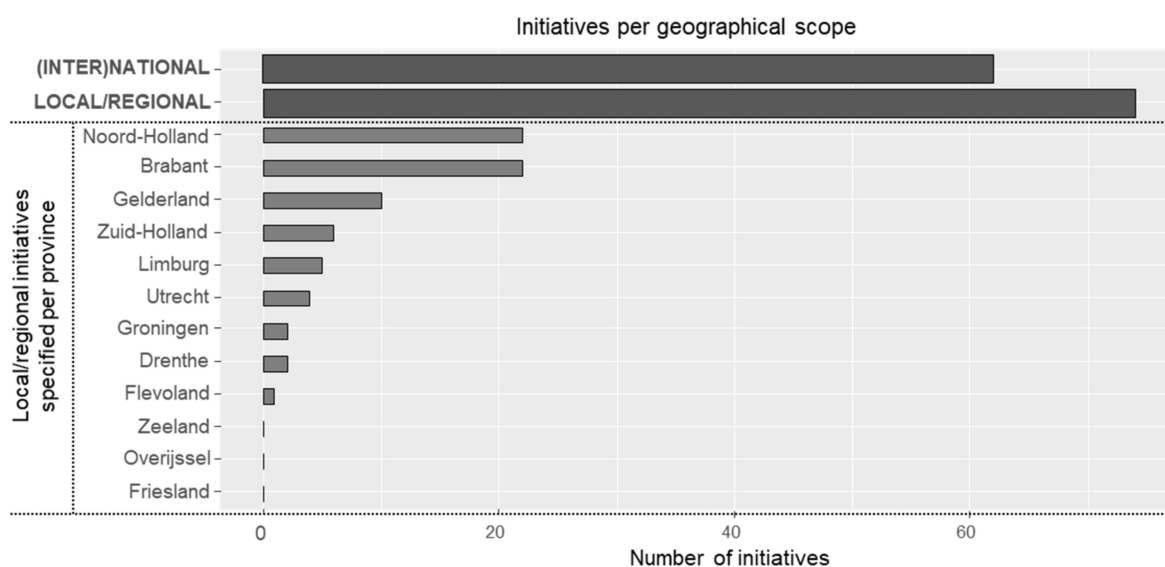


Figure A4. Graphic overview of the number of Dutch smart mobility initiatives per geographical scope, specified per province. Note that around half of the initiatives are not necessarily bound to a geographical area and cover a wider national or international scale (e.g., a traffic information app). This leaves the other half of the initiatives that take place locally or regionally, which are also specified per province in this graph. Figure is made by the authors.

Appendix B

Graphic representations of the most occurring words and word relations for the Dutch smart mobility news articles and initiatives.

