UNIVERSITEIT GENT

RAPPORT ONDERZOEKSRESULTATEN DATASCIENCES VERVOERSSTROMEN ZEELAND

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Contents

1 EXECUTIVE SUMMARY (DUTCH)

Dit rapport beschrijft de resultaten van het pilootproject “Datasciences vervoersstromen Zeeland”. Deze pilot bestudeert de opportuniteiten van data verzameld via mobiele applicaties om inzicht te geven in het verplaatsingsgedrag van mensen voor sectoren als toerisme, transport & mobiliteit, economie. Voor deze pilot werd de nieuw ontwikkelde mobiele app voor toeristische informatie (‘Zeeland-app’) uitgebreid met de contexttechnologie van het bedrijf Sentiance. Na toestemming van de gebruiker wordt via deze technologie locatie- en sensordata verzameld zodat inzicht kan gegeven worden over de afgelegde trajecten, de gebruikte transportmode en de reden van verplaatsing.

De data-campagne liep over een periode van vijf maanden van juni t/m oktober 2017, in lijn met de lancering van de nieuwe applicatie. Gebruikers werden na de installatie van de app gevraagd om deel te nemen aan de data-campagne. Initieel verscheen deze vraag na het derde gebruik van de app. Mid augustus werd dit aangepast zodat deze vraag reeds bij het eerste gebruik verscheen. Na goedkeuring werd data verzameld tot de de-installatie van de applicatie en onder voorwaarde dat de locatieservices aan staan op het toestel. De Zeeland-app kende een hoge tevredenheid in de app-stores en er waren geen opmerkingen rond de gebruikte data-technologie.

De campagne trok in totaal 1,505 gebruikers die toegang gaven tot hun data. Dit was gemiddeld 7% van populatie waarbij er een merkbare stijging was éénmaal de vraag tot deelname reeds bij het eerste gebruik gesteld werd. **In totaal werden meer dan 120,000 verplaatsingen geregistreerd voor een totale afstand van meer dan 2,2 miljoen km en meer dan 52,000 uren verplaatsing**. De verplaatsingen registreren naast autogebruik ook fiets, voetganger en openbaar vervoer als geconnecteerde tripsegmenten. Het gedrag is voornamelijk unimodaal met gemiddeld 1,2 tripsegmenten per verplaatsing. Autoverplaatsingen zijn prominent aanwezig met 55% van het totaal aantal verplaatsingen. De data capteert echter ook de verplaatsingen op fiets (17%) en als voetganger (26%) en in minder mate trein (2%). **Dit maakt dat de dataset een unieke kijk geeft op het multimodaal mobiliteitsgedrag van de bezoekers**. Zo kan voor elke transportmode een aparte kaart gegenereerd worden die de populaire invalsroutes en gebieden toont en kunnen per mode mobiliteitsstatistieken getrokken worden.

Naast het mobiliteitsgedrag geeft de data ook **een inkijk in het verblijfsgedrag van de gebruikers**. Hierbij wordt per gebruiker gekeken naar aaneengesloten verblijfsdagen binnen de regio Zeeland. Voor de geobserveerde bezoeken aan de regio is **de gemiddelde verblijfsduur vier dagen**. Deze duur gaat van een dag tot meer dan 100 dagen. **Meer dan de helft van de geobserveerde verblijven zijn dagbezoeken**. De data toont echter niet enkel éénmalige bezoeken. De app wordt door gebruikers meestal geïnstalleerd na aankomst in Zeeland. Eenmaal geïnstalleerd blijft ze voor een langere periode actief. Hierdoor kunnen bij deze gebruikers **weerkerende bezoekspatronen** geobserveerd worden over langere periodes, gaande van weerkerende dagbezoeken tot frequente langdurige verblijven.

Op basis van de verblijfspatronen kunnen de gebruikers gesegmenteerd worden in verschillende gebruikerssegmenten. Deze segmenten worden gevormd op basis van de geobserveerde spatiotemporeel data. Ze houden verband met toeristische segmenten zoals dagtoerist en verblijfstoerist. Men moet bij deze interpretatie wel rekening houden met mogelijke artefacten (bv. app-download vóór het bezoek vs. na aankomst, gebruik door inwoners vs. 2de verblijven). Verschillende gebruikerssegmenten werden gedefinieerd, gaande van interne gebruikers (omvat inwoners en 2de verblijven), éénmalige dagbezoekers, éénmalig lange-verblijfsbezoekers en weerkerende bezoekers. Eenmaal gesegmenteerd kunnen deze verschillende gebruikersclusters in detail geanalyseerd en vergeleken worden:

- Gemiddeld autogebruik over de verschillende segmenten schommelt tussen 39% en 64%, fiets tussen 14% en 25%, en wandelen tussen 19% en 36%;
- De interne en éénmalig lange-verblijfsbezoekers wandelen gemiddeld meer, de éénmalige dagbezoekers en weerkerende bezoekers gebruiken meer de wagen;

- Eénmalige dagtoeristen komen na Nederland (50%) vnl. uit België (28%) en Duitsland (20%); lange-verblijfsbezoekers komen uit Nederland (62%) en Duitsland (25%) en minder uit België (12%). Andere landen zoals Luxemburg, Zwitserland, UK en Frankrijk zijn aanwezig maar in kleine getallen (<1%).

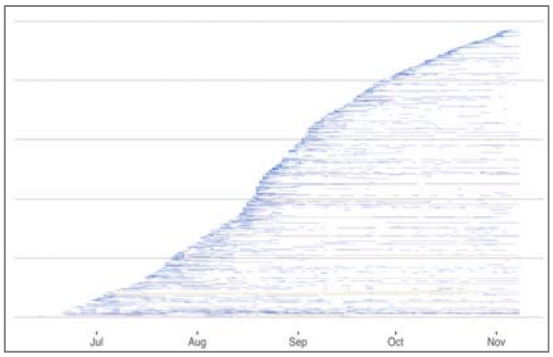
Voor de totale populatie werden **herkomst/bestemmingsmatrices** opgemaakt worden die het bezoek binnen de regio Zeeland in kaart brengen, **opgedeeld volgens de dertien Zeeuwse gemeenten**. Uit deze H/B matrices lezen we ondermeer de populariteit van bestemmingen zoals Veere en Schouwen-Duiveland, en de verkeersstromen die bij een verblijf in een gemeente gegenereerd wordt binnen de gemeente zelf en naar andere gemeenten in de auto, op de fiets en als wandelaar.

Bovenstaande analyses werden in detail uitgevoerd voor **vier focussites**, nl. Neeltje Jans, Schouwen-Duiveland, Cadzand en Goes. Hierbij werd voor elke site gekeken naar de modal split voor deze bestemming voor de verschillende gebruikerssegmenten, de spatiale verdeling van bezoeken binnen de site, en de verdeling van de plaatsen van waaruit deze site bezocht werd.

Voor dagtoeristen werd een gedetailleerde analyse gemaakt naar hun oorsprong, de lokale bestemmingen en de modal split. Algemeen bevat de data voor elke verplaatsing eveneens een inschatting van het doel van een verplaatsing. Dit omvat categorieën zoals ‘travel’, ‘restaurant’, ‘shop’, ‘office’, ‘residential’. Deze categorieën zijn inschattingen op basis van de locatie en publieke webbronnen. De context werd binnen deze pilot nog niet op correctheid gecontroleerd. Maar de data toont het potentieel naar meer gedetailleerde inzichten in de verplaatsingsmotieven van doelgroepen en de aantrekkelijkheid van voorzieningen in bepaalde gebieden.

Algemeen kan gesteld worden dat met deze pilot een unieke dataset verzameld werd. **De combinatie van toeristische mobiele applicatie en dataverzameling bereikt op een eenvoudige manier een unieke doelgroep die zich bereid toont om gegevens te delen**. De data geeft inzicht in multimodale mobiliteitsstromen van bezoekers, nuttig voor mobiliteitsmanagement van de regio. Daarnaast toont de data verblijfspatronen en laat het toe om de gebruikers te segmenteren volgens consumentsegmenten. Dit geeft naast mobiliteit inzicht in de toeristische activiteit van de gebruikers tijdens hun verblijven. De informatie op deze manier verzameld zal in de toekomst ongetwijfeld kunnen bijdragen tot een verbeterd management van mobiliteit en toerisme en de verdere ontwikkeling van het toeristisch aanbod.

(a)



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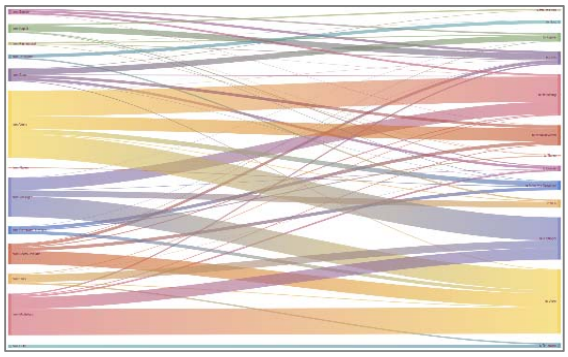

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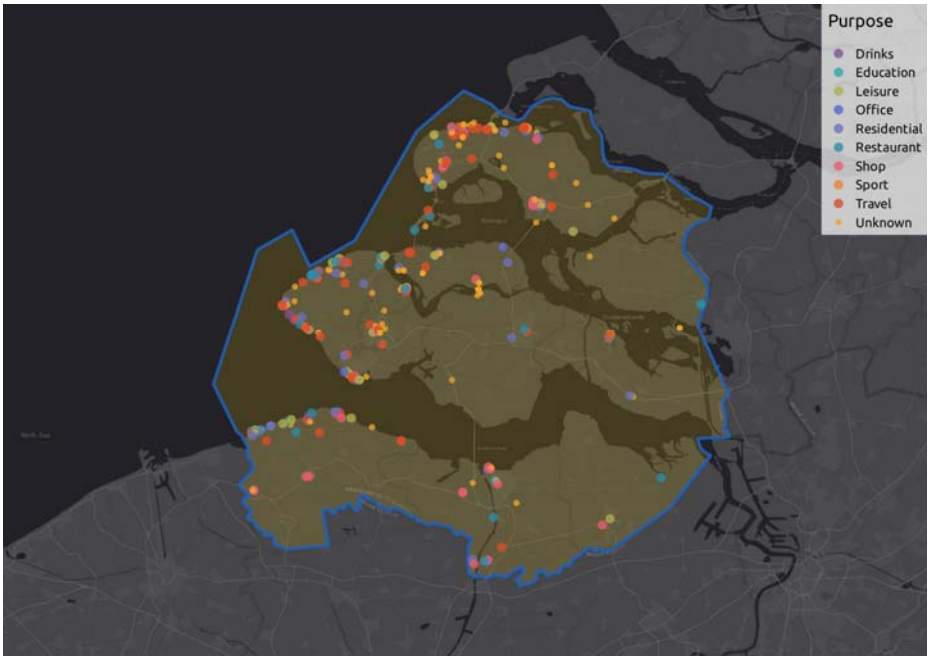


(d)

Illustraties van enkele resultaten: (a) algemeen tripoverzicht, (b) verblijfsperiodes in Zeeland per gebruiker, (c) autostromen tussen gemeentes bij bezoek Zeeland, (d) inzicht in het verplaatsingsdoel van dagtoeristen.

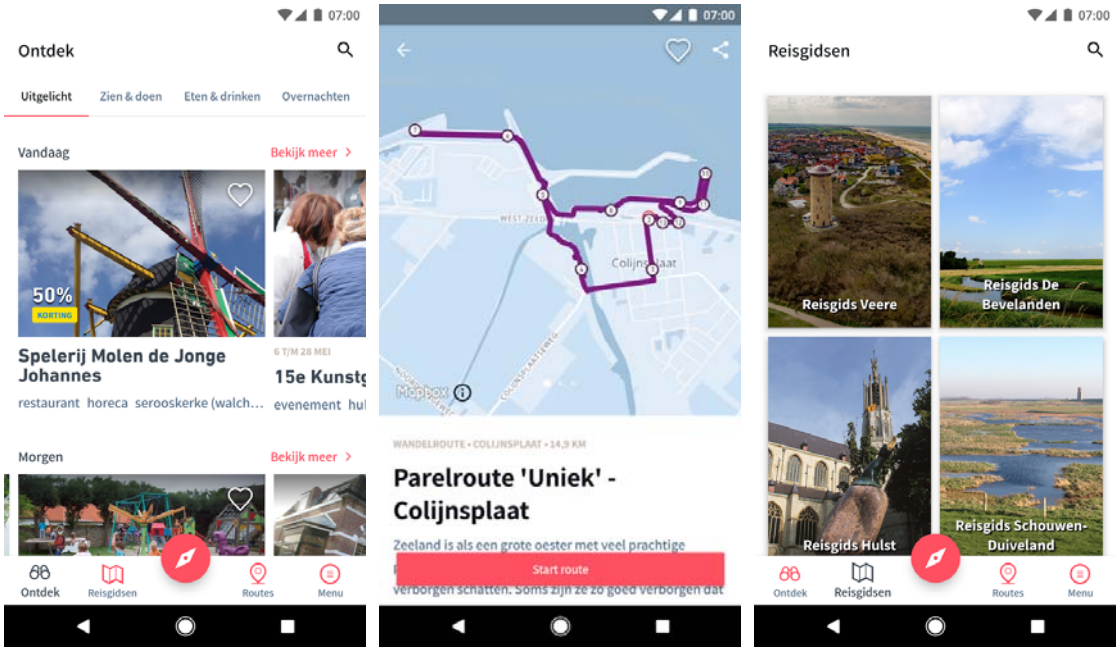
2 INTRODUCTION

An important part of the visit to any location, whether this is a day out or a whole holiday, is to explore the region. Tourists choose various forms of transport to do so. Even more, they choose different ones in different stages of their travels, for different purposes, from different reasons... In order to optimise their experience and travel itself, various projects have been set up and insights gained in all phases of this process (dreams, plans, bookings and on-site experience). In addition, knowledge about the guest in all phases of the journey is essential. One of the methods for data analysis is big data analytics. Big data analytics is a new technical discipline in response to the large amount of data that can be collected continuously at any time of the day. Here, the goal is not to collect more data but to convert data into valuable and meaningful insights. With this aim, the pilot project for the Zeeland province was set up between i-KNOW UGent, VVV Zeeland and the province.

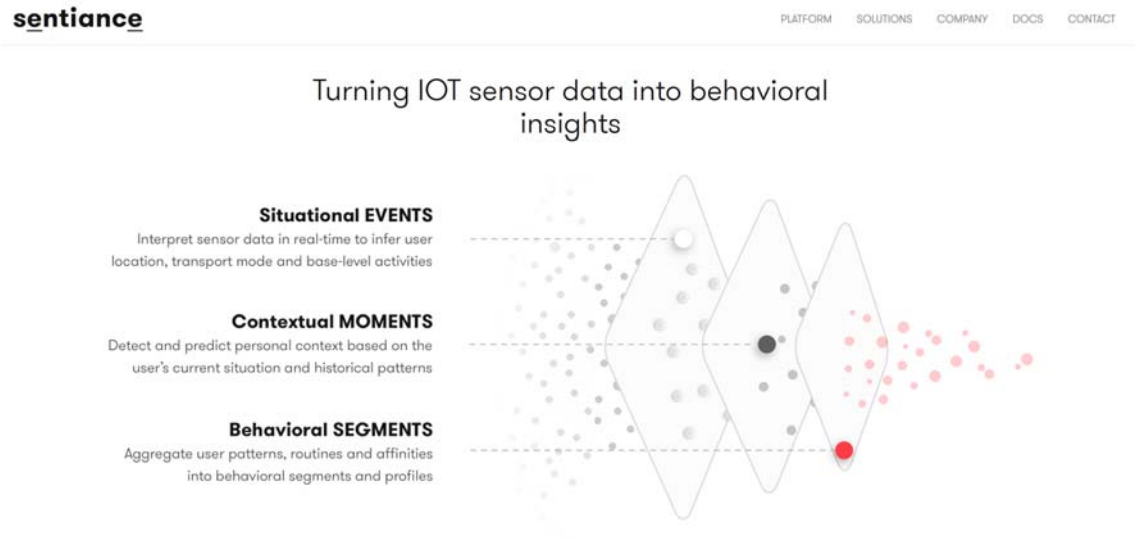
The pilot project relied on the new Zeeland app, provided by VVV Zeeland. This mobile app offers information services for the Zeeland visitor and at same time asks the user to share data for tourism insight. The data logging uses technology of Sentiance, a company in IoT data science technology and solutions. The Sentiance technology offers contextual insight in consumer behaviour using the sensors present in a smartphone. Once installed on a smartphone, it can document on the trips travelled, the transport mode used and purpose of visits. Their technology was integrated within the VVV Zeeland mobile application and Sentiance has provided the technical support on the integration within the application during the pilot project. i-KNOW UGent was responsible for further processing and aggregating the collected data into insight for mobility and tourism, and to evaluate and report on their findings. The full data collection period lasted for five months (from 8 May to 1 November 2017). The collected data was made available for the following purposes:

- Gaining insight into tourist mobility flows throughout Zeeland based on the smartphone sensor data,
- Gaining insight into the use of different types of transport modes,
- Gaining insight into number of app users and their mobility patterns,
- Understanding Zeeland visitors mobility profiles and
- Potential incentives that might be used to influence users' mobility behaviour.

The results of the pilot research activities are presented in this report.



Screenshots of the VVV Zeeland mobile application



Screenshot of the Sentiance website (http://www.sentiance.com)

3 GENERAL OVERVIEW

The following chapter gives insight into terminology used all through the report and general overview of the collected data.

3.1 Basic definitions

Trip represents user movement between the trip's origin and destination location. Trips can be unimodal (travelled by utilizing one transport mode) or multimodal (travelled by utilizing more than one transport mode).

To have a better insight into trip characteristics, we define a **trip leg** as a part of the trip made by single transport mode. Thus, unimodal trips will have a single trip leg while multimodal trips will have multiple trip legs (e.g. walking to the train station, traveling by train and then using the public transport to reach the final destination).

In our dataset, each record represents a trip leg and has its unique trip leg identification (trip leg id). Next to the trip leg identification, each trip leg has a trip identification (which is unique for every trip). Thus, we can recognise trip legs that belong to the same trip as they have the same trip identification (trip id).

3.2 Units

For the reporting purposes, the following units have been used all through the report:

- Distance: kilometres [km]
- Duration: Minutes [min]
- Speed: Kilometres per hour [km/h]

3.3 Target sight description and metadata

Error! Reference source not found. illustrates the geographical scope of the data collection. Figure 2 gives an overview of all the trips recorded in the dataset, where a more detailed insight for the Zeeland region in given on Figure 3. During the pilot study, overall 10 597 users downloaded the SDK of which **1 505 users contributed with their data**. This resulted in the collection of 124 725 trips and 151 612 trip legs, giving an average of 1.2 trip legs per trip. The average length of the recorded trip is around 17.5 km. Table 1 gives a detailed insight into the collected data set. Figure 4 shows the evolution of the number of users during the entire pilot study.

Figure 1 Zeeland area

Figure 2 Zeeland area and full trips dataset

Figure 3 Focus on Zeeland area

Figure 4 Evolution of the number of users during the pilot study period

Table 1 Metadata

Attribute	Value
users	1,505
trips	124,725
trip legs	151,612
distance	2,201,957 km
duration	3,149,152 min

4 MODAL SPLIT

This section examines the modal split of all the transportation trips observed in the population. Out of the 151 612 recorded trip legs, 99 had insufficient data available to define the transport mode utilized for the trip and were removed from further analysis and the reported findings. Of the remaining trip legs, the modal split characteristics are presented in Table 2 . Figure 5 and Figure 6 give detailed view of the utilized transport modes.

Results show that more than half of all trip legs are made by car. However, the dataset also holds relevant information on walking and biking, which make up resp. 26% and 17% of all trip legs. **The valuable amount of data on bike and pedestrian leads to potential new insights in mobility and tourism as transport modes are typically harder to investigate than car-related transport**. Compared to the view showed on Figure 6, where modal split is presented in terms of the travelled distance, it is evident that cars were most often used for the longer trips, whereas shorter trips were made by biking and walking. Other transport modes present in the dataset include train, tram and airplanes. As one might expect, train and flight were used for the longer trips.

Table 2 Modal split overview

Transport mode	Number of trip legs	Total distance	Total duration
Walking	39,112	59,875	657,481
car	83,203	1,901,495	2,041,927
train	3,465	79,562	78,396
biking	25,662	110,601	362,989
flight	27	27,271	2,092.95
tram	44	530	1,150

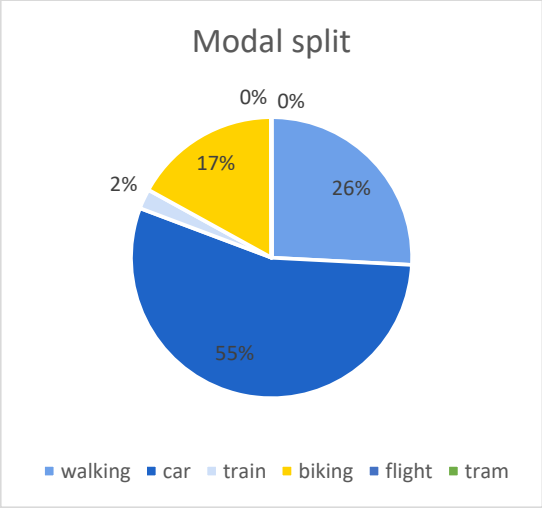


Figure 5 Modal split

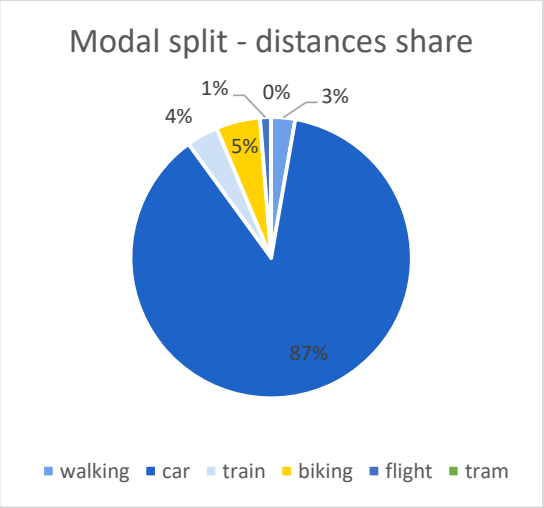


Figure 6 Share of travelled distances per transport mode

The Figure 7 - Figure 17 give more detail on the usage of different transport modes. One notices that cars are utilized for ranges of up to 200 km, bikes up to 30 km, and walking trips up to 3km. Plane trips and train trips are characterised by long distances, while tram trips exhibit quite irregular pattern with potential outliers.

Figure 8, Figure 10, Figure 12 and Figure 14 show the spatial distribution of trips made by foot, bike, car and train for the pilot area. These views allow to analyse the main access points and corridors used to reach or leave the area, especially for car and train. In addition, walking and bike trips strongly highlight the urban and coastal areas in the region.

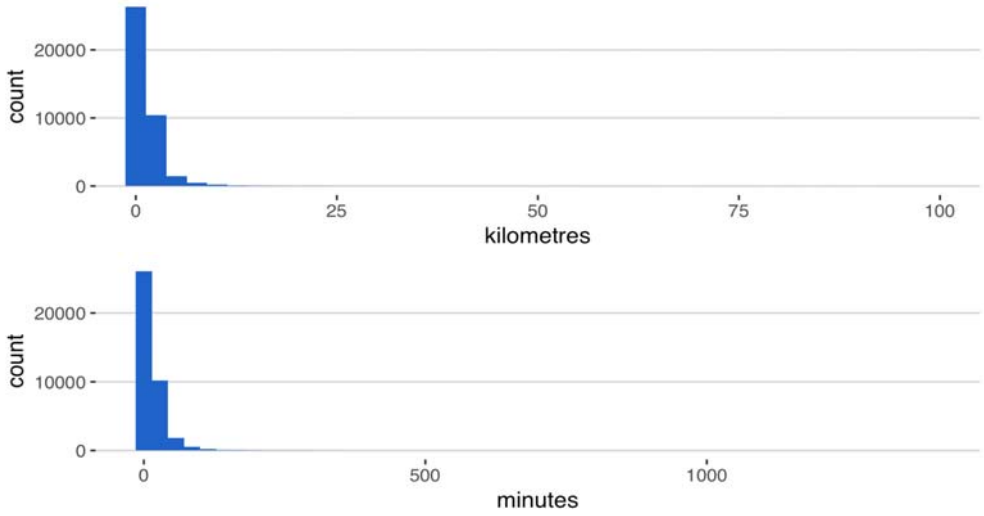


Figure 7 Distribution of distances and travel times for walking trips

Figure 8 Map of walking trips in Zeeland area

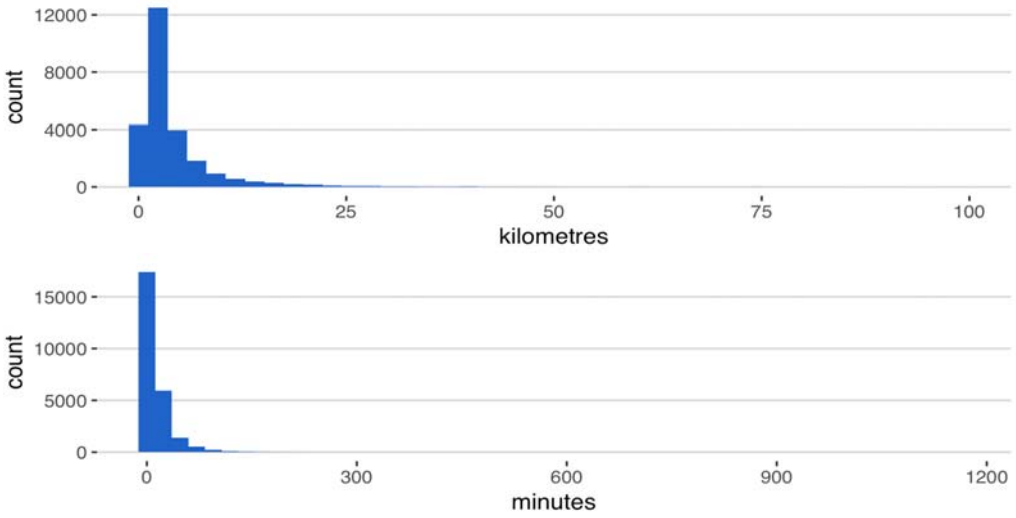


Figure 9 Distribution of distances and travel times for biking trips

Figure 10 Map of bike trips in Zeeland area

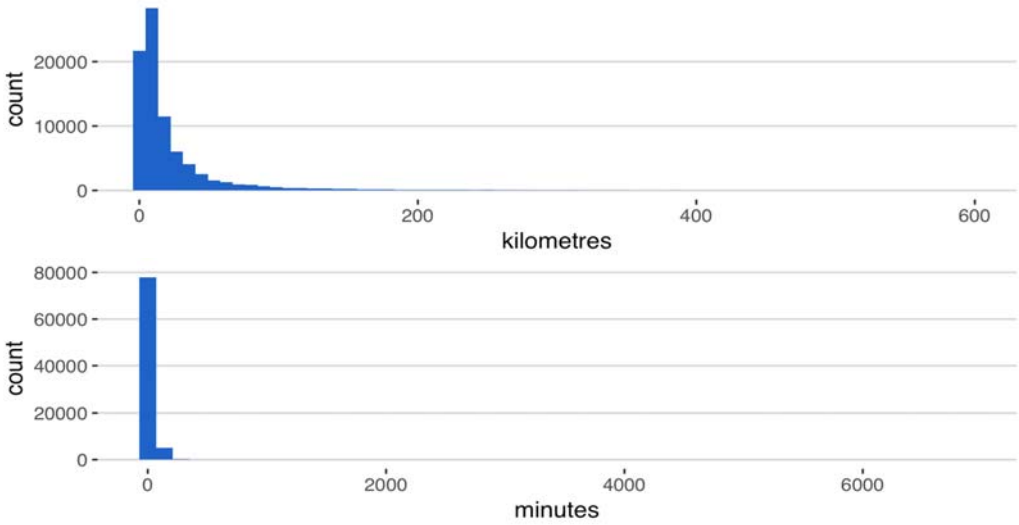


Figure 11 Distribution of distances and travel times for car trips

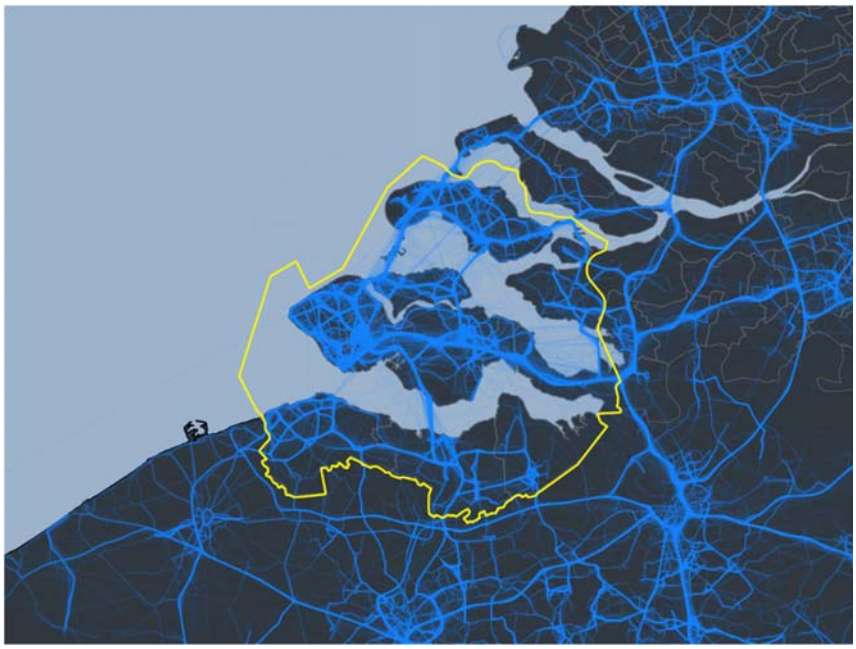


Figure 12 Map of car trips in Zeeland area

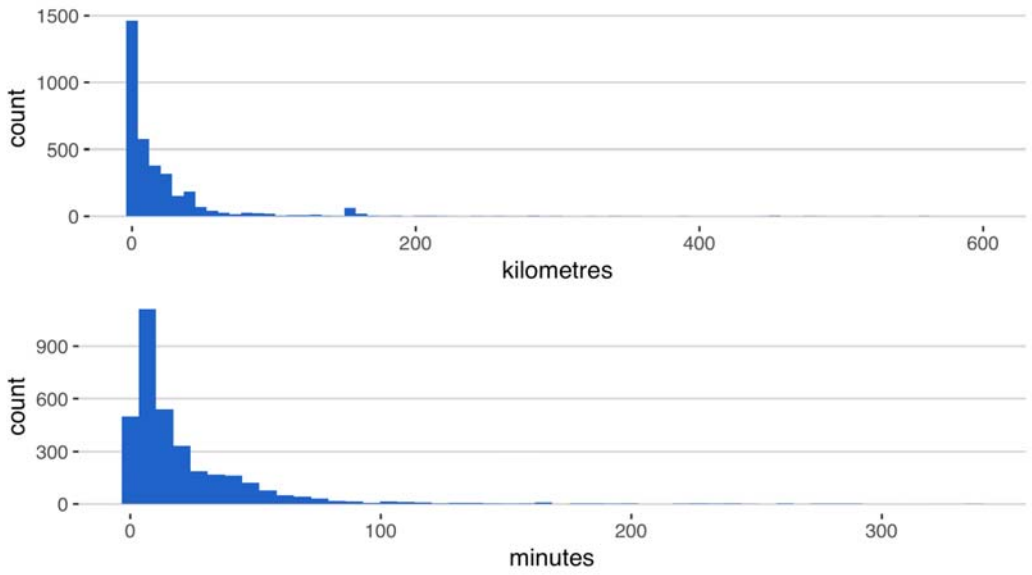


Figure 13 Distribution of distances and travel times for train trips

Figure 14 Map of train trips in Zeeland area

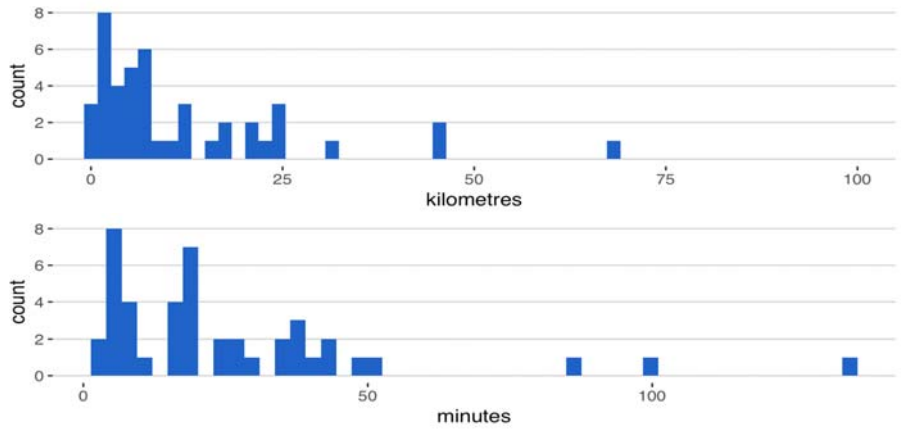


Figure 15 Distribution of distances and travel times for tram trips

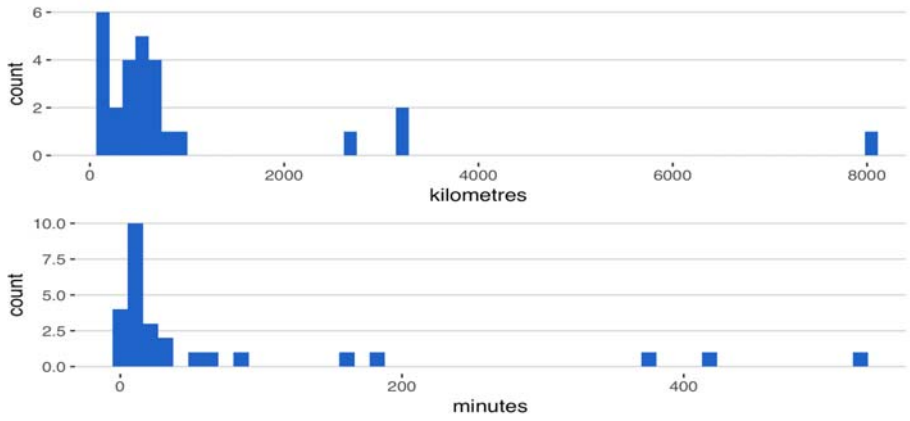


Figure 16 Distribution of distances and travel times for flight trips

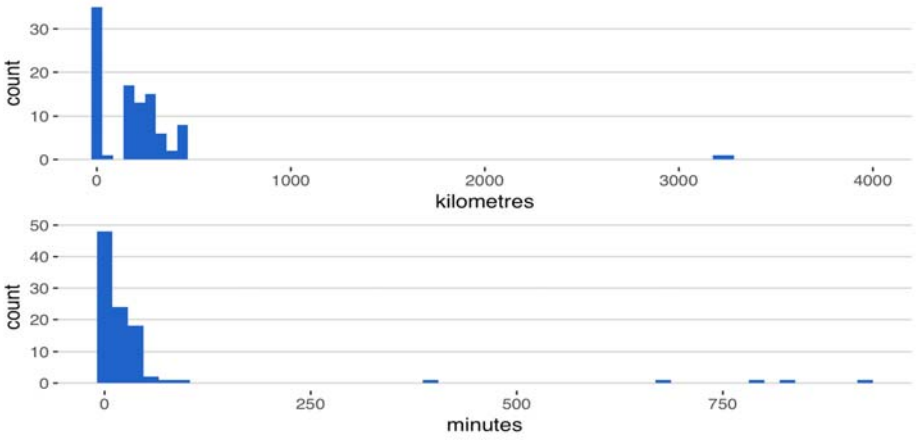


Figure 17 Distribution of distances and travel times for unrecognised transport mode trips

5 STAYING PERIODS IN ZEELAND

The logging of location data starts at the install of the mobile application and approval of the user. The download of the mobile application can take place at various different times by different users: e.g. several weeks before the actual visit (in order to plan), after arrival in Zeeland or simply out of curiosity without actually visiting Zeeland. This means that even for similar types of tourists, different data behaviour can be observed. A day tourist who has downloaded the app beforehand will be 'seen' entering and leaving Zeeland, a day tourist who only downloads the app on arrival is only seen exiting Zeeland. In order to come to a correct interpretation of the observed data, careful definitions of 'stay' and 'visitor' need to be put into place. This is developed in the following two sections.

Out of all the users, **those for whom the Zeeland region was observed at least once as either their trip's origin or destination location created 101 000 trips**. **This corresponds to 81.1% of the trips in the full dataset**. This also gives us a potential to take a bit deeper look at those app users/devices who actually spent time within the Zeeland region.

To be more precise, **we consider a stay in Zeeland region to be a sequence of days that one spends continuously within the region**. If it is observed that user/device id left the region for more than a day and then returned, his/her return will mark a beginning of the second stay within the Zeeland region, and so on. Each of these stays, as previously mentioned, is expressed in the number of days continuous spent within the region. The average number of days spent in Zeeland or **the average stay duration is four days**. Given that only 25% of stays were actually longer than the average duration, we took a look at the median value which was two days. This means that **at least half of the observed stays in the Zeeland region were only one day long**.

When interpreting the long stays, one should be aware that long stays might be a result of individuals who live within the Zeeland region and also use the app or of individuals who actually have a second residence in Zeeland. Given the duration of the data campaign, this could not be further split up. The longest stay observed in the dataset was 112 days. Out of this consideration and in order to have a more detailed insight into potential touristic related stays we give in Figure 18 a distribution of stays shorter than 20 days. The graph shows an interesting peak showing day visitors of Zeeland.

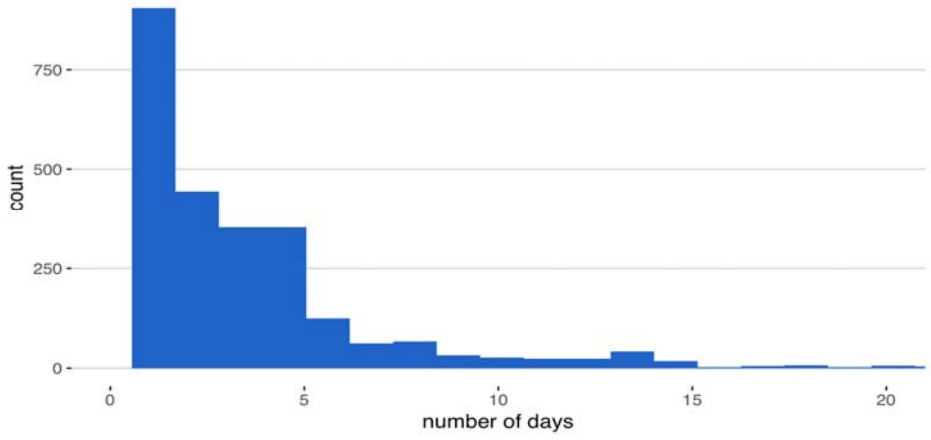


Figure 18 Distribution of duration of stays within the Zeeland region

Figure 19 gives a more detailed look at the staying/visiting patterns of the app users. The *y*-axis represents each individual user/device id present in the dataset and *x*-axis is the timeline of the pilot study. Such representation makes this insight comparable with the evolution of the number of users during the pilot study period, given in Figure 4, where the left margin of the patterns on the Figure 19 corresponds to the curve on Figure 4. This shows that **a considerable number of users started using the app while being in Zeeland** (blue shaded area at the left side of the Figure 19).

If we consider the left margin of the patterns on the Figure 19 as a continuous curve, one can notice the highest angle of the curve during the August and September. Figure 20 illustrates this in more details, showing that **most of the users who started using the app/visited the Zeeland region did so throughout the course of August and September with highest peak during the second half of August**.

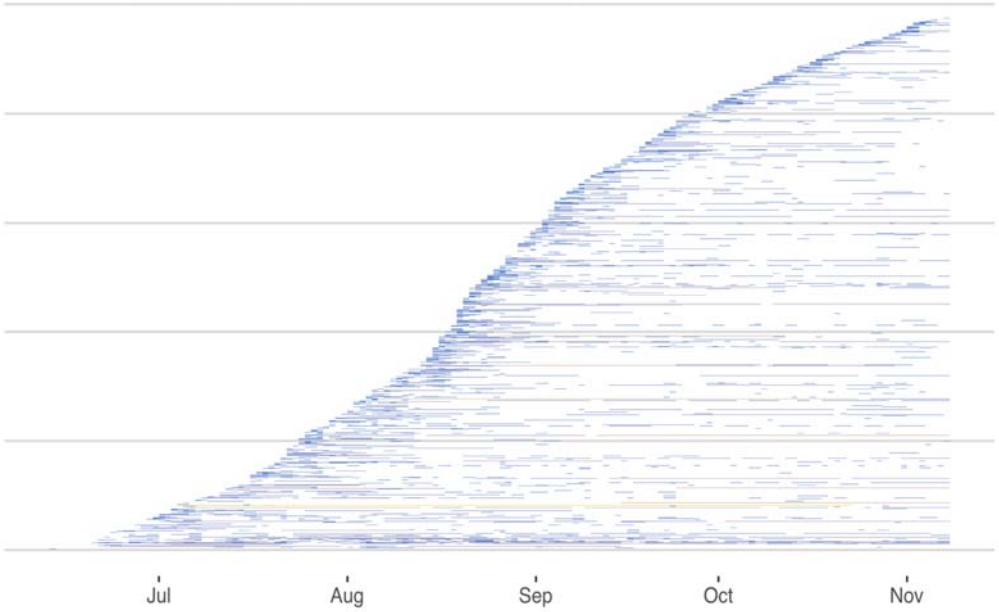


Figure 19 Distribution of the days spends in the Zeeland region

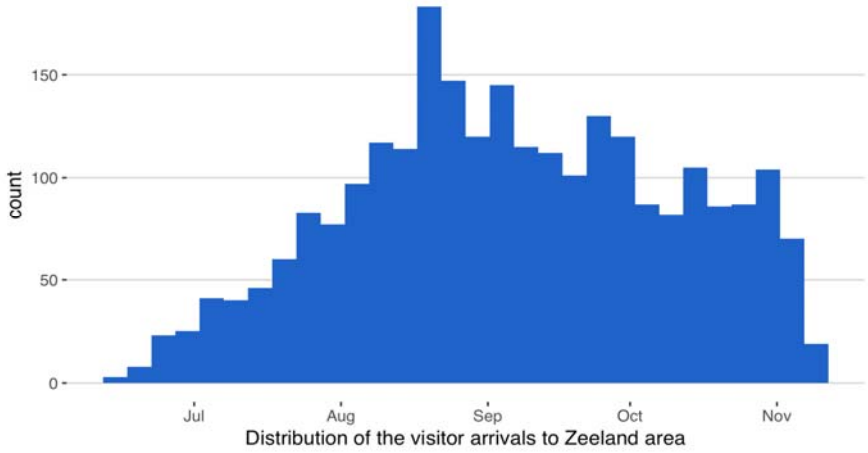


Figure 20 Distribution of visitor arrivals to Zeeland area

Figure 21 and Figure 22 give a different point of view on the moment when users entered or left the Zeeland region. They show weekly patterns of the observed arrivals and departures, indicating the highest inflow through the course of Friday with almost continuous decrease on the number of the observed beginnings of the staying period through the rest of the week. The end of the staying period in Zeeland area shows a bit different pattern, but still with the highest frequencies over the weekends.