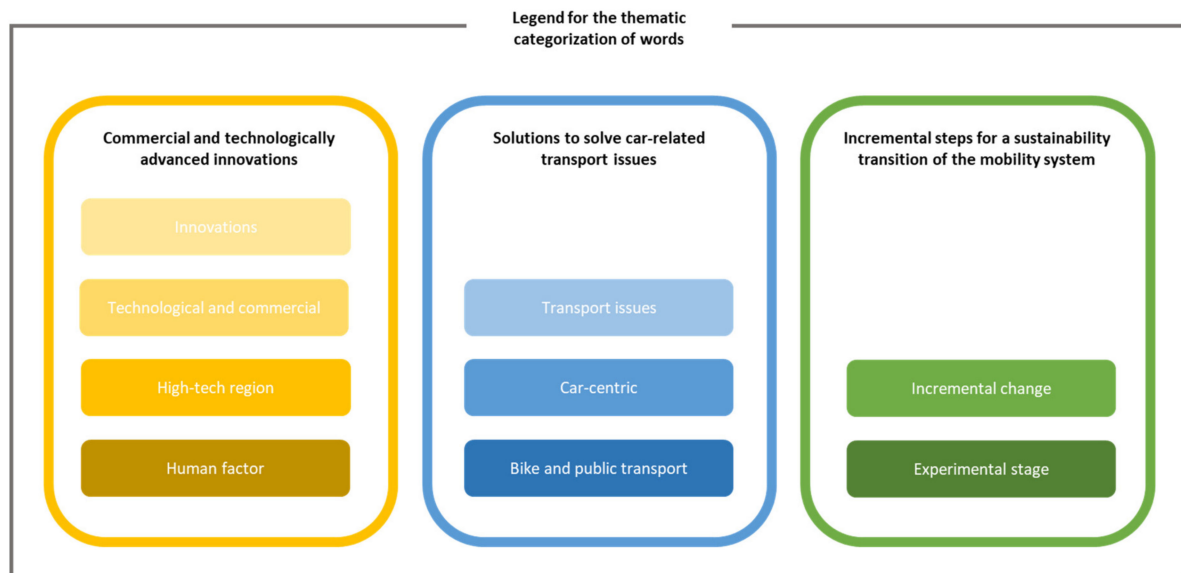
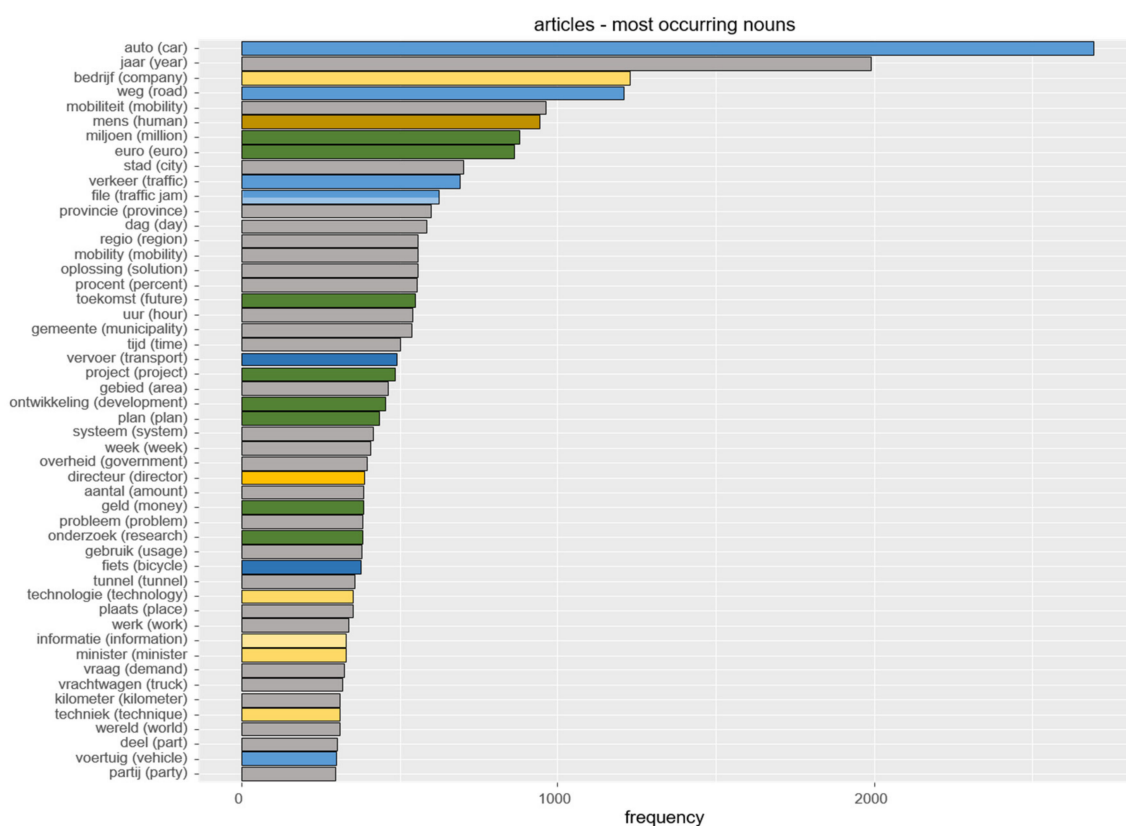
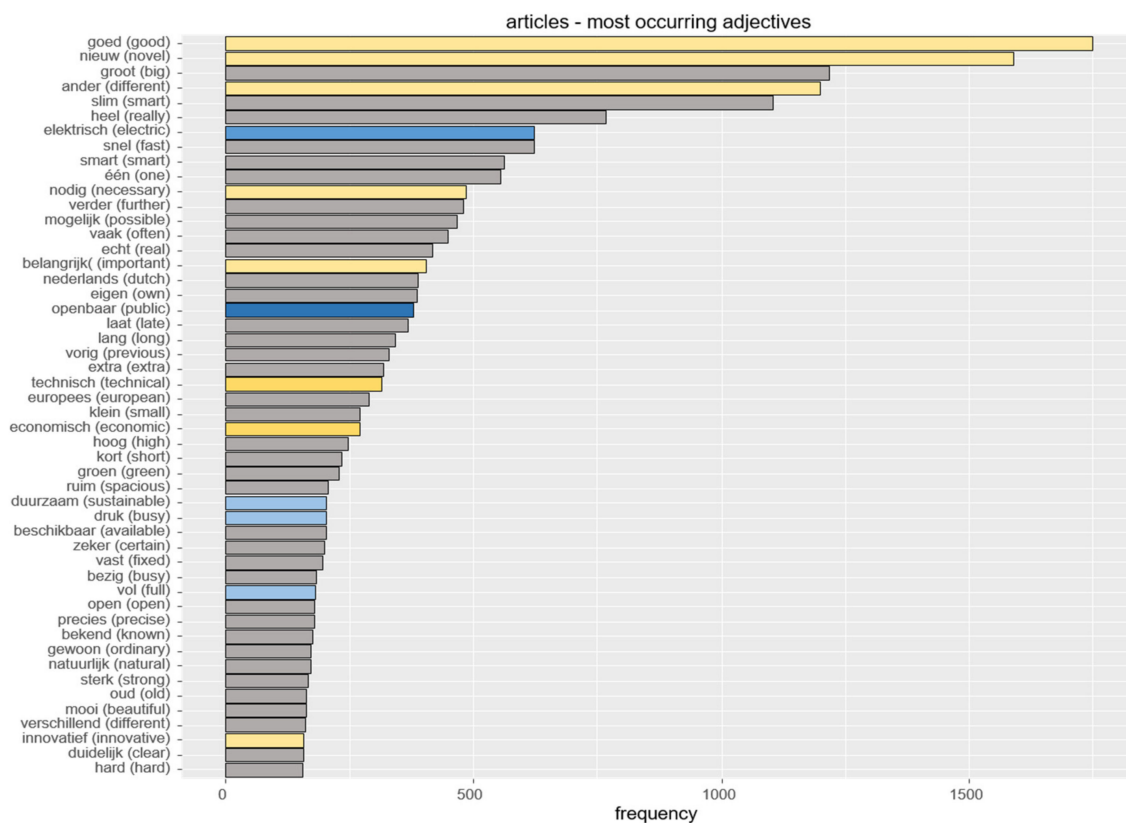