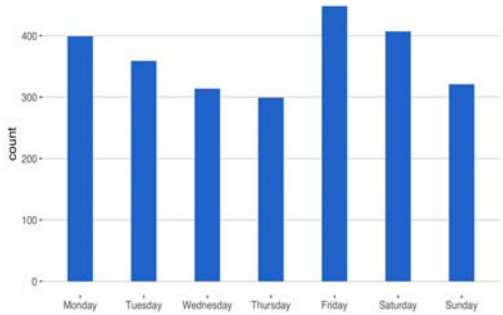


Figure 21 Frequency of arrivals to Zeeland region at weekly level

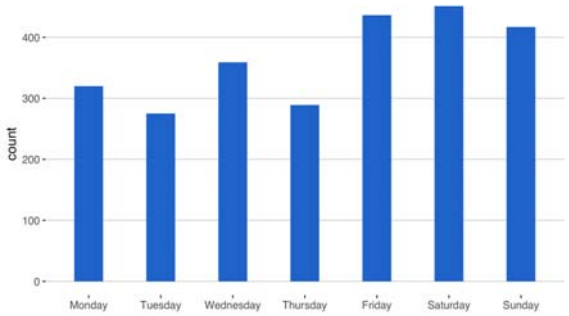


Figure 22 Frequency of departures from Zeeland region at weekly level

6 USER CLUSTERS

In this section, we are interested in segmenting the observed population in different tourism categories: day tourist, recurring tourist and long-stay resident. As seen in the previous section, a category like day tourism seems to pop up naturally in the statistics. However given the nature of the data, one has to be careful in correctly defining rules. In addition, even a category like day tourism needs to be carefully defined. It can be that user is observed spending a single day in Zeeland or that over the period of the summer, a user makes several day trips to Zeeland. For this reason, we define different user clusters based on clear rules and with a tourism-independent meaning.

Initially, we observe two main clusters of users. We referred to these as internal and external users:

- **Internal users** correspond to those users for whom multiple trips were observed and they all both start and end within the Zeeland region. There are no trips noted outside the Zeeland region nor any of them crosses the outer borders of the Zeeland region. The interpretation of internal users might be two fold. On one end, they might be local residents who use the app. On the other end, they might be external visitors who started using the app after they already arrived within the Zeeland region and they also might have uninstalled the app before leaving the Zeeland region, making all of their observed trips limited to the duration of the staying period within the region.
- The second main cluster we refer to as **external users** and it reflects users for whom trips outside the Zeeland region have been observed.

The external users can be further refined into four sub-clusters.

- The first sub-cluster captures the moving patterns where only one trip has the observed destination location within the Zeeland region (and has started outside of the Zeeland region) and only one trip has observed origin location within the Zeeland region (and has ended outside of the Zeeland region). Furthermore, the time period between these two observed trips is less than 24 hours. We note this cluster with '**External 24**' label. This cluster contributes to the tourism class 'day tourist'.
- The second sub-cluster captures the moving patterns where only one trip has the observed destination location within the Zeeland region (and has started outside of the Zeeland region) and only one trip has observed origin location within the Zeeland region (and has ended outside of the Zeeland region). However, the time period between these two observed trips is longer than 24 hours. We note this cluster with '**External long**' label. This cluster contributes to the tourism class 'longer-stay tourist'.
- The third sub-cluster captures patterns of users for whom multiple trips were observed that either originate within the Zeeland region, and end outside, or originate outside the Zeeland region, and end inside. For users within this sub-cluster no distinction was made based on the observed time period that passed between sequential trips with altering Zeeland region as trip's origin or destination (meaning that one user can have a mix of staying time periods both shorter and longer than 24 hours). We label this sub-cluster with the '**External recurring**' label. This cluster can be a mix of day visits and longer stays.
- The final, fourth sub-cluster captures the rest of the users and is labeled by the '**External-unsorted**' label.

In the rest of the report, we will refer to these clusters by their labels. Figure 23 shows the distribution of the users per each of the main clusters and the sub-clusters. In the remainder of the section, we report on the observed behaviour of these different user clusters.

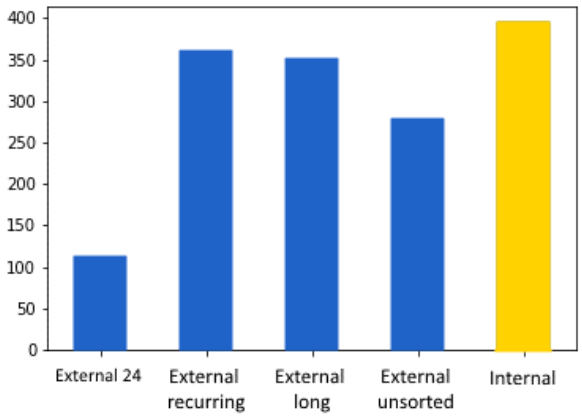
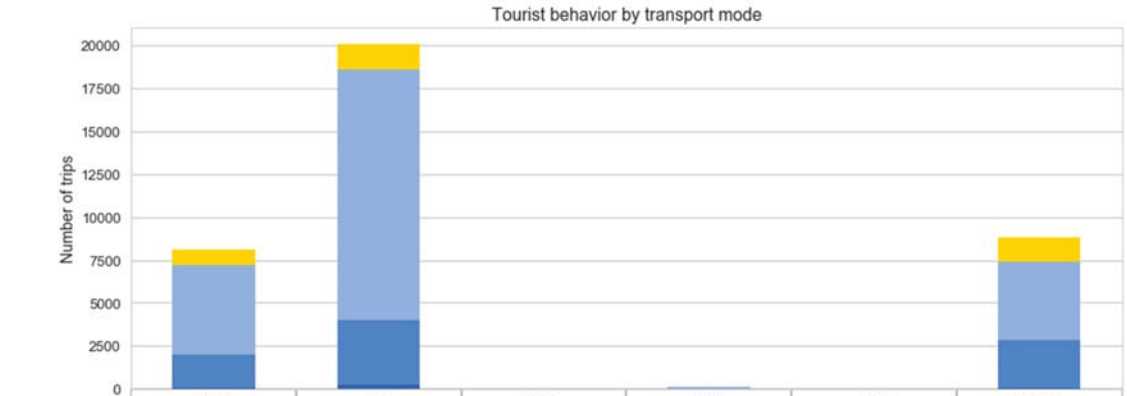


Figure 23 Distribution of users per cluster

6.1 Transport mode insights

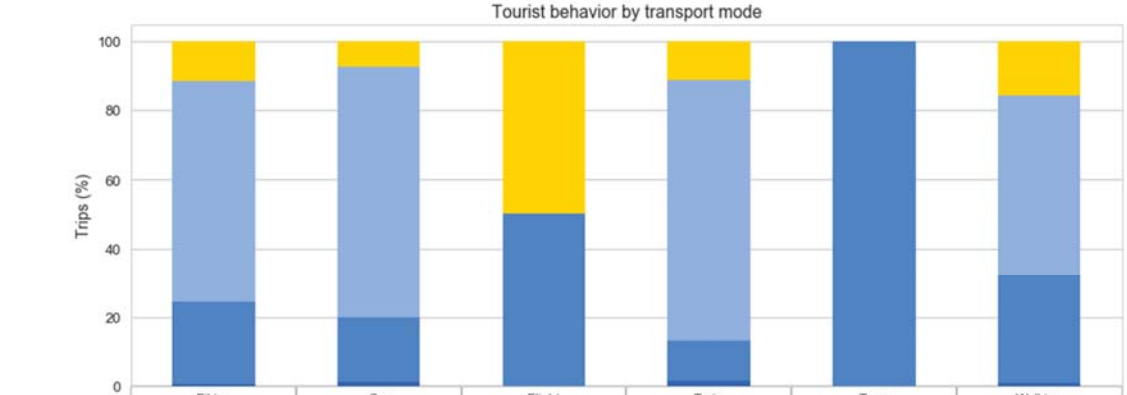
Figure 24 and Figure 25 show the frequency of the matched sub-cluster labels for the main cluster – external users and the observed main transport modes for the trips. The main transport mode for the trip is considered the one by which the longest distance within the trip was travelled. For example if one walked to the train station for 200 m, took a train ride over the distance of 16 km, and then took the public transport to reach the final destination that was 2 km far away from the destination train station, the main transport mode assigned to this trip would be the train. Taking into the account that the average number of modes used per trip was 1.2, this interpretation gives a systematic insight into the transport mode use without introducing large errors. In addition, it is useful to note that the main transport mode based analysis is regularly used for the official mobility statistics.

The interpretation of the sub-clusters distribution for trips made by transport modes plane and tram is limited by the small sample of users who utilized these transport modes, nonetheless a better insight can be gained for other transport modes. Figure 26 reveals that the ‘External long’ and the ‘Internal’ are more prone to take a walk. The other two sub-clusters, although they both have quite high share of car related trips, exhibit different pattern when it comes to the use of bikes and the ‘External recurring’ sub-cluster has almost equal share of bike usage as the ‘External long’ and the ‘Internal’ clusters, while bike usage is the lowest for the ‘External 24’ sub-cluster.



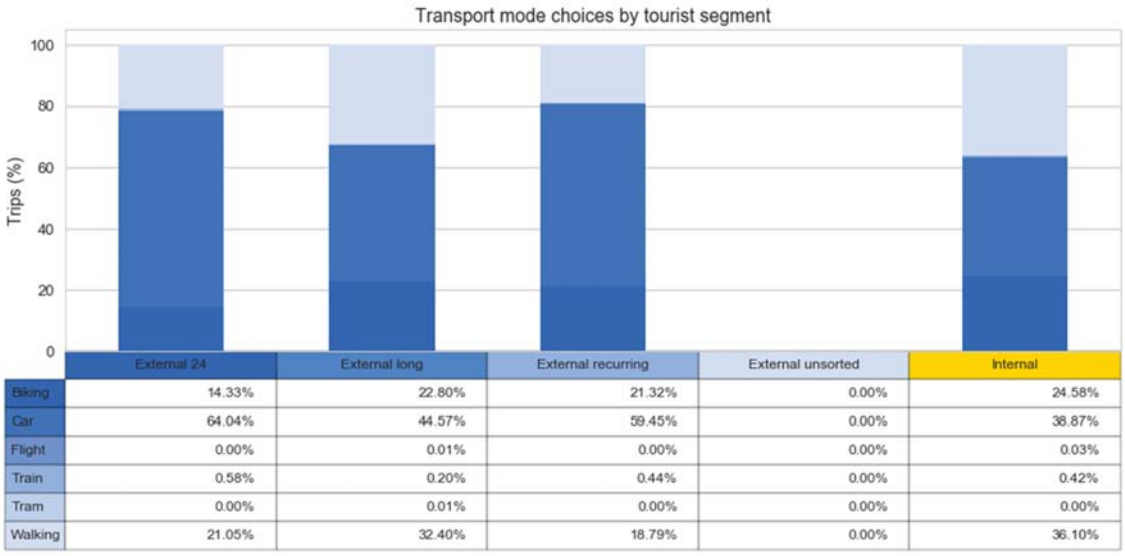
	Biking	Car	Flight	Train	Tram	Walking
External 24	49	219	0	2	0	72
External long	1,939	3,790	1	17	1	2,755
External recurring	5,223	14,568	0	108	0	4,604
External unsorted	0	0	0	0	0	0
Internal	939	1,485	1	16	0	1,379

Figure 24 Frequencies of transport mode use for the external users cluster



	Biking	Car	Flight	Train	Tram	Walking
External 24	0.60%	1.09%	0.00%	1.40%	0.00%	0.82%
External long	23.79%	18.89%	50.00%	11.89%	100.00%	31.27%
External recurring	64.09%	72.61%	0.00%	75.52%	0.00%	52.26%
External unsorted	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Internal	11.52%	7.40%	50.00%	11.19%	0.00%	15.65%

Figure 25 Transport mode use for the external users cluster (relative values)



	External 24	External long	External recurring	External unsorted	Internal
Biking	14.33%	22.80%	21.32%	0.00%	24.58%
Car	64.04%	44.57%	59.45%	0.00%	38.87%
Flight	0.00%	0.01%	0.00%	0.00%	0.03%
Train	0.58%	0.20%	0.44%	0.00%	0.42%
Tram	0.00%	0.01%	0.00%	0.00%	0.00%
Walking	21.05%	32.40%	18.79%	0.00%	36.10%

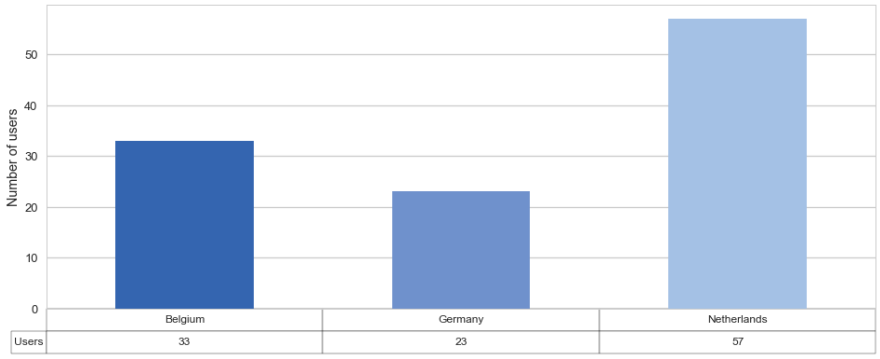
Figure 26 Modal split for the external users cluster

6.2 Trip origin locations

In order to gain a better insight into potential tourism related trips, we take a deeper look at the user clusters and the distribution of the trips' origins for trips that end within the Zeeland region (Figure 27 - Figure 30). Notably, all four sub-clusters observed within the Zeeland region have three main countries of origin for trips that end in the Zeeland region and these are:

I. Netherlands – always the country with the most trips' origins, for each external users sub-cluster,
II. Germany – second the most frequent country of origin, for all external users sub-cluster except for the 'External 24',
III. Belgium – the second most frequent country of origin for the 'External 24' sub-cluster and the third most often country of origin for other external users sub-clusters.

Other countries that appear as the origin locations for the trips that end within the Zeeland region are: Bulgaria, France, Luxemburg, Switzerland and United Kingdom. Furthermore, the most divers set of the origin countries is noted for the 'External recurring' sub-cluster.



	Belgium	Germany	Netherlands
Users	33	23	57

Figure 27 Sub-cluster 'External 24' - country of the origin for trips that end in Zeeland region

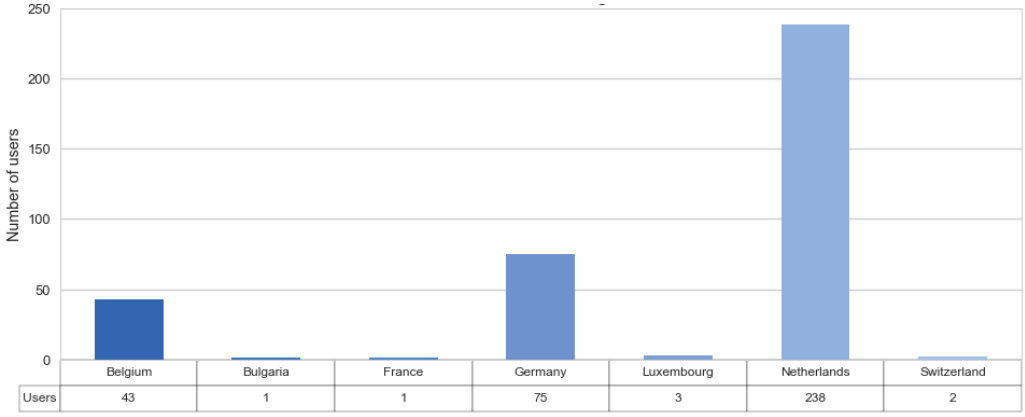


Figure 28 Sub-cluster 'External recurring' - country of the origin for trips that end in Zeeland region

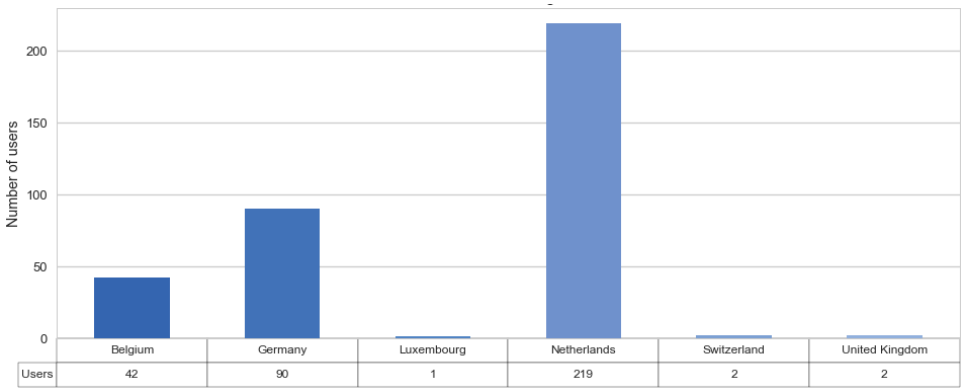


Figure 29 Sub-cluster 'External long' - country of the origin for trips that end in Zeeland region

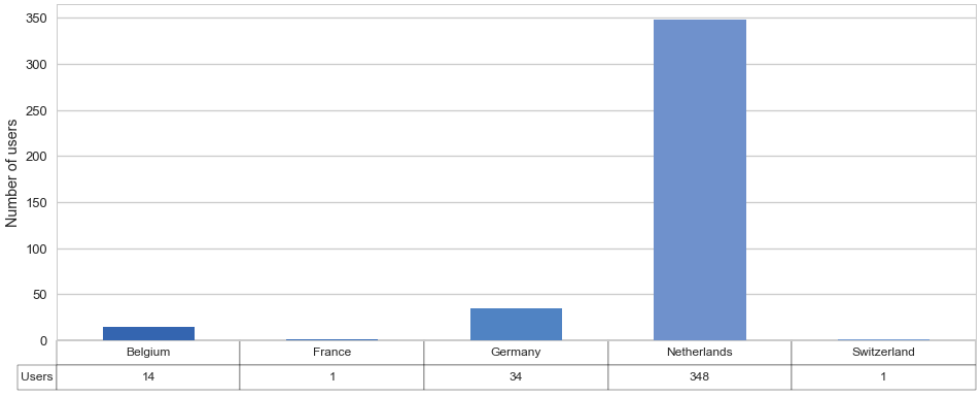


Figure 30 Sub-cluster 'External unsorted' - country of the origin for trips that end in Zeeland region

6.3 Origin destination matrices

At the lower geographical level, the Zeeland province envelops thirteen municipalities:

A. Zeeuws-Vlaanderen (Zeelandic Flanders) COROP region
   (1) Hulst
   (2) Sluis
   (3) Terneuzen

B. Overig Zeeland COROP region
   (4) Noord-Beveland (North Beveland)
   (5) Schouwen-Duiveland
   (6) Tholen
   - Walcheren
     (7) Middelburg
     (8) Veere
     (9) Vlissingen
   - Zuid-Beveland (South Beveland)
     (10) Borsele
     (11) Goes
     (12) Kapelle
     (13) Reimerswaal.

Our origin-destination analysis takes these municipalities' geographical borders to produce the origin destination matrix (Figure 31) for the whole Zeeland region. The origin destination matrix gives a number of trips that have the origin location situated in one of the municipalities listed in the first column and the destination location that corresponds to the municipality listed in the last row of the matrix. The matrix diagonal indicates that a large number of trips start and end in the same municipality. The largest number of the within-municipality observed trips took place in Veere closely followed by Schouwen-Duiveland, while the least of them were observed within Reimerswaal.

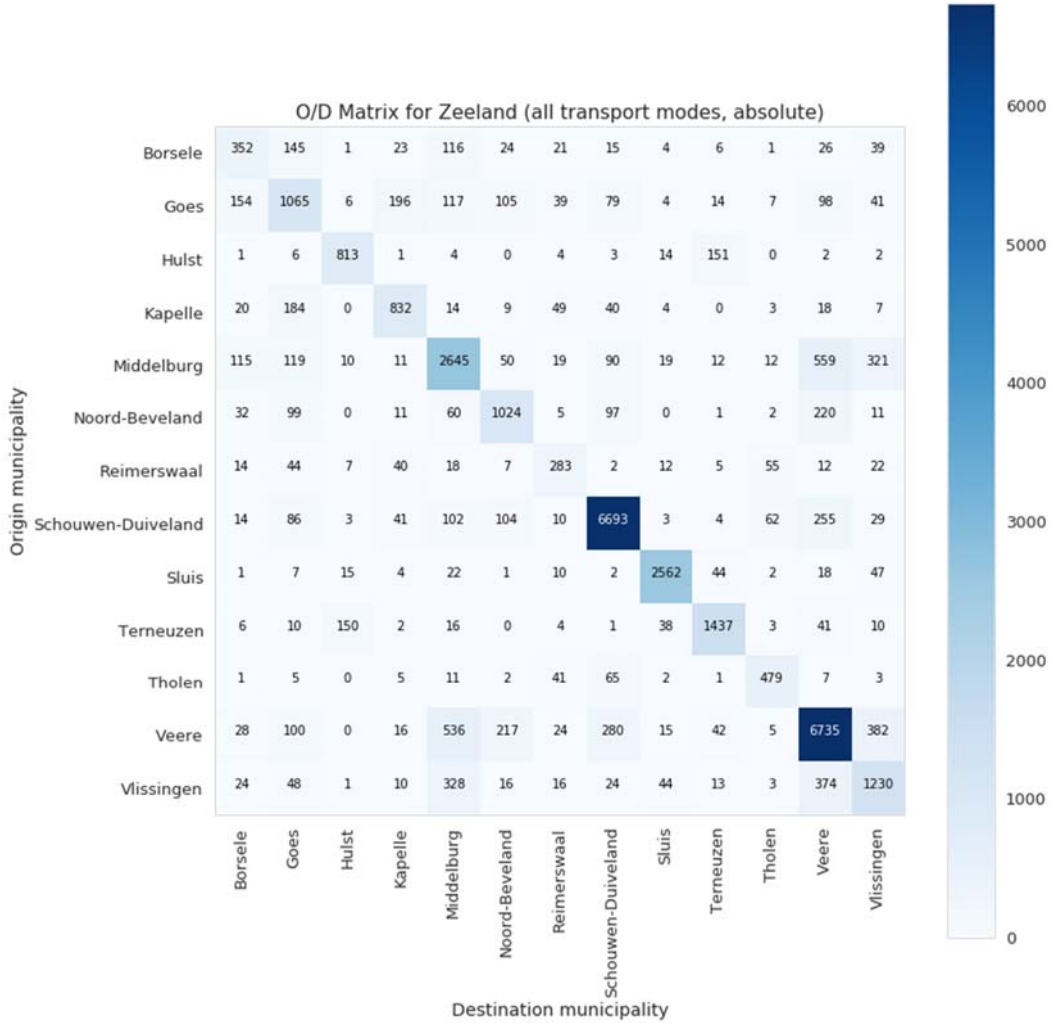


Figure 31 Origin destination matrix for Zeeland province

Figure 32 shows the relative ratio of traffic flows between, and within, the municipalities. One can notice that municipalities Sluis and Schouwen-Duiveland have the most homogeneous trip characteristics, having more than 90% of trips that start and end within them. However, Borsele, Reimerswaal, Goes and Vlissingen have distinctively different pattern with more than 40% of trips that are external concerning the municipality area. Figure 33 and Figure 34 visualise connectivity between municipalities in a different way. Figure 33 gives visualisation of all traffic flows related to the municipalities where bold horizontal lines indicate within the municipality flows. Figure 34 Gives the same visualisation, but without the within the municipality flows, making it easier to identify the distribution of flows among different municipalities in the region.

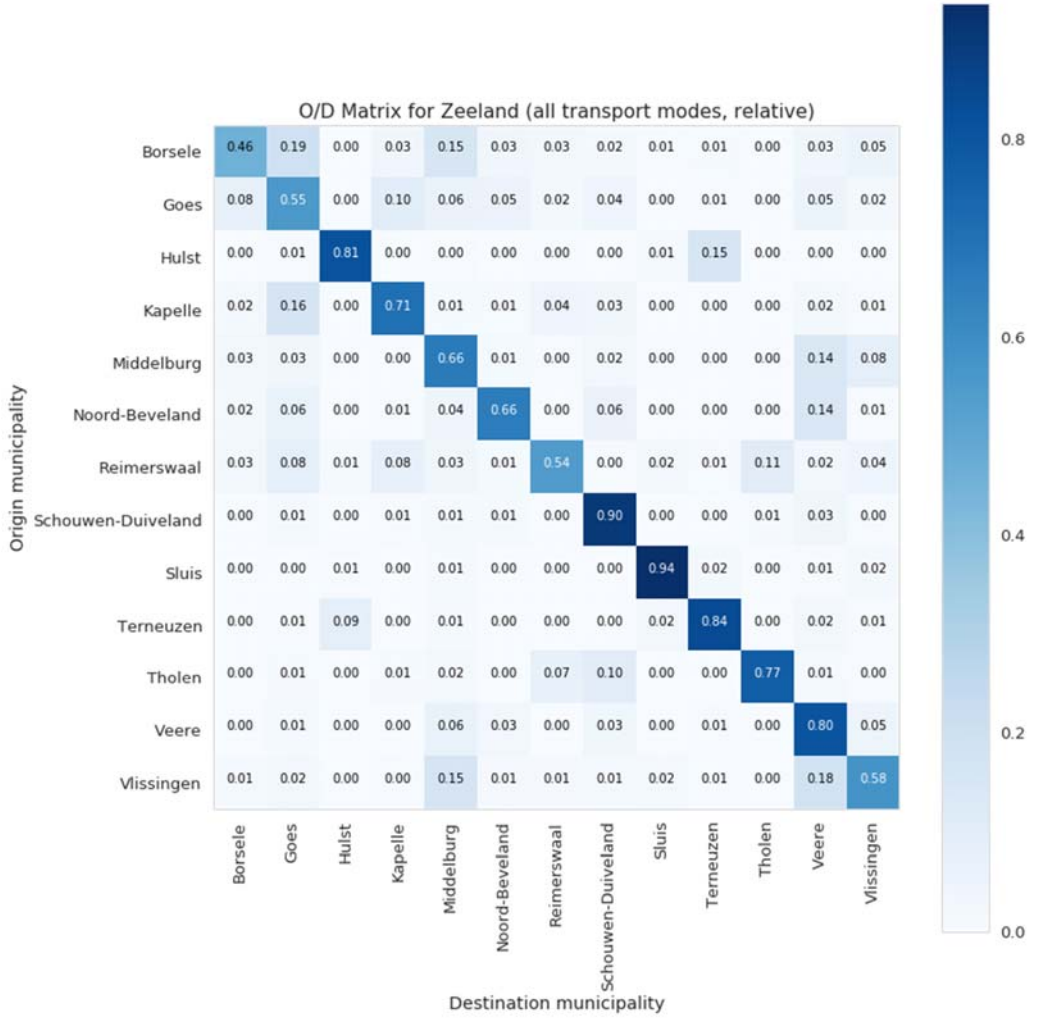


Figure 32 Origin destination matrix for Zeeland province-relative values

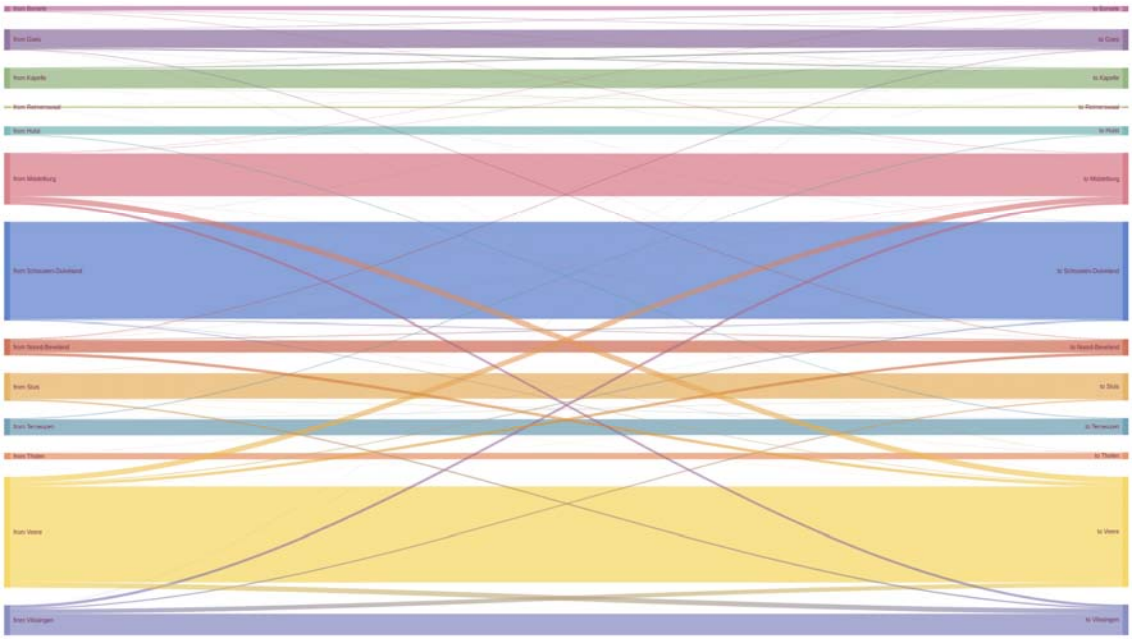


Figure 33 Flows between municipalities; including loops (origin and destination are the same municipality)

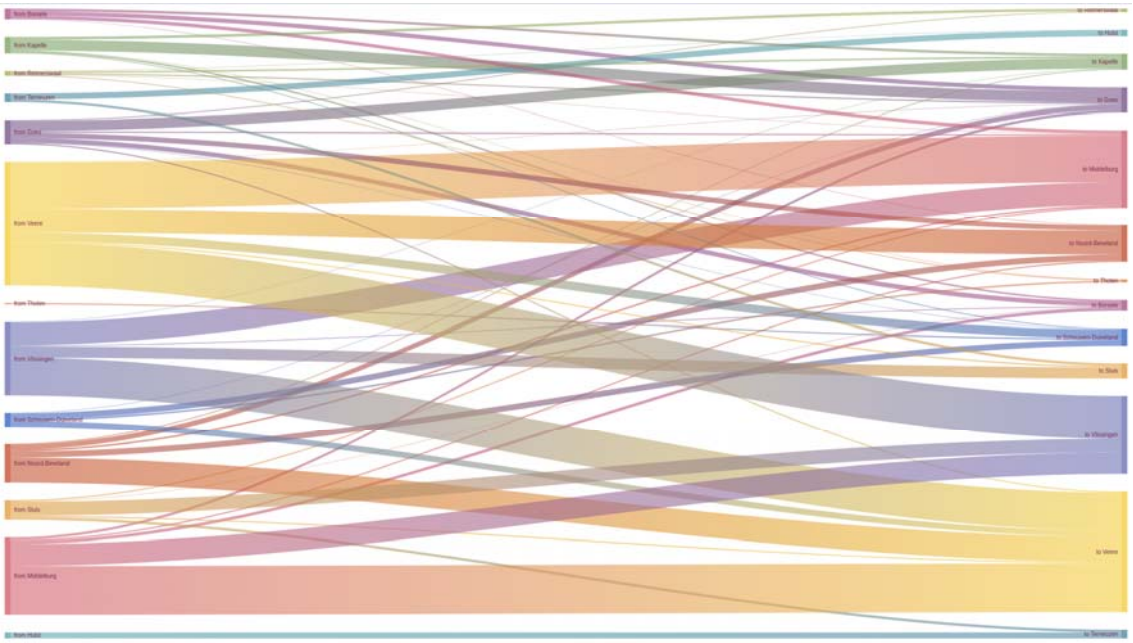


Figure 34 Flows between municipalities, not including loops

The following subchapters give a more detailed view in origin destination patterns for different transport modes.

6.3.1 Origin destination matrix – bike

Figure 35 and Figure 36 give a cross view of the origin destination matrix for the bike trips. The most of the local bike trips were made in the Schouwen-Duiveland and Veere municipalities, whereas notable number of non-local bike trips were made between Veere and Middelburg (in both directions) and Veere and Vlissingen. Relative values reveal that more than 20% of bike trips in Borsele, Noord-Beveland, Reimerswaal and Vlissingen have inter-municipalities characteristics.

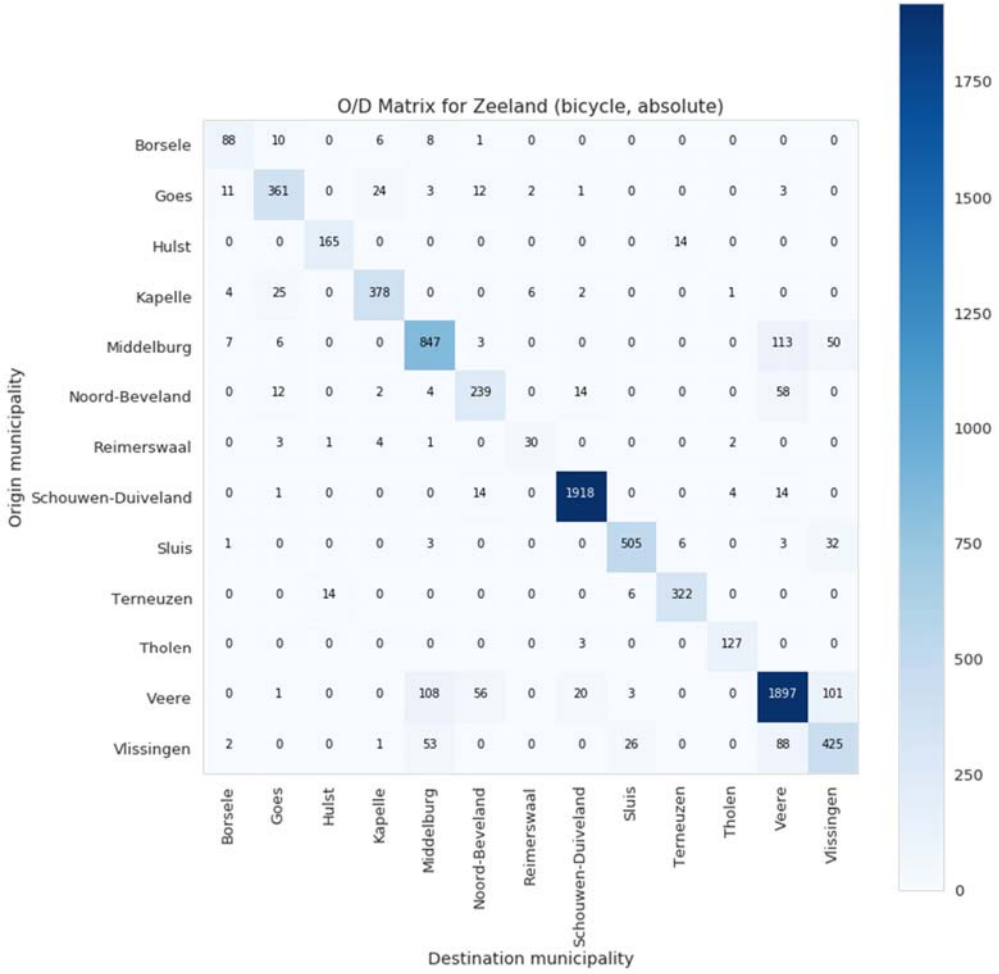


Figure 35 Bike trips - origin destination matrix for Zeeland province

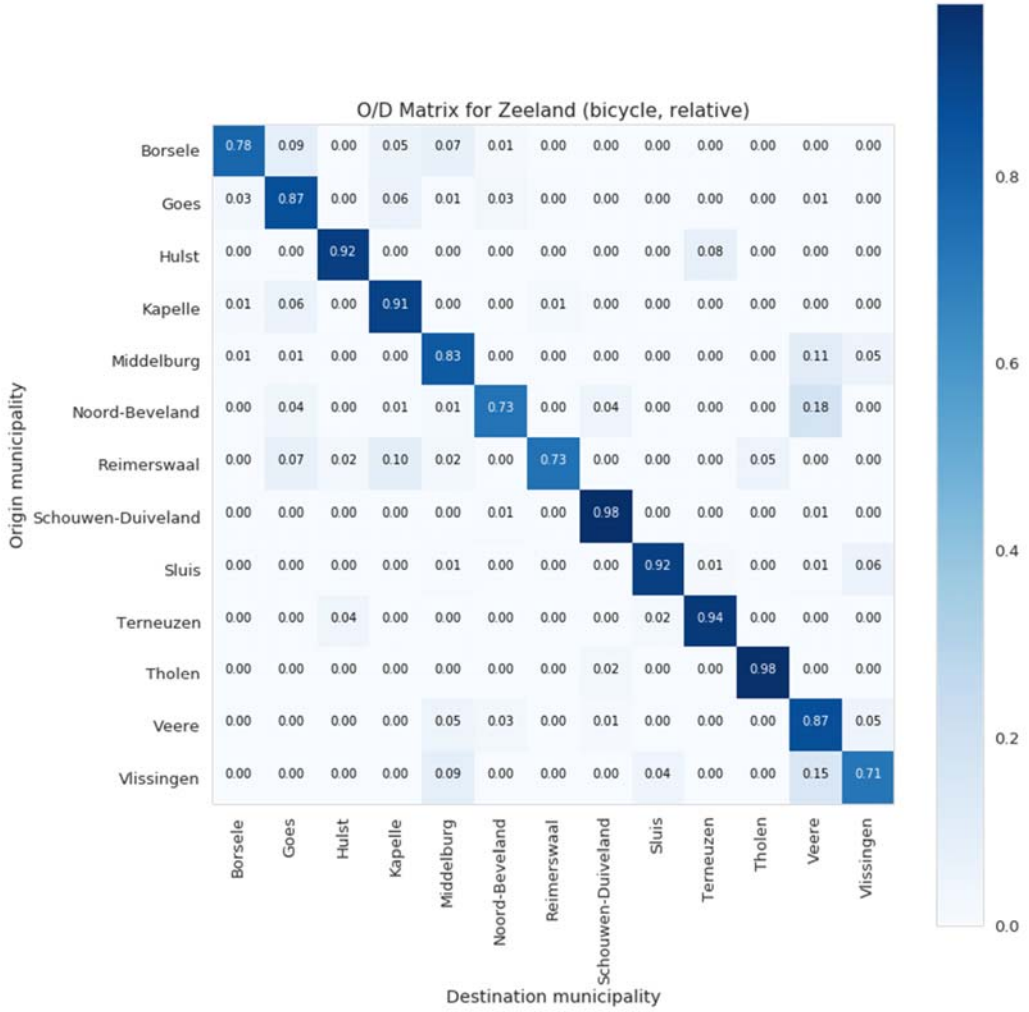


Figure 36 Bike trips - origin destination matrix (relative values) for Zeeland province

6.3.2 Origin destination matrix – car

The Car origin-destination matrix (Figure 37) shows more inter-municipality activity compared to bike. This is of course due to the increased car use for the longer (non-local) trips. In addition, local car trips seem to be the most frequent in the Schouwen-Duiveland area and Schouwen-Duiveland and Veere exhibit a significantly higher number of local car trips when compared to the rest of the province.

The view of the relative number of car trips within the Zeeland region (Figure 38) strongly highlights that in some municipalities cars are mainly used for regional travels. This is the most notable for Kapelle, where for 80% of the time a car was used, this was for trips between different municipalities. However, Kapelle is not a lone case here and is closely followed by the Borsele, Goes and Vlissingen, where cars seem to be rarely used for trips within the municipality itself (around 30% of times).

In addition, one can notice interesting patterns regarding the regional car trips:

- almost 40 % of car trips that start in the Kapelle end in the Goes area,
- 60 % of car trips that start in Vlissingen had the observed destination in Middelburg or Veere;

- about 20 % of the observed car traffic flows between Borsele and Goes, Borsele and Middelburg, Middelburg and Veere (in both directions), Hulst and Terneuzen, Noord-Beveland and Veere, Vlissingen and Veere.
- only 23 % of car trips that started in Kapelle ended there also.