Figure A5. Legend for the thematic categorization of words in the graphic representations of nouns, adjectives, simple noun phrases, and proper nouns of the initiatives and news articles. Figure is made by the authors.

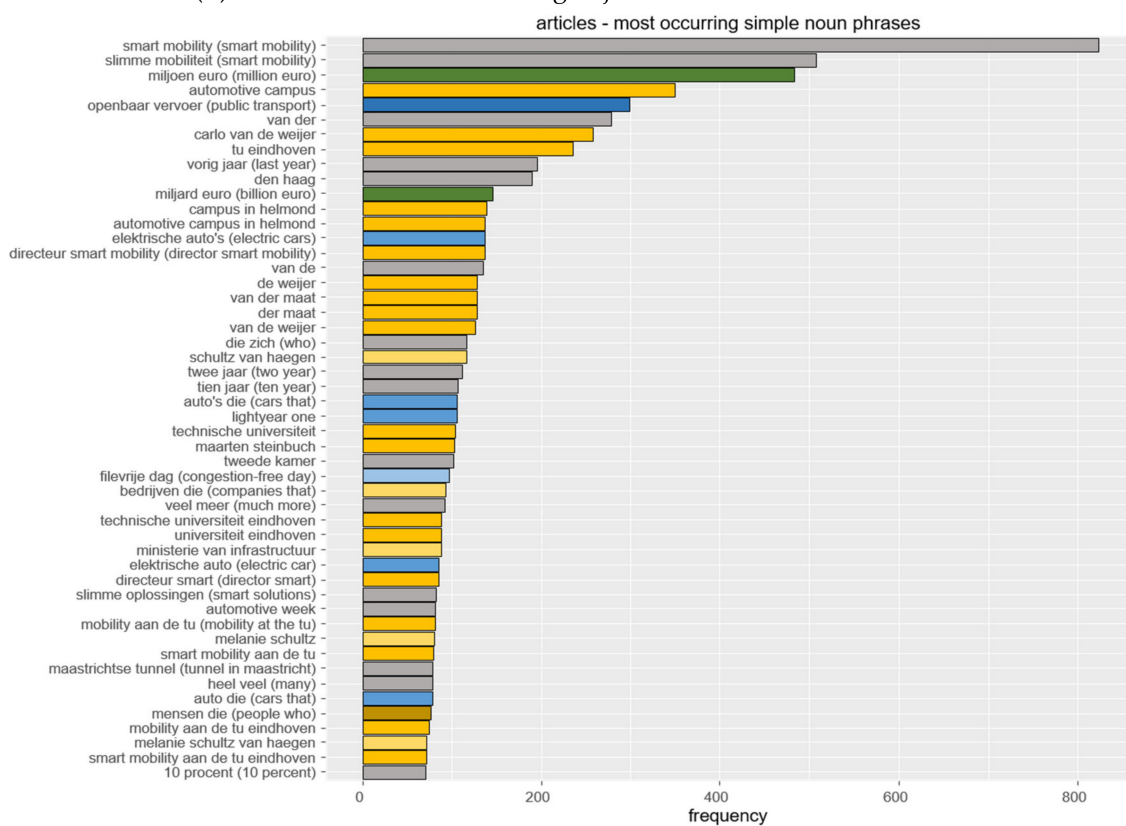


(a) Overview of most occurring nouns for the news articles.

Figure A6. Cont.