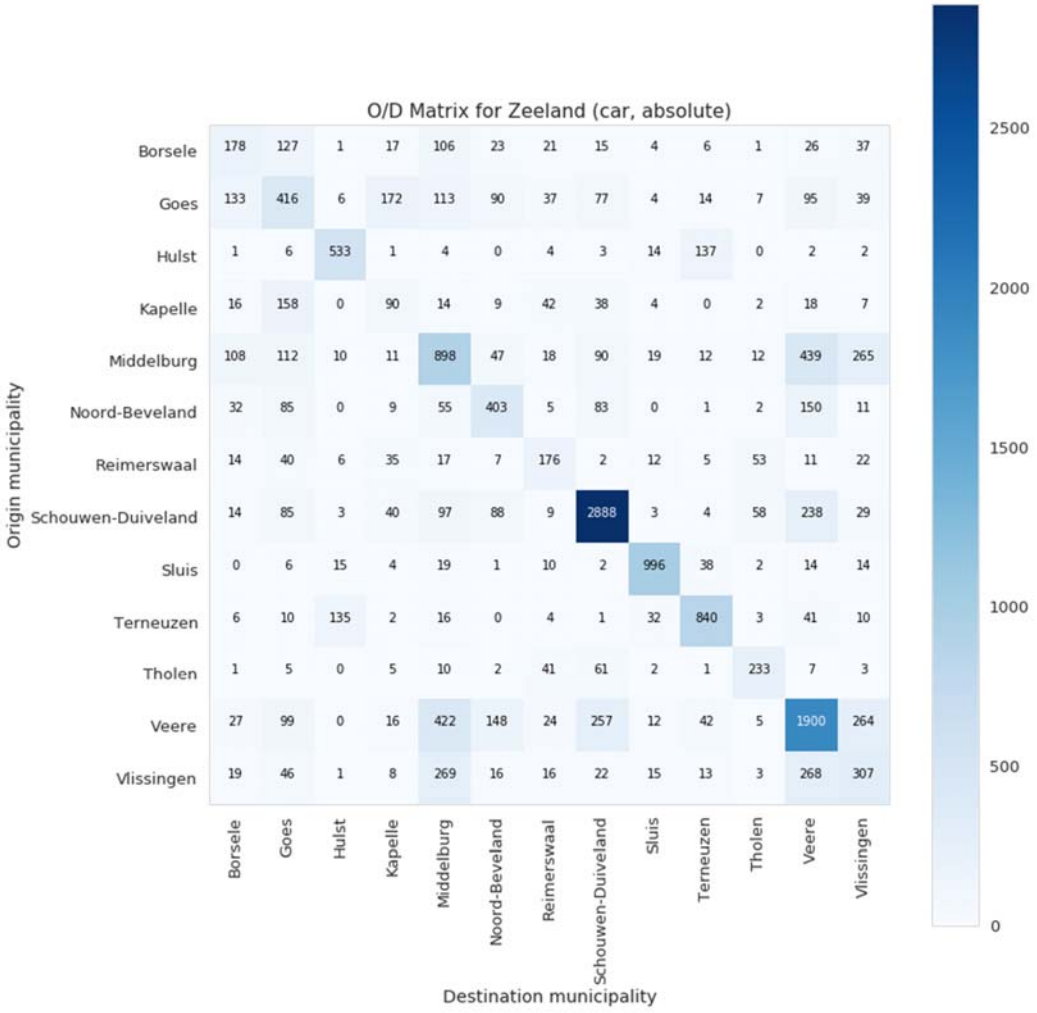


Figure 37 Car trips - origin destination matrix for Zeeland province

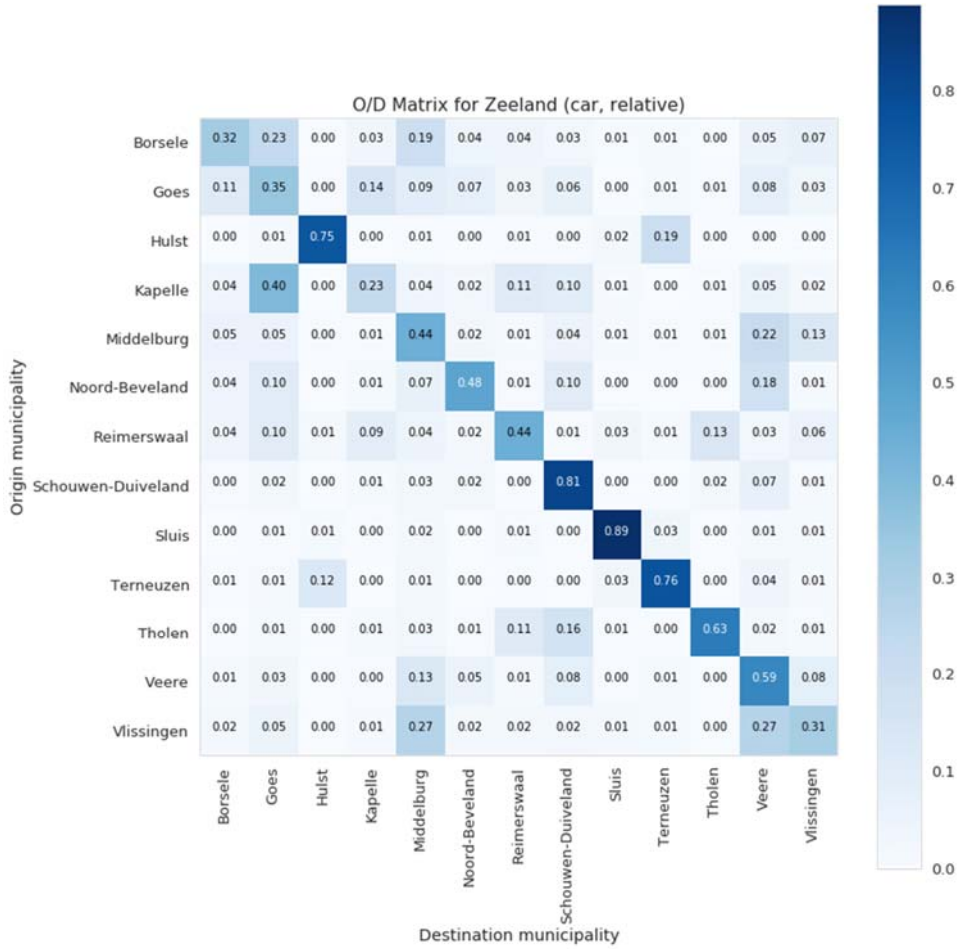


Figure 38 Car trips - origin destination matrix (relative values) for Zeeland province

6.3.3 Origin destination matrix – walking

Figure 39 and Figure 40 give a deeper insight into walking trips observed within the Zeeland region.

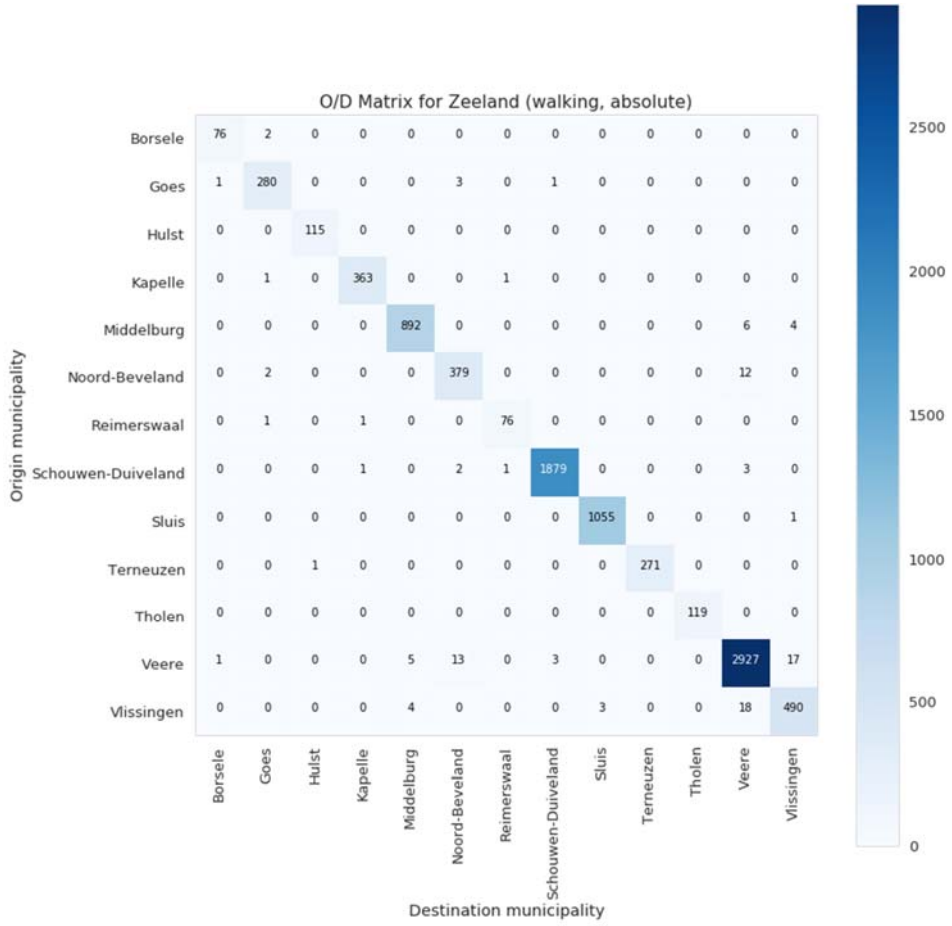


Figure 39 Walking trips - origin destination matrix for Zeeland province

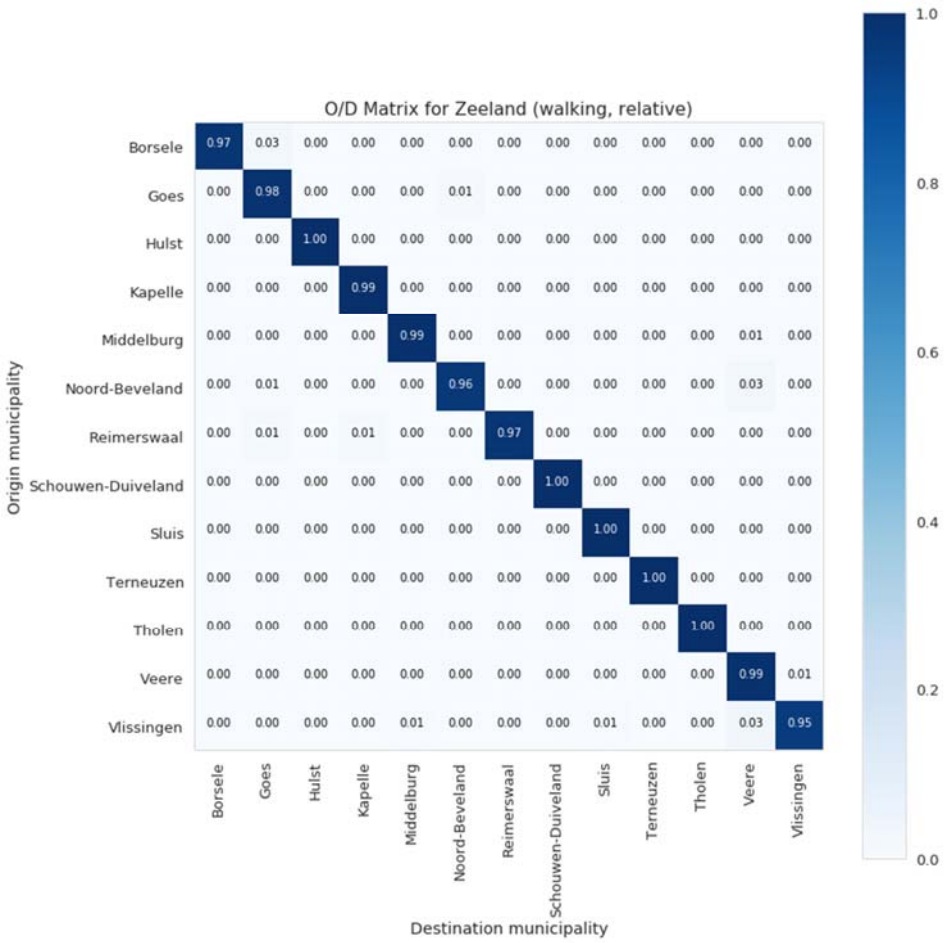


Figure 40 Walking trips - origin destination matrix (relative values) for Zeeland province

Reasonably, only a small portion of the observed walking trips were between different municipalities and, very likely, there were trips that took place at the sole border of the municipalities. However, between Borsele and Goes, Noord-Beveland and Veere, and Vlissingen and Veere these walking traffic flows were the highest (3 %), whereas for most of the other relations they were 0 %.

6.3.4 Origin destination matrix – train

Looking at the origin destination matrix for the train trips, one can notice that a limited number of train trips was present in the dataset (Figure 41 and Figure 42). Most of the observed train trips were local, mainly inside of the municipalities Borsele, Goes, Middelburg and Vlissingen. Some additional train trips were noted between Borsele and Goes (in both directions), and Schouwen-Duiveland and Middelburg.

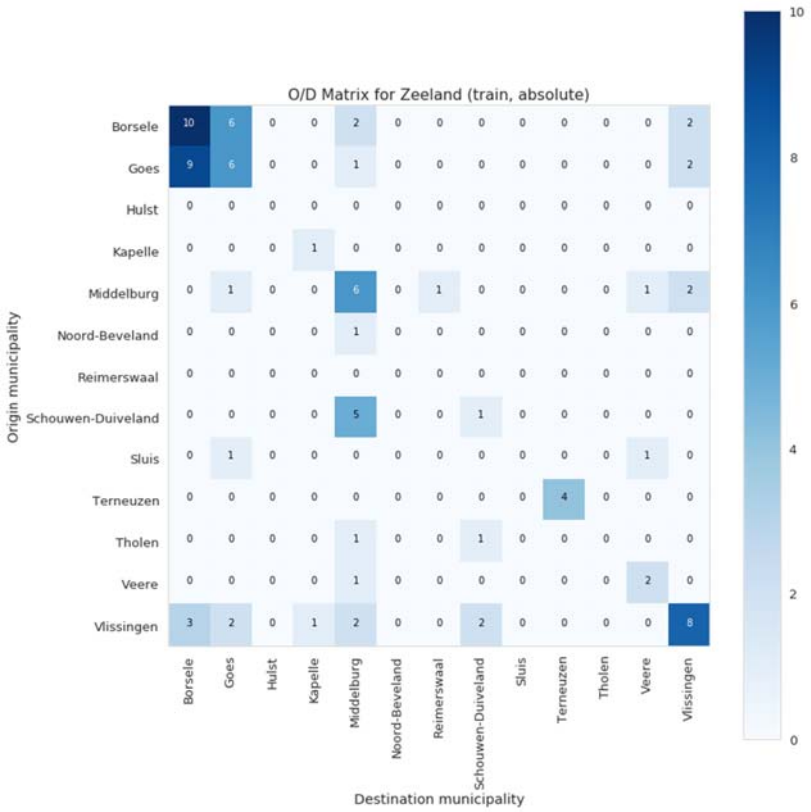


Figure 41 Train trips - origin destination matrix for Zeeland province

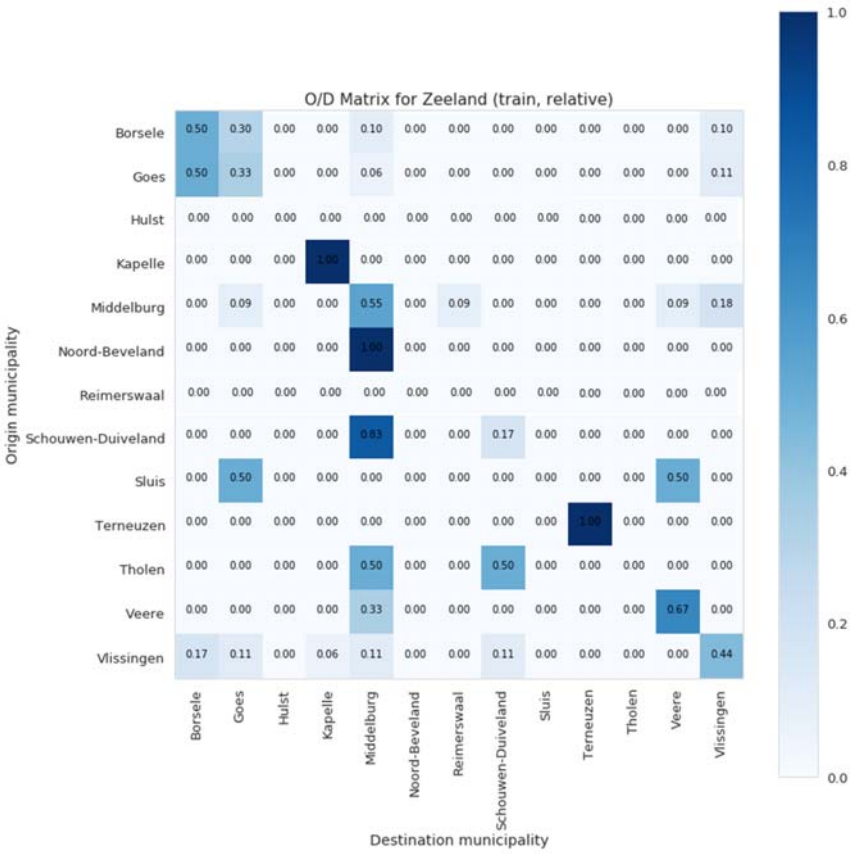


Figure 42 Train trips - origin destination matrix (relative values) for Zeeland province

7 SPOTLIGHT ON THE FOUR FOCUS LOCATIONS

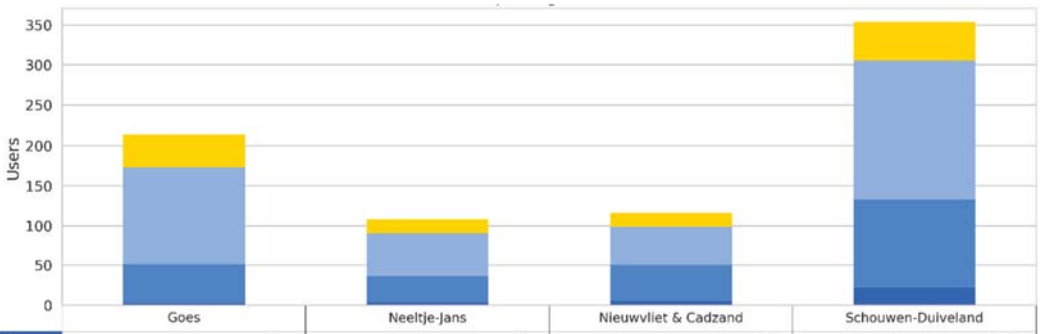
During the pilot study, four locations within the Zeeland region have been selected by the Province as focus areas for this study:

I. Neeltje Jans
II. Schouwen-Duiveland
III. Nieuwvliet / Cadzand
IV. Goes.

Figure 43 gives a geographical view on where these four locations are situated with in Zeeland area. On Figure 44 and Figure 45, we give a general overview of different user sub-clusters for the four target locations. One can notice that the most users have recorded activity within Schouwen-Duiveland, whereas relative distributions of clusters are quite diverse for each of these areas. For example, Goes has the least 'External 24' users share, that increases for Neeltje Jans, Nieuwvliet / Cadzand and Schouwen-Duiveland areas. Presence of 'Internal' cluster exhibits exactly the opposite pattern, whereas 'External long' has the highest share in Nieuwvliet / Cadzand.

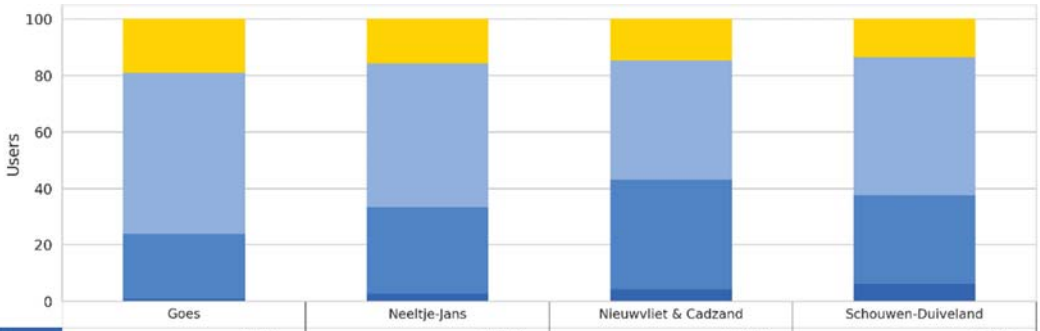
For each of the focus areas we give a deeper insight into observed patterns in the following subchapters.

Figure 43 Zeeland analysis focus locations



	Goes	Neeltje-Jans	Nieuwvliet & Cadzand	Schouwen-Duiveland
External 24	2	3	5	22
External long	49	33	45	111
External recurring	122	55	49	172
External unsorted	0	0	0	0
Internal	41	17	17	48

Figure 44 Distribution of user clusters across focus locations



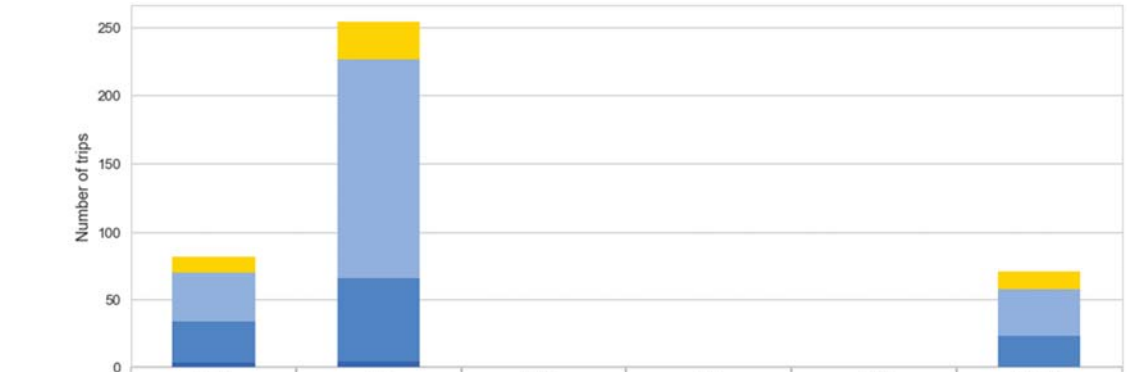
	Goes	Neeltje-Jans	Nieuwvliet & Cadzand	Schouwen-Duiveland
External 24	0.93%	2.78%	4.31%	6.23%
External long	22.90%	30.56%	38.79%	31.44%
External recurring	57.01%	50.93%	42.24%	48.73%
External unsorted	0.00%	0.00%	0.00%	0.00%
Internal	19.16%	15.74%	14.66%	13.60%

Figure 45 Distribution of user clusters across focus locations (relative)

7.1 Neeltje Jans (destination on Schouwen-Duiveland)

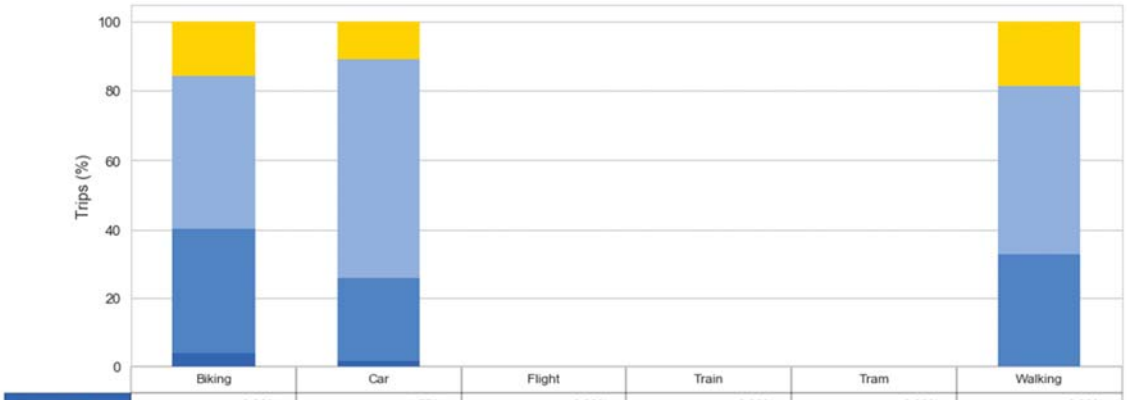
Neeltje Jans is an artificial island, halfway between Noord-Beveland and Schouwen-Duiveland. It was originally constructed to facilitate the building of the Oosterscheldedam. After the Oosterscheldedam was constructed, a fun park with attractions and other various expositions were situated on the island, attracting travellers to visit them. In the collected observations, we firstly took a look at all of those trips that start or end at the Neeltje Jans island.

Figure 46 and Figure 47 give an overview of the distribution of user clusters (absolute and relative values) for each observed transport mode, while Figure 48 gives an insight into the modal split for all the user clusters observed at Neeltje Jans island. One can notice that the 'External recurring' sub-cluster has the highest share of the car trips, whereas increasing share of bike trips is observed between 'External recurring', 'External long' and 'Internal' sub-clusters. The 'External 24' sub-cluster is characterised by the highest share of walking trips. In addition, reasonably, we did not observe the use of other transport modes for this target location in the pilot's dataset.



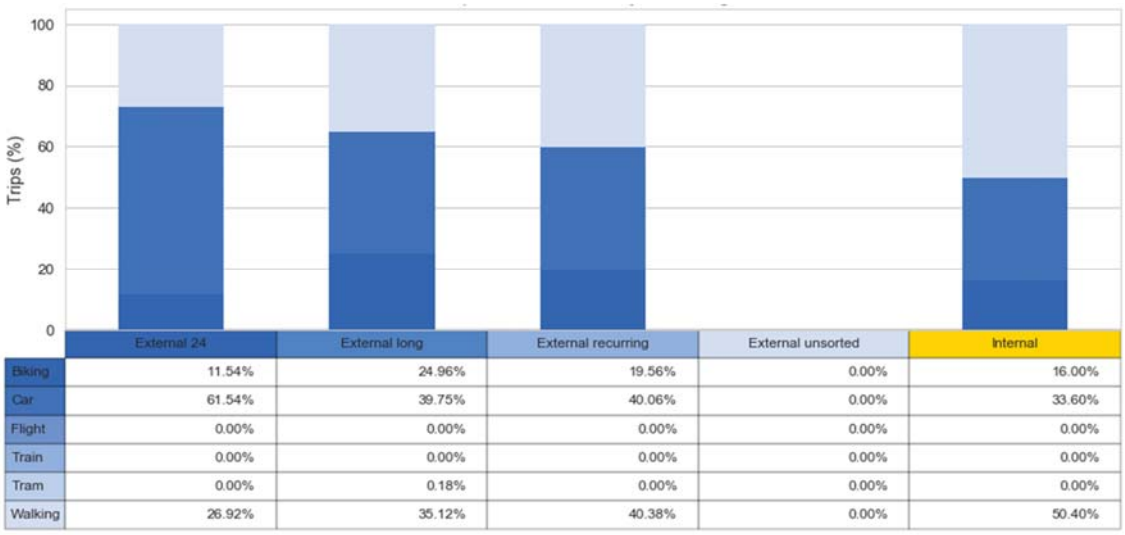
	Biking	Car	Flight	Train	Tram	Walking
External 24	3	4	0	0	0	0
External long	30	61	0	0	0	23
External recurring	36	161	0	0	0	34
External unsorted	0	0	0	0	0	0
Internal	13	28	0	0	0	13

Figure 46 Overview of observed transport modes and user clusters for Neeltje Jans island



	Biking	Car	Flight	Train	Tram	Walking
External 24	3.66%	1.57%	0.00%	0.00%	0.00%	0.00%
External long	36.59%	24.02%	0.00%	0.00%	0.00%	32.86%
External recurring	43.90%	63.39%	0.00%	0.00%	0.00%	48.57%
External unsorted	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Internal	15.85%	11.02%	0.00%	0.00%	0.00%	18.57%

Figure 47 Overview of observed transport modes and user clusters for Neeltje Jans island (relative data)



	External 24	External long	External recurring	External unsorted	Internal
Biking	11.54%	24.96%	19.56%	0.00%	16.00%
Car	61.54%	39.75%	40.06%	0.00%	33.60%
Flight	0.00%	0.00%	0.00%	0.00%	0.00%
Train	0.00%	0.00%	0.00%	0.00%	0.00%
Tram	0.00%	0.18%	0.00%	0.00%	0.00%
Walking	26.92%	35.12%	40.38%	0.00%	50.40%

Figure 48 Modal split for users clusters on the Neeltje Jans island

Figure 49 illustrates where on the island the trip destinations were observed. All of the observed trips that have destination at Neeltje Jans island, originated in the Nederland, or more precisely in one of the regions/municipalities indicated on Figure 50 and Figure 51.

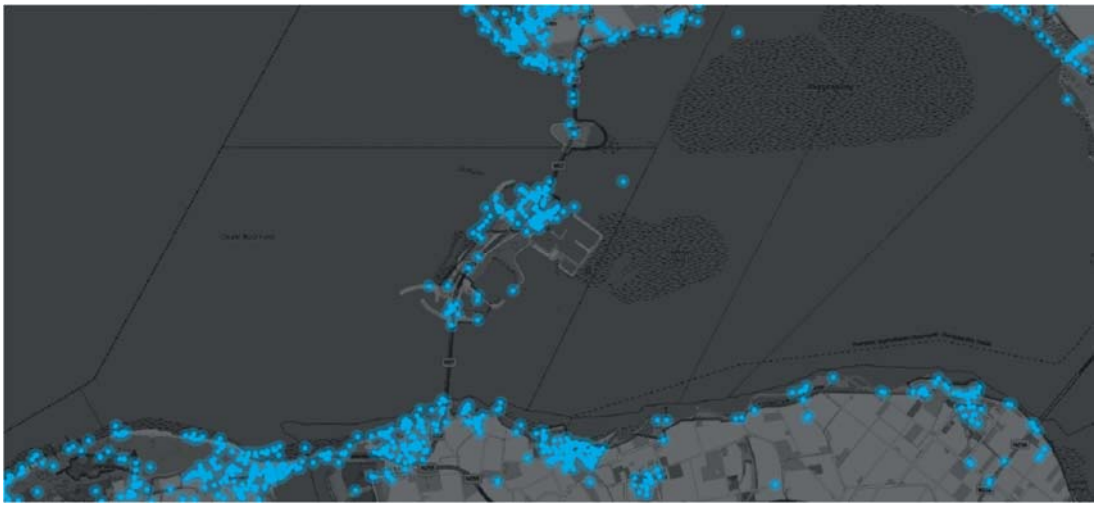


Figure 49 Trips with destination on Neeltje Jans and its vicinity

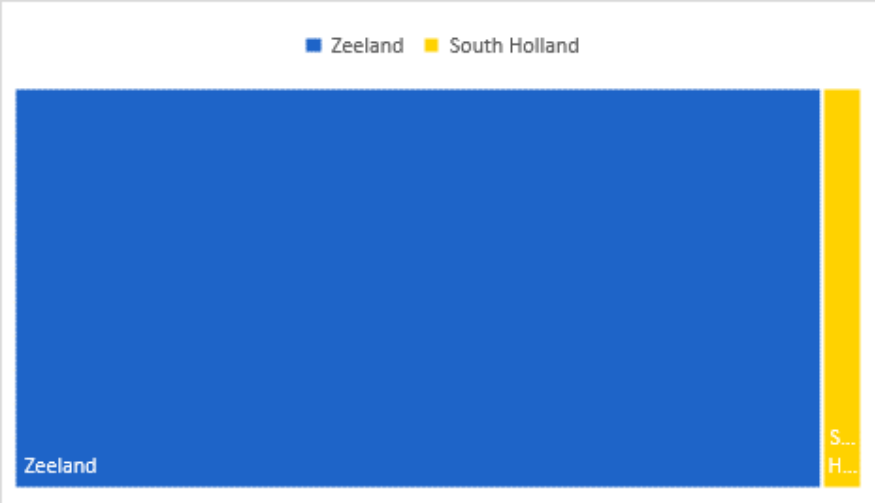


Figure 50 Region of origin for trips ending at Neeltje Jans

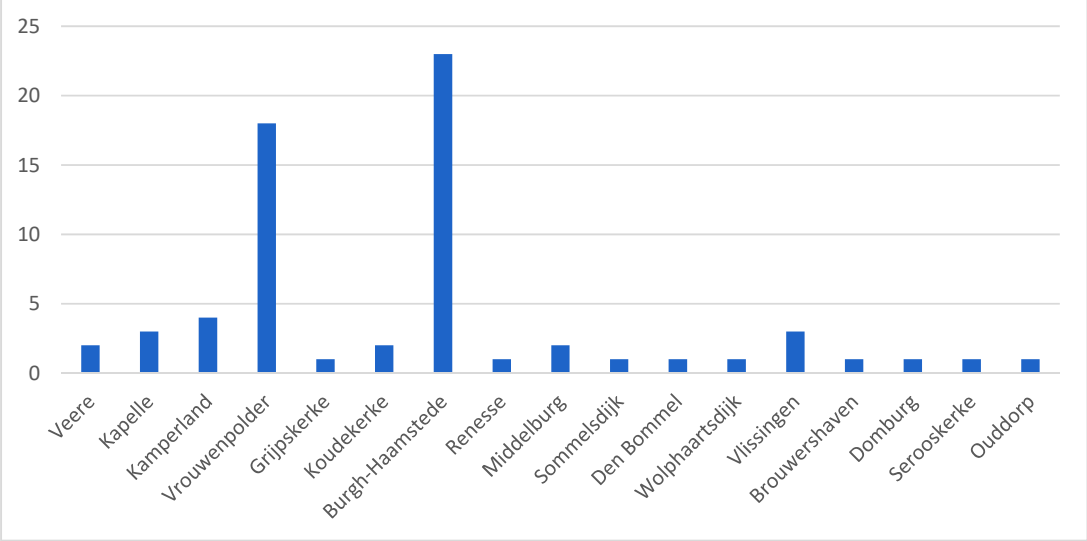


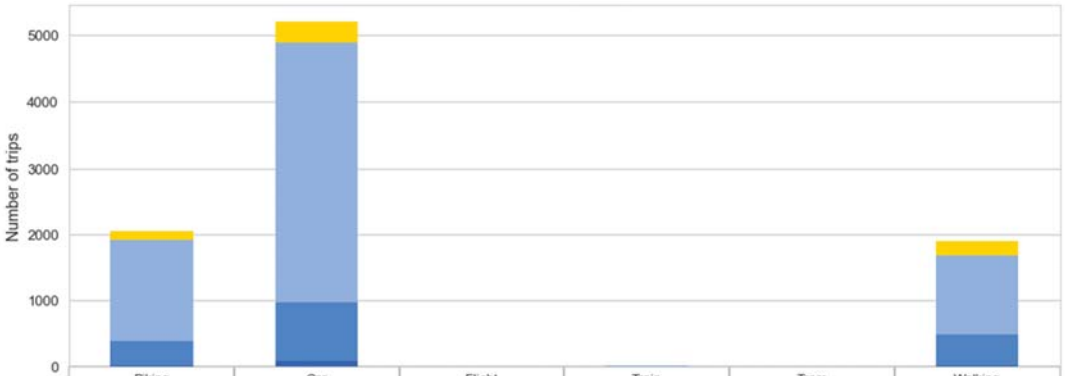
Figure 51 Origin for trips ending at Neeltje Jans

7.2 Schouwen-Duiveland

Schouwen-Duiveland is a municipality and an island in the province of Zeeland. The municipality covers an area of around 500 square kilometres of which around the half is covered by water. The island is mostly flat and some parts are below the sea level. On the western tip is a dune whose highest point is about 42 meters above sea level. The island has two fixed connections to Goeree-Overflakkee, the Brouwersdam and the Grevelingen. The Oosterschelde is like the Zeeland Bridge to North Beveland area. The island is, especially in the summer period, very popular with tourists. Particularly, the Renesse area is a popular holiday destination for young people.

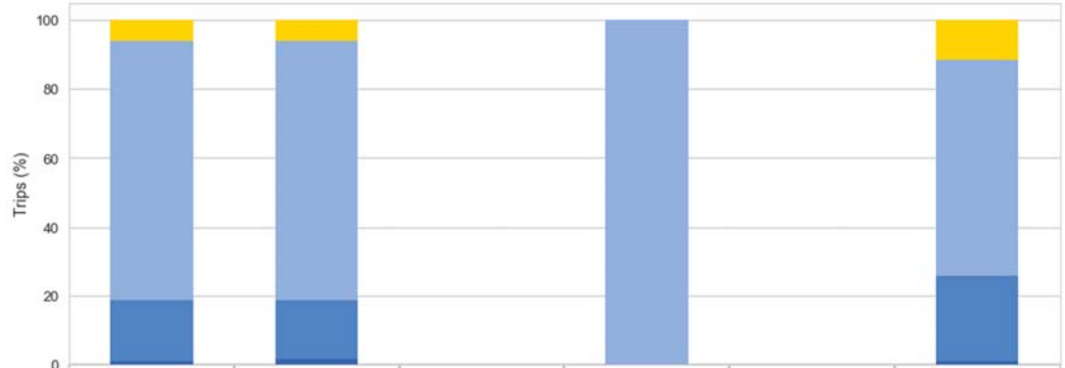
Figure 52 - Figure 54 show a detailed overview of the transport modes usage and the user clusters distribution for the trips where we observed the Schouwen-Duiveland as either trip's origin or destination location. Compared to the Neeltje Jans target location, a bit more balanced use of transport modes

among different user clusters is observed. Furthermore, the car is observed as the transport mode with the highest share for the ‘External 24’ sub-cluster, whereas its share continuously decreases for ‘External recurring’, ‘External long’ and ‘Internal’ sub-clusters. Having said this, the share of walking trips continuously increases between ‘External 24’, ‘External recurring’ and ‘External long’ reaching the highest share for the ‘Internal’ cluster (more than 30 %). Looking at the absolute values, the car is most often used to reach the Schouwen-Duiveland and the train is observed to be used only by the ‘External recurring’ users.



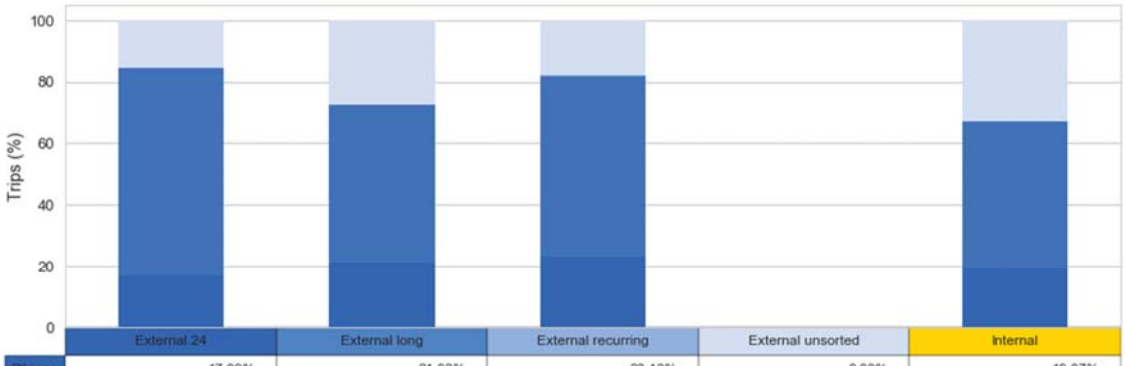
	Biking	Car	Flight	Train	Tram	Walking
External 24	20	79	0	0	0	18
External long	361	884	0	0	0	472
External recurring	1,542	3,919	0	9	0	1,197
External unsorted	0	0	0	0	0	0
Internal	127	319	0	0	0	220

Figure 52 Overview of observed transport modes and user clusters for Schouwen-Duiveland



	Biking	Car	Flight	Train	Tram	Walking
External 24	0.98%	1.52%	0.00%	0.00%	0.00%	0.94%
External long	17.61%	17.00%	0.00%	0.00%	0.00%	24.75%
External recurring	75.22%	75.35%	0.00%	100.00%	0.00%	62.77%
External unsorted	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Internal	6.20%	6.13%	0.00%	0.00%	0.00%	11.54%

Figure 53 Overview of observed transport modes and user clusters for Schouwen-Duiveland (relative data)



	External 24	External long	External recurring	External unsorted	Internal
Biking	17.09%	21.03%	23.13%	0.00%	19.07%
Car	67.52%	51.49%	58.78%	0.00%	47.90%
Flight	0.00%	0.00%	0.00%	0.00%	0.00%
Train	0.00%	0.00%	0.13%	0.00%	0.00%
Tram	0.00%	0.00%	0.00%	0.00%	0.00%
Walking	15.38%	27.49%	17.95%	0.00%	33.03%

Figure 54 Modal split for users clusters on the Schouwen-Duiveland

Figure 55 gives a geographical overview of the target location with the indication of the observed trip's origins and destinations at the Schouwen-Duiveland island. Compared to the Neeltje Jans target location, Schouwen-Duiveland related trips origins have international character (Figure 56), with 1 % of trips originating in Belgium. In addition, we observed a more versatile selection of the regions (Figure 57) and the municipalities (Figure 58) for the Schouwen-Duiveland island than for the Neeltje Jans target location.

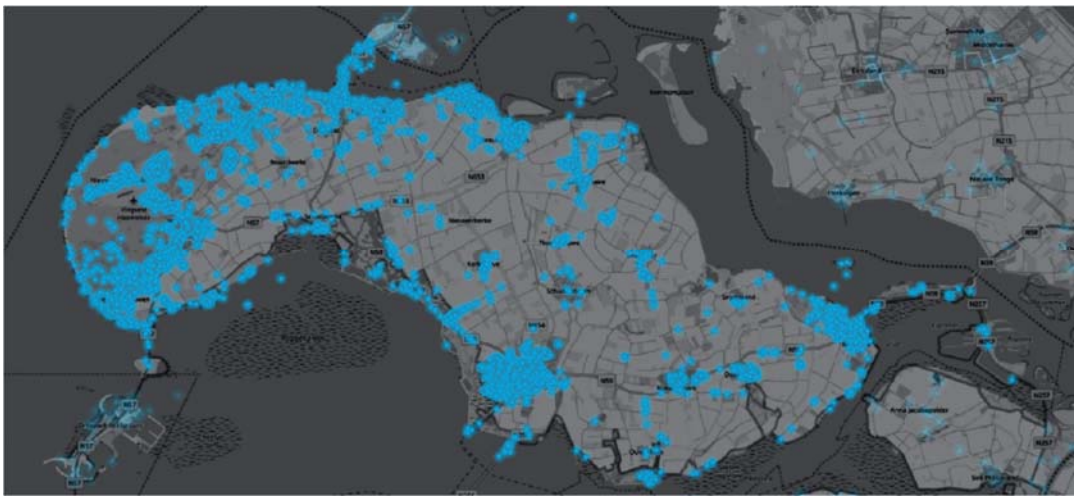


Figure 55 Trips with destination on Schouwen-Duiveland and its vicinity

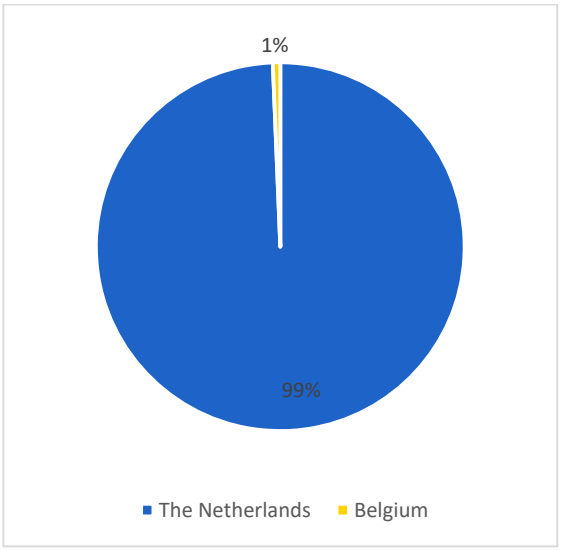


Figure 56 Country of origin for trips ending at Schouwen-Duiveland

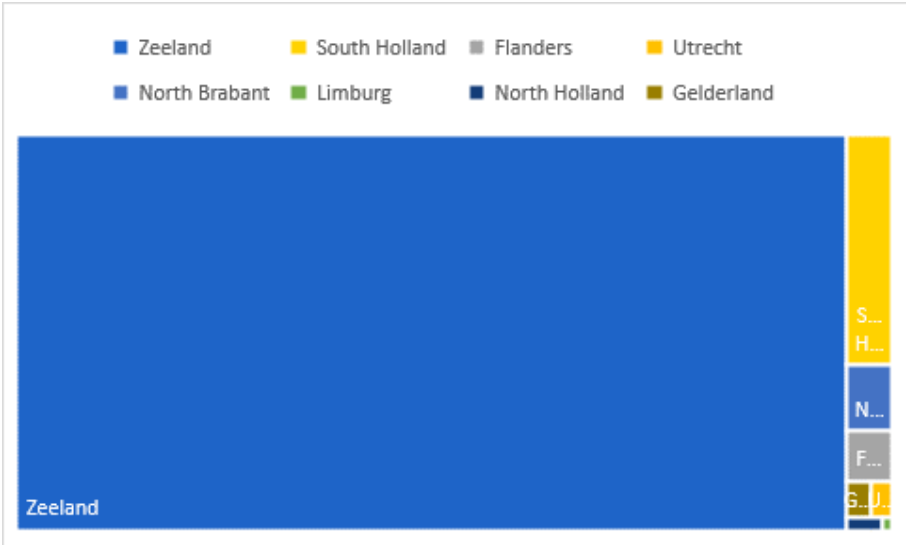


Figure 57 Region of origin for trips ending at Schouwen-Duiveland

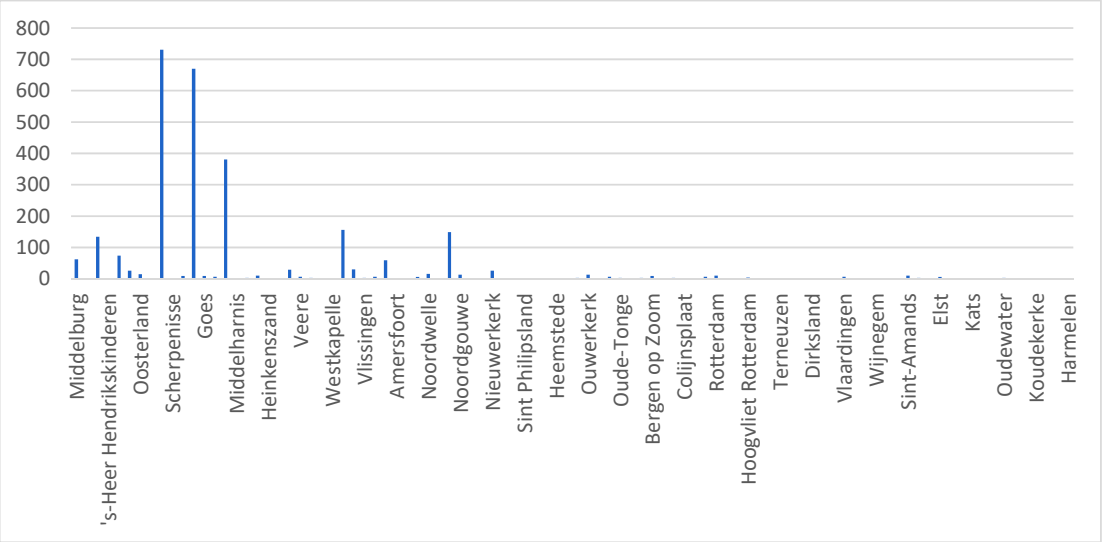
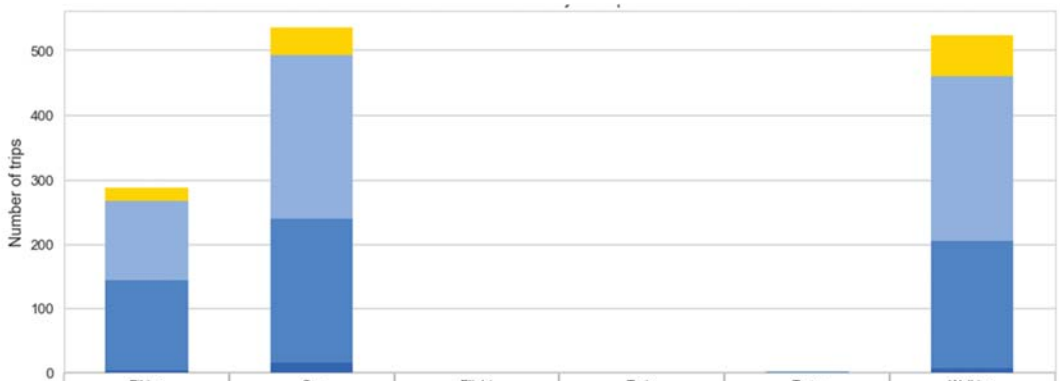