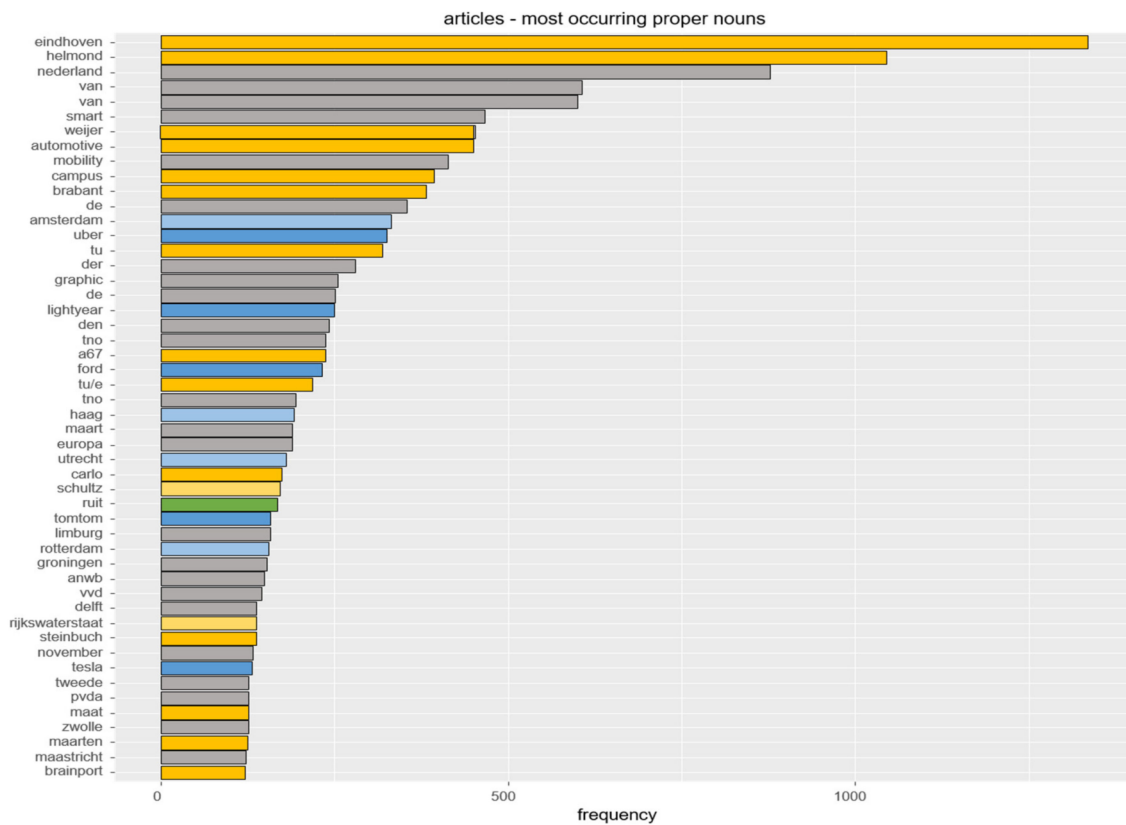


(b) Overview of most occurring adjectives for the news articles.