Figure 58 Origin for trips ending at Schouwen-Duiveland

7.3 Nieuwvliet / Cadzand

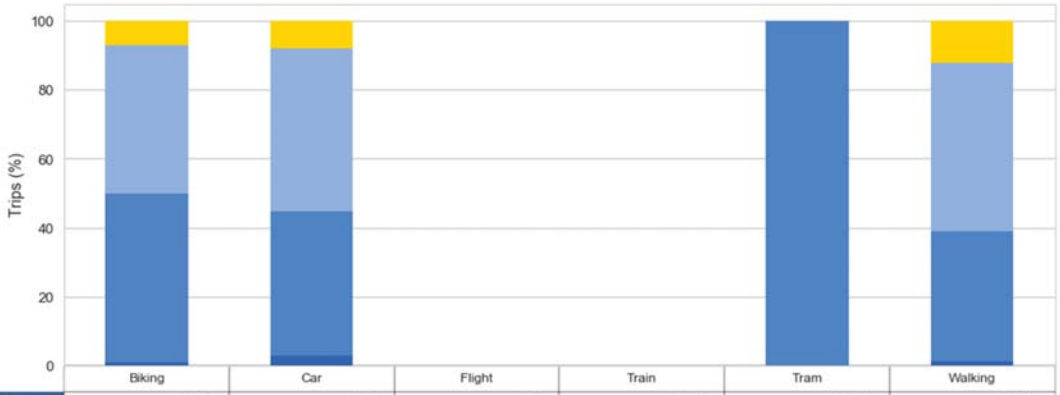
Nieuwvliet and Cadzand are small villages situated in the Zeeland province. The Nieuwvliet consists of two parts: Nieuwvliet-Dorp and Nieuwvliet-Bad. The Nieuwvliet-Dorp is located two kilometers from the coast and is the part where the most residents live. The Nieuwvliet-Bad is located directly on the coast and is a location where many campsites and recreational parks are located, together with the two wide sandy beach. This makes the area highly attractive to tourists. The Cadzand also integrates the Cadzand-Bad resort area with the highest number of hours of sunshine per year in the Netherlands, making it highly interesting destination for tourists.

Figure 59- Figure 61 show a detailed overview of the transport modes usage and the user clusters distribution for the trips where we observed the Nieuwvliet/Cadzand area as either trip's origin or destination location. Compared to the Neeltje Jans and Schouwen-Duiveland target locations, the transport mode usage is more similar to the one observed at Neeltje Jans (high use of the car, bike and walking while only one tram trip is observed). Same as previously, the 'External 24' sub-cluster exhibits the highest share of the car use and the lowest share of the bike use. Share of the walking trips is the highest for the 'Internal' and 'External recurring' sub-clusters making this pattern distinct from the two previous target locations. The bike usage seems to be the highest for the 'External long' sub-cluster. Taking a look at the absolute values, the quantity of the observed walking trips utilized to reach/leave this area is remarkably high and comparable with the number of the car trips. This pattern seems to be unique for the Nieuwvliet/Cadzand area when compared to the other target locations.



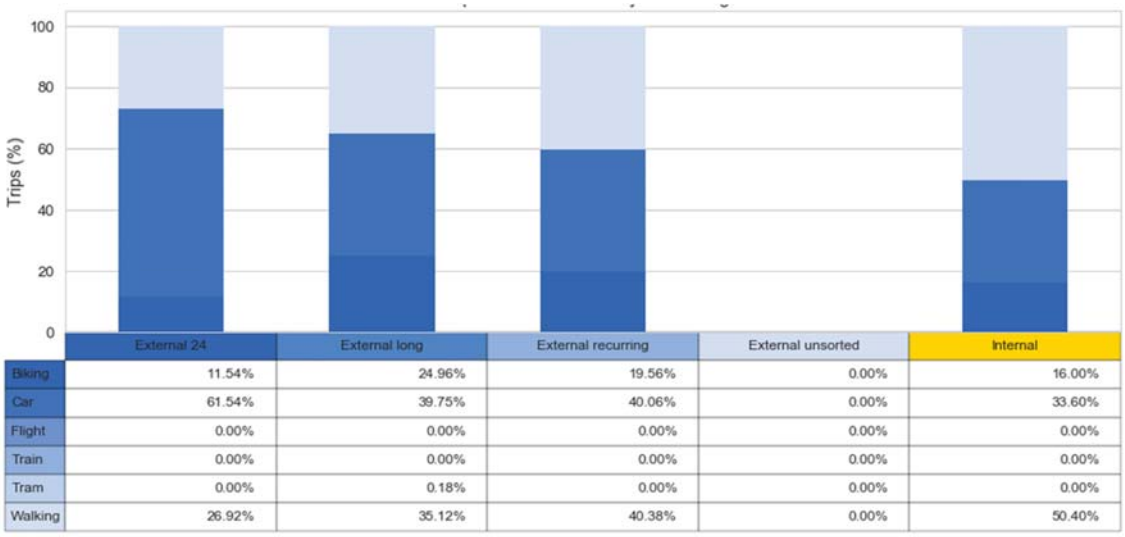
	Biking	Car	Flight	Train	Tram	Walking
External 24	3	16	0	0	0	7
External long	140	223	0	0	1	197
External recurring	124	254	0	0	0	256
External unsorted	0	0	0	0	0	0
Internal	20	42	0	0	0	63

Figure 59 Overview of observed transport modes and user clusters for Nieuwvliet/Cadzand area



	Biking	Car	Flight	Train	Tram	Walking
External 24	1.05%	2.99%	0.00%	0.00%	0.00%	1.34%
External long	48.78%	41.68%	0.00%	0.00%	100.00%	37.67%
External recurring	43.21%	47.48%	0.00%	0.00%	0.00%	48.95%
External unsorted	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Internal	6.97%	7.85%	0.00%	0.00%	0.00%	12.05%

Figure 60 Overview of observed transport modes and user clusters for Nieuwvliet/Cadzand area (relative data)



	External 24	External long	External recurring	External unsorted	Internal
Biking	11.54%	24.96%	19.56%	0.00%	16.00%
Car	61.54%	39.75%	40.06%	0.00%	33.60%
Flight	0.00%	0.00%	0.00%	0.00%	0.00%
Train	0.00%	0.00%	0.00%	0.00%	0.00%
Tram	0.00%	0.18%	0.00%	0.00%	0.00%
Walking	26.92%	35.12%	40.38%	0.00%	50.40%

Figure 61 Modal split for users clusters on the Nieuwvliet/Cadzand area

Figure 62 gives a geographical overview of the target location with the indication of the observed trip's destinations at the Nieuwvliet/Cadzand area, whereas Figure 66 gives the same insight for the observed trips' origins at the Nieuwvliet/Cadzand area. The share of the international trips that end or start in this area is higher than it was observed for the previously mentioned target locations. In more details, around 2% of trips that end in the Nieuwvliet/Cadzand area originates in Flanders (Figure 63 - Figure 65). Similarly high, around 6% of the trips that originate in the Nieuwvliet/Cadzand area, end at the international locations (Figure 67 - Figure 69). These international destination locations are more diverse than it was the case for the trips origins. Although these international trips mainly end in Belgium, we have observed some trips that end in Luxembourg area also.

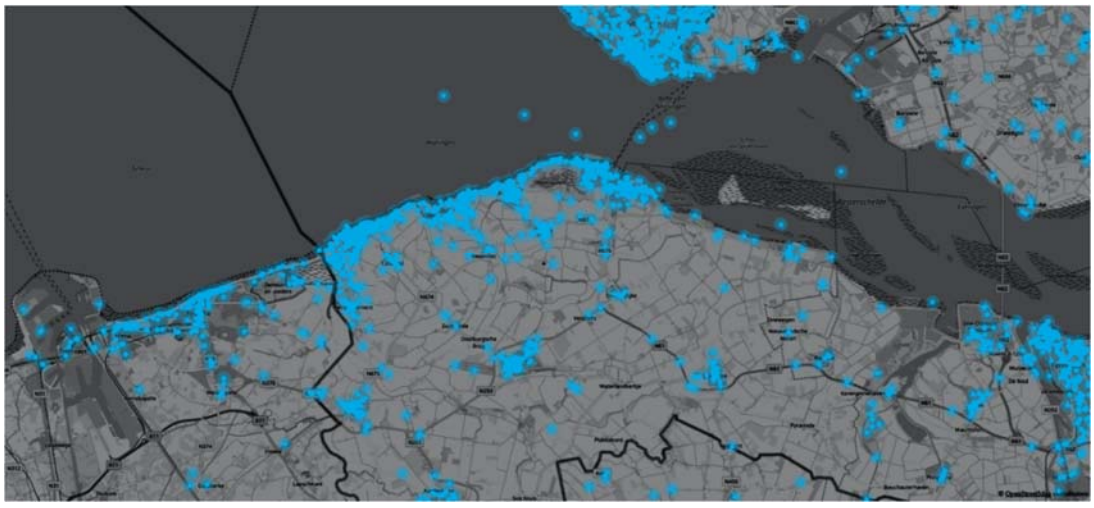


Figure 62 Trips with destination in Nieuwvliet / Cadzand and its vicinity

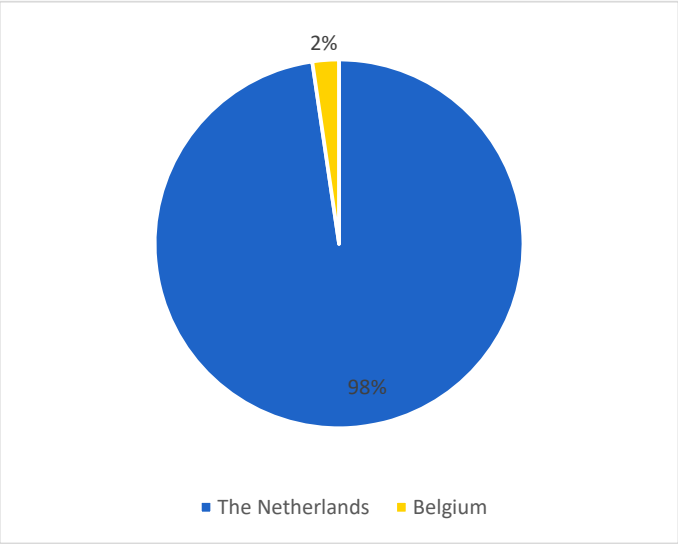


Figure 63 Country of origin for trips ending at Nieuwvliet / Cadzand

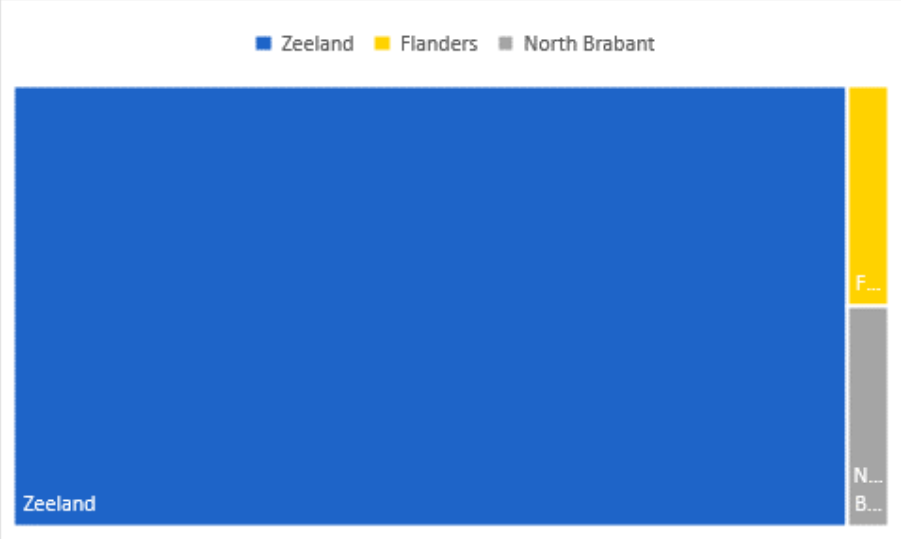


Figure 64 Region of origin for trips ending at Nieuwvliet / Cadzand

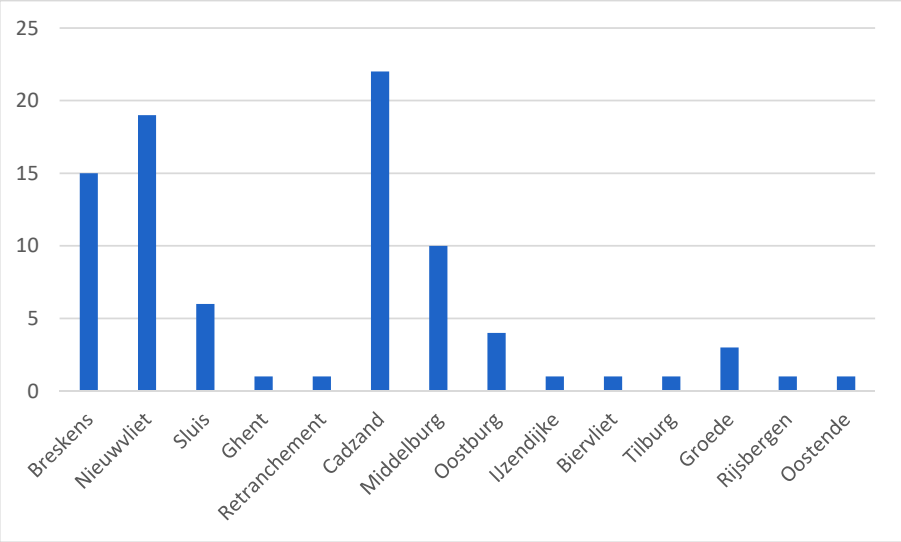


Figure 65 Origin for trips ending at Nieuwvliet / Cadzand

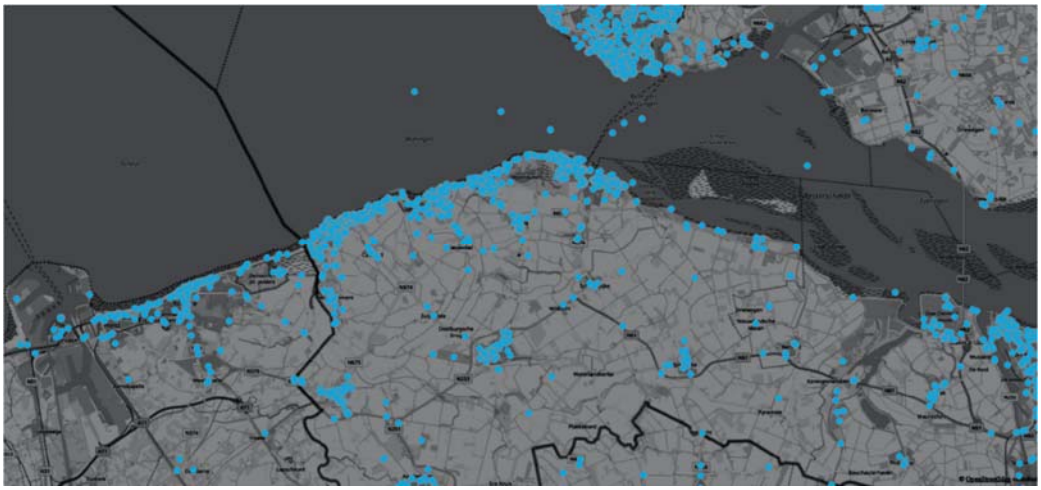


Figure 66 Trips with origin in Nieuwvliet / Cadzand and its vicinity

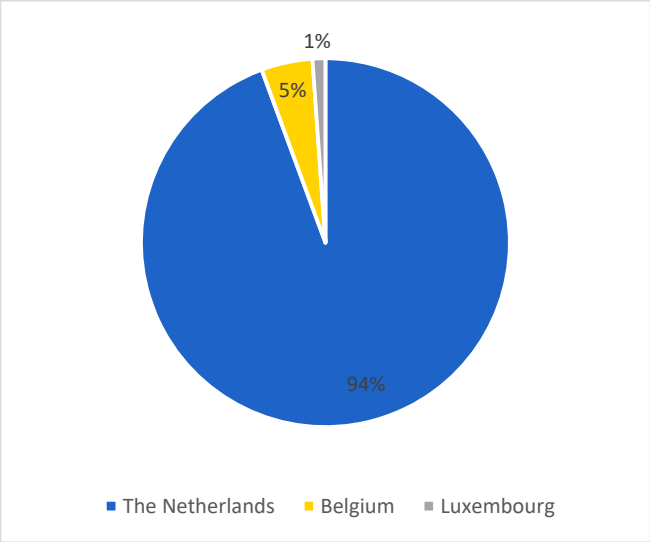


Figure 67 Country of destination for trips starting at Nieuwvliet / Cadzand

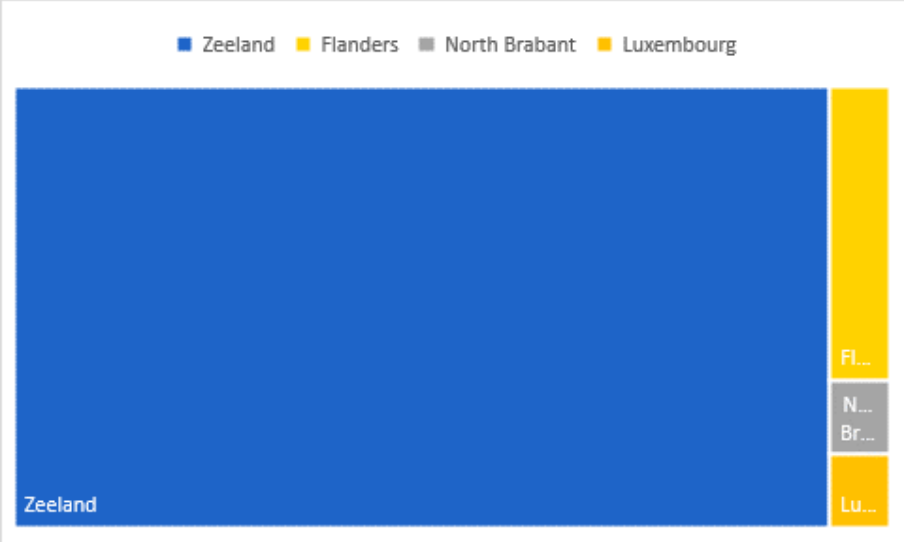


Figure 68 Region of destination for trips starting at Nieuwvliet / Cadzand

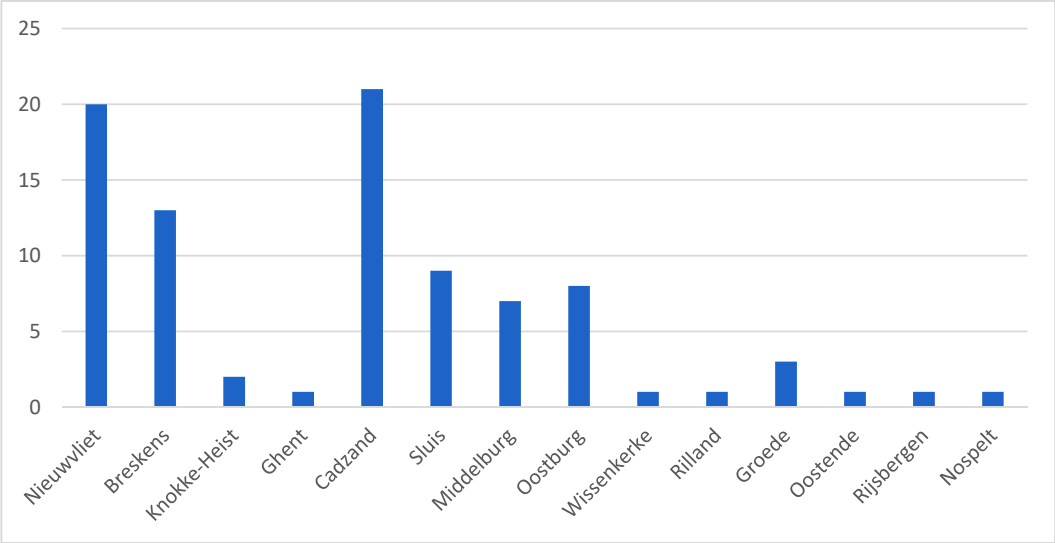
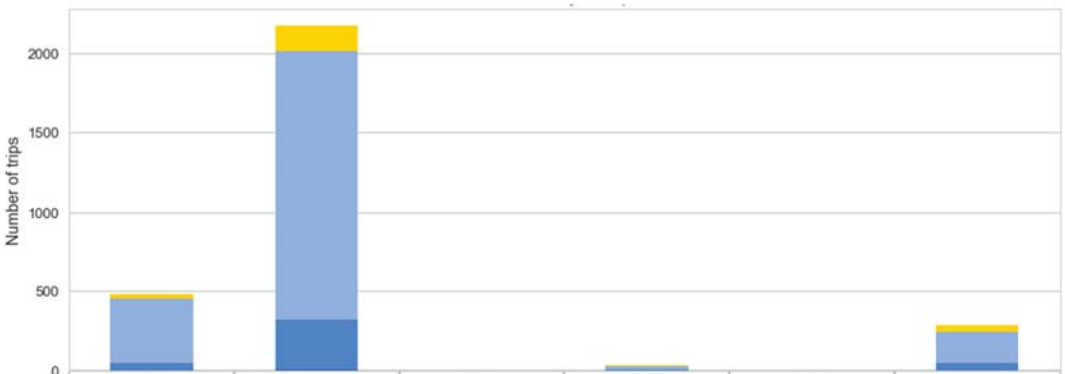