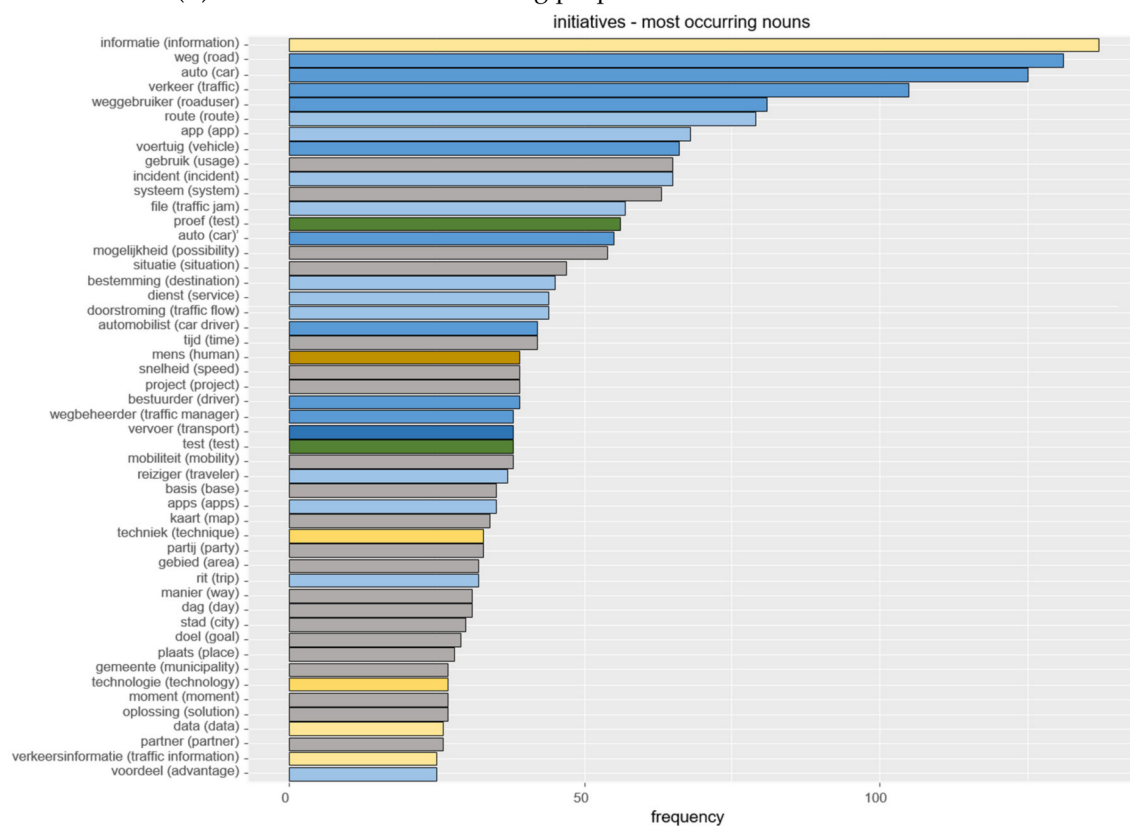


(c) Overview of most occurring simple noun phrases for the news articles.

Figure A6. Cont.

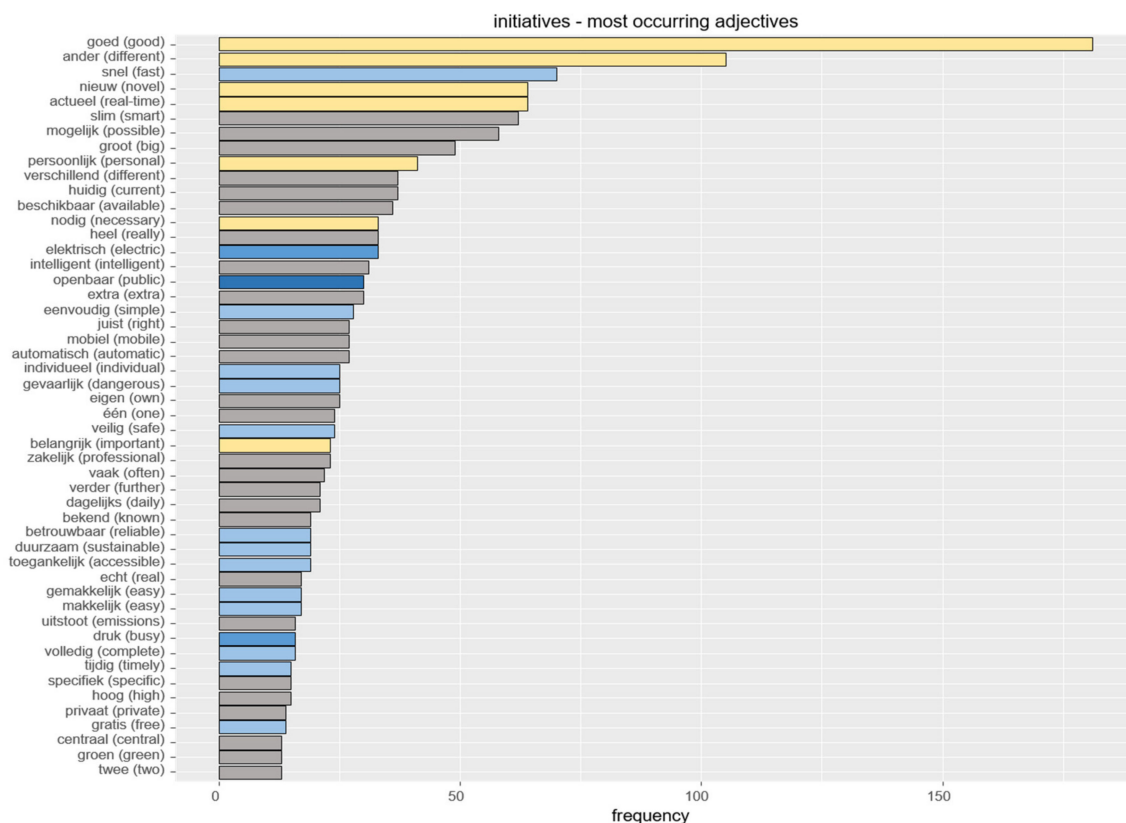


(d) Overview of most occurring proper nouns for the news articles.

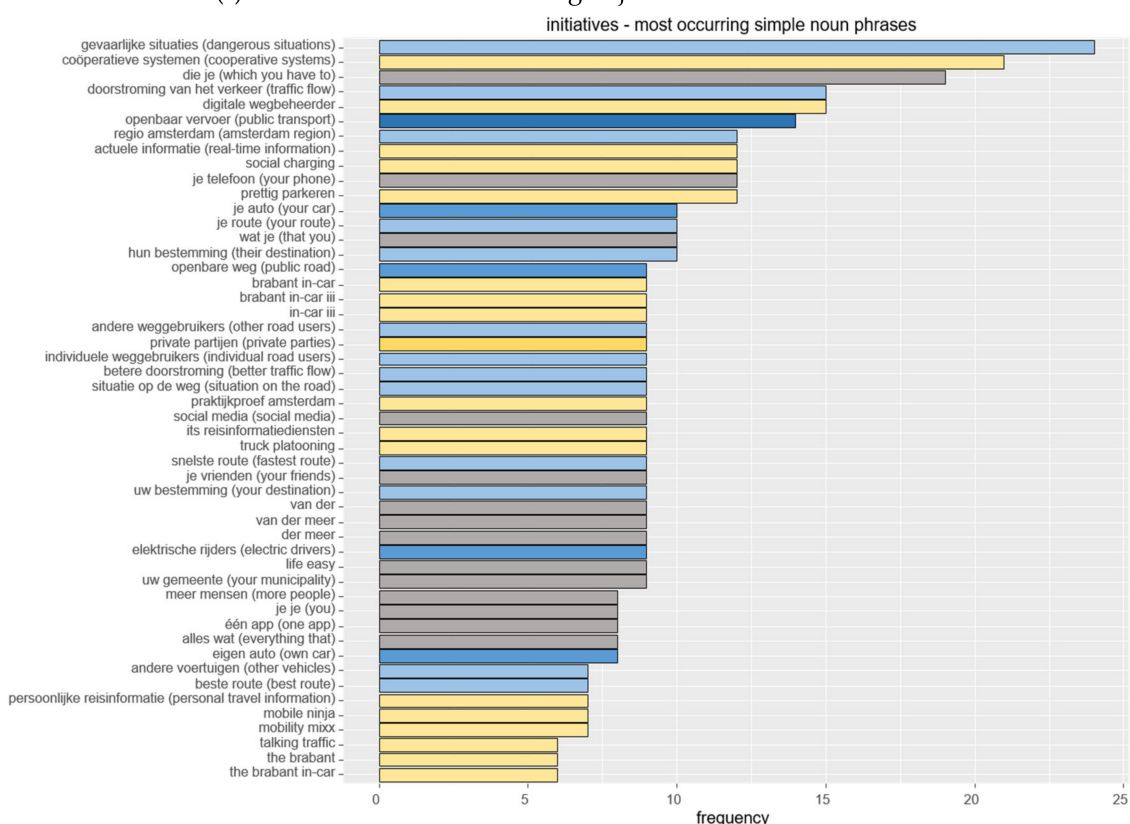


(e) Overview of most occurring nouns for the initiatives.

Figure A6. Cont.



(f) Overview of most occurring adjectives for the initiatives.



(g) Overview of most occurring simple noun phrases for the initiatives.

Figure A6. Graphic representations of the most occurring words and word relations for the Dutch smart mobility news articles and initiatives. The graphs show the frequency of nouns, adjectives, simple noun phrases, and proper nouns, which are colored by theme. The graphs display the original Dutch words and their English translations, with exception of proper names. Figures are made by the authors.

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