Figure 69 Destination for trips starting at Nieuwvliet / Cadzan areas

7.4 Goes

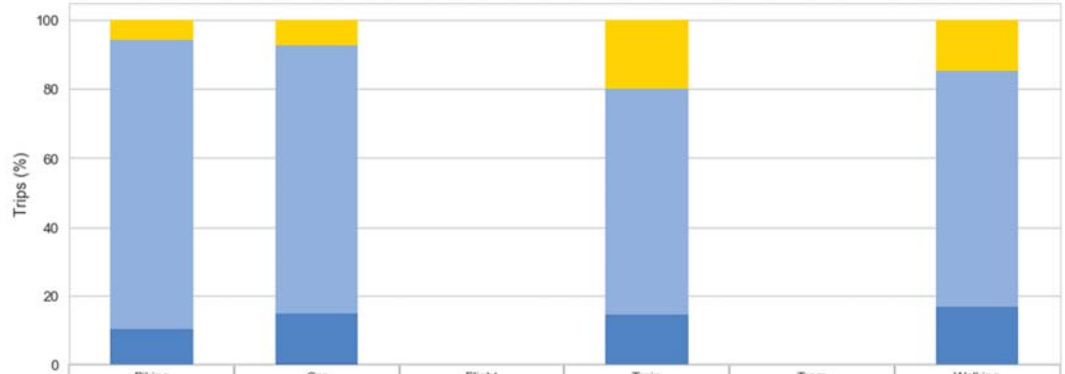
Goes is a municipality and a city in the southwestern Netherlands on Zuid-Beveland, in the province of Zeeland. It is situated along the A58 corridor, which ensures accessibility from the west (Vlissingen and Middelburg) and east Bergen op Zoom and Roosendaal. From the north (Zierikzee and Rotterdam) Goes is accessible via the N256. Goes also has a train station on the Roosendaal - Vlissingen railway line. From this station, intercity trains run to Vlissingen and Lelystad Centrum and stops in at all stations in Zeeland. The adjacent bus station offers connections with, among others, Zierikzee, Kamperland, Middelburg, Terneuzen and Ghent. There is a very high share of bike trips (>50%) among residents in Goes, which earned it a nomination for the bicycle city of the Netherlands in 2008.

Figure 70 - Figure 71 give an overview of the distribution of user clusters (absolute and relative values) for each observed transport mode, while Figure 72 gives an insight into the modal split for all the user clusters observed in the Goes area.



	Biking	Car	Flight	Train	Tram	Walking
External 24	0	5	0	0	0	0
External long	49	317	0	5	0	48
External recurring	403	1,692	0	23	0	196
External unsorted	0	0	0	0	0	0
Internal	27	157	0	7	0	42

Figure 70 Overview of observed transport modes and user clusters for the Goes area



	Biking	Car	Flight	Train	Tram	Walking
External 24	0.00%	0.23%	0.00%	0.00%	0.00%	0.00%
External long	10.23%	14.60%	0.00%	14.29%	0.00%	16.78%
External recurring	84.13%	77.94%	0.00%	65.71%	0.00%	68.53%
External unsorted	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Internal	5.64%	7.23%	0.00%	20.00%	0.00%	14.69%

Figure 71 Overview of observed transport modes and user clusters for the Goes area (relative data)

	External 24	External long	External recurring	External unsorted	Internal
Biking	0.00%	11.69%	17.42%	0.00%	11.59%
Car	100.00%	75.66%	73.12%	0.00%	67.38%
Flight	0.00%	0.00%	0.00%	0.00%	0.00%
Train	0.00%	1.19%	0.99%	0.00%	3.00%
Tram	0.00%	0.00%	0.00%	0.00%	0.00%
Walking	0.00%	11.46%	8.47%	0.00%	18.03%

Figure 72 Modal split for users clusters in the Goes area

One can notice several distinct patterns when comparing mobility behaviour of users who were observed in the Goes area with mobility patterns of other (above-mentioned) target locations. For one, only in Goes area we have observations related to the train transport mode. Secondly, all the users in the 'External 24' cluster used the car to reach/leave Goes. The same as for Schouwen-Duiveland and Neeltje Jans, the observed trips to or from Goes are mainly characterised by the high utilisation of cars. Moreover, train trips were observed for each sub-cluster, except the 'External 24', with the highest share for the 'Internal' cluster.

Figure 73 gives a geographical overview of the target location with the indication of the observed trip's destinations in the Goes area. One can notice that, similar to the Neeltje Jans area, all the observed trips have their origin within the Nederland. However, a more spread pattern across region and municipalities is observed when compared to the Neeltje Jans area (Figure 74 - Figure 75).

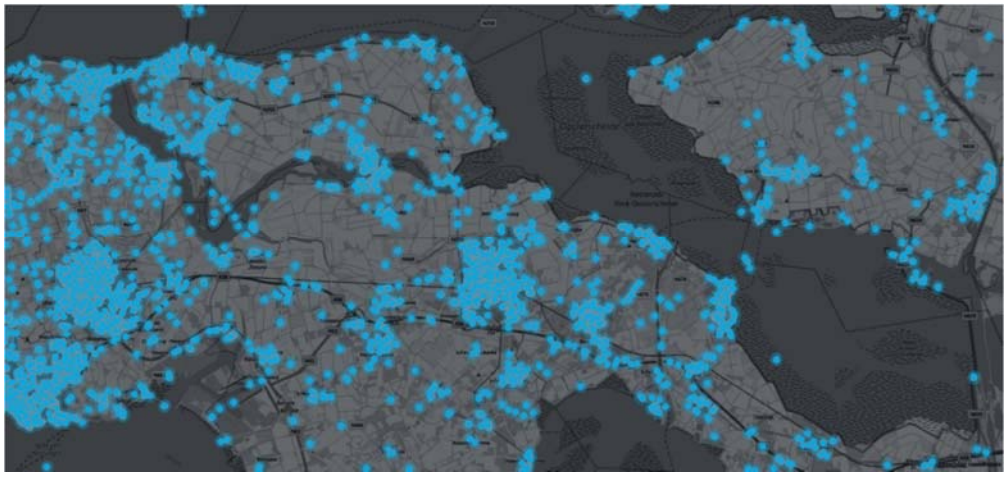


Figure 73 Trips with destination in Goes and its vicinity

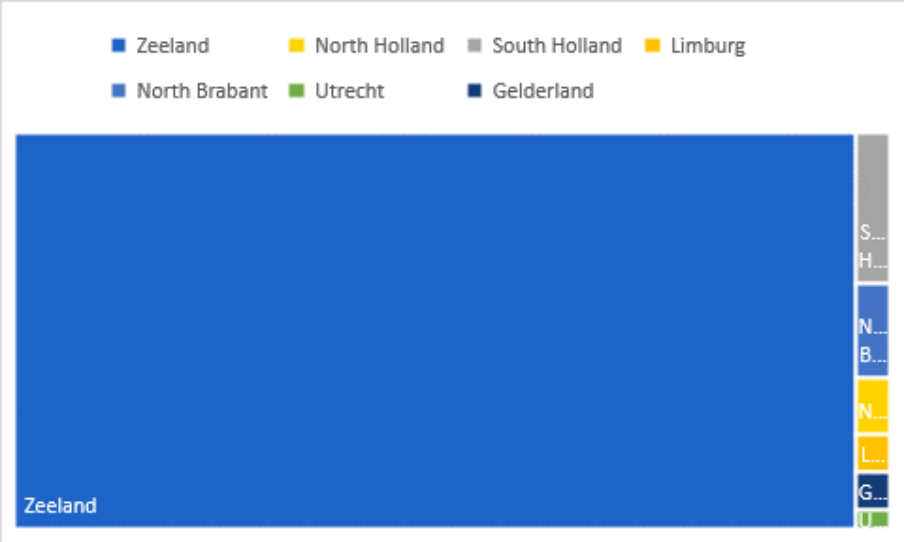


Figure 74 Region of origin for trips ending at Goes

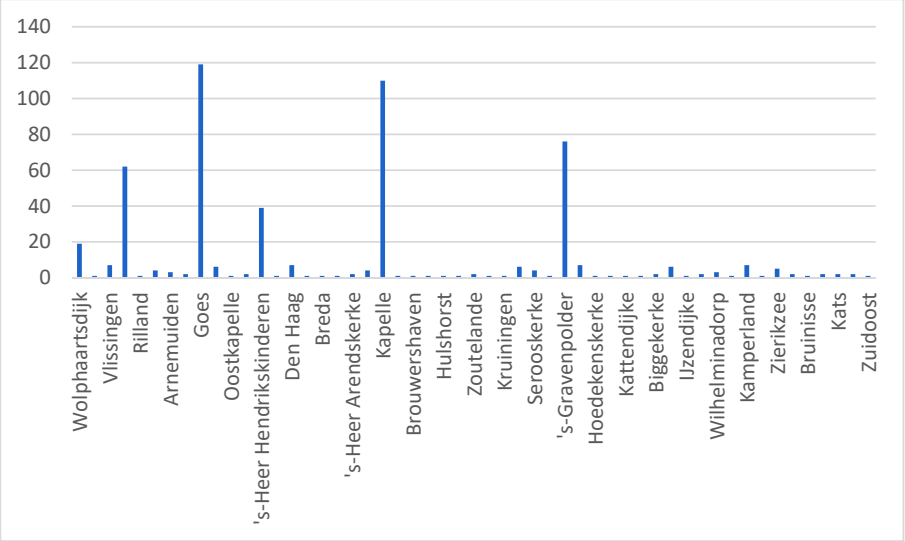


Figure 75 Origin for trips ending at Goes

8 SPOTLIGHT ON THE ‘EXTERNAL 24’ USERS CLUSTER

In this chapter, we take a closer look at the ‘External 24’ sub-cluster, i.e. the users that spend a day in the Zeeland region. **Error! Reference source not found.** gives an overview of the estimated home origin of the users in the corresponding ‘External 24’ sub-cluster. The most these trips come from within the Zeeland region and other provinces in the Nederland (Figure 76-Figure 77). Next to the trips that originated in Nederland, most of the observed trips originated in Belgium, in Antwerp and Ghent area (Figure 78). The trips that originated in Germany were mainly from the Cologne, Monchengladbach and Oberhausen municipalities (Figure 79).

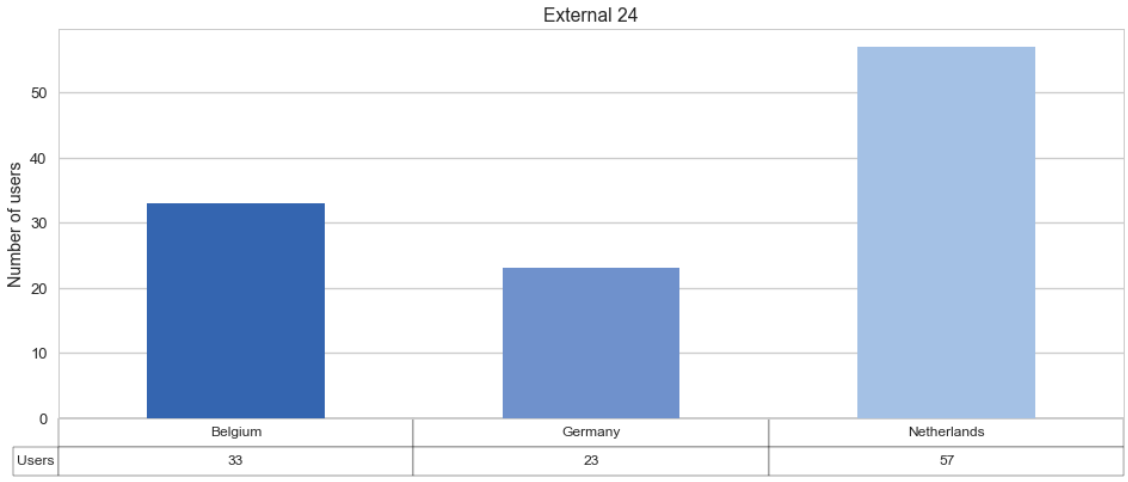


Figure 76 Trip origins (by country) for the ‘External 24’ profile

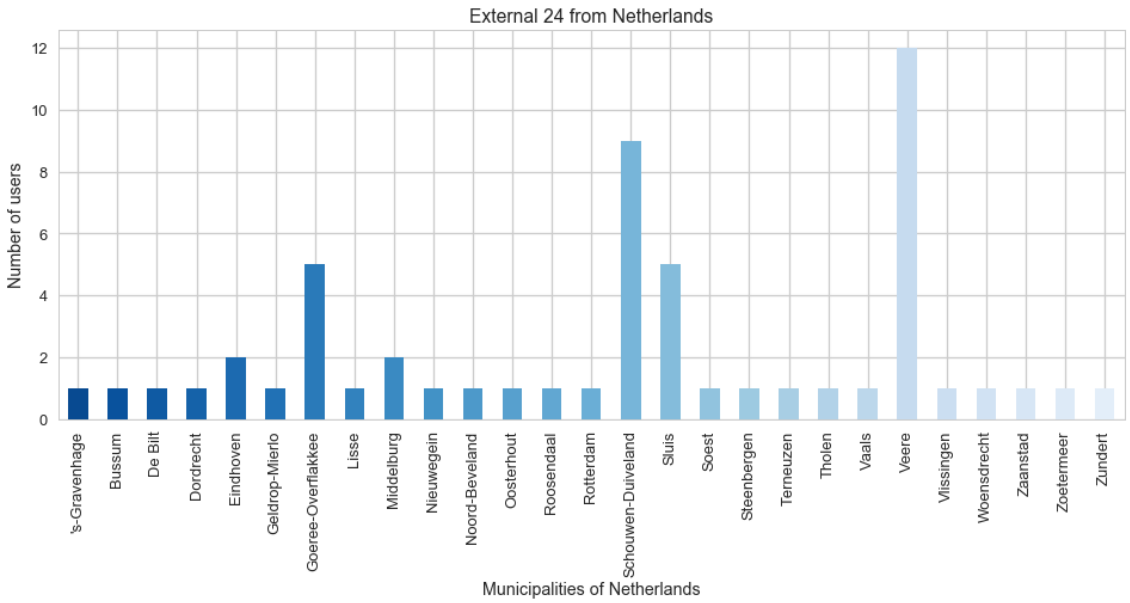


Figure 77 Municipality of origin for trips that started with in Nederland

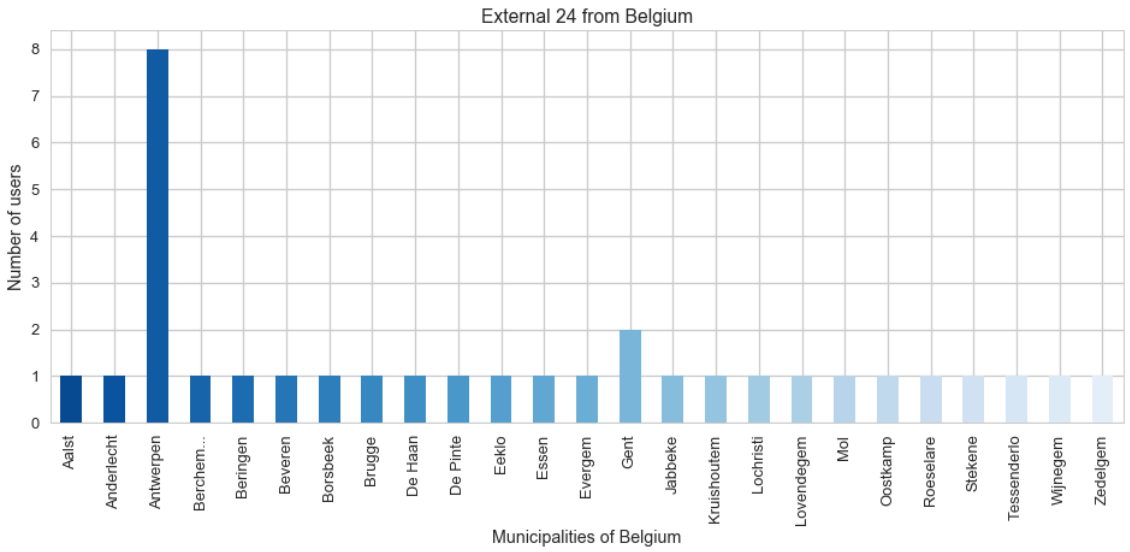


Figure 78 Municipality of origin for trips that started with in Belgium

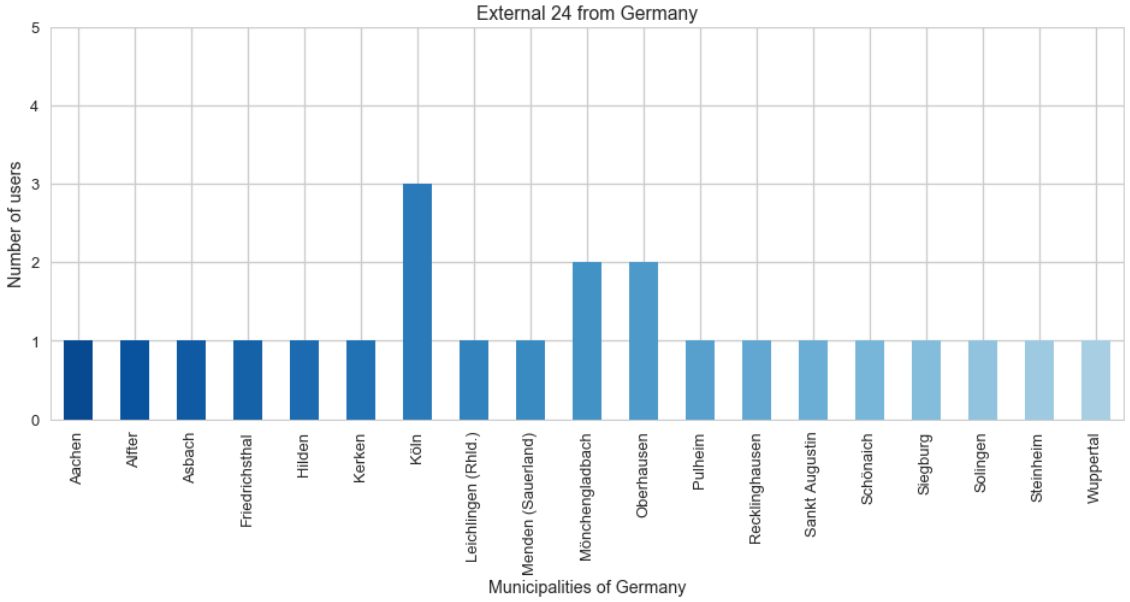


Figure 79 Municipality of origin for trips that started with in Germany

Locally, the most of the ‘External 24’ sub-cluster trips ended in the Schouwen-Duiveland municipality, followed by Veere and Sluis. The lease of the External 24’ sub-cluster trips ended in Borsele, Hulst and Tholen.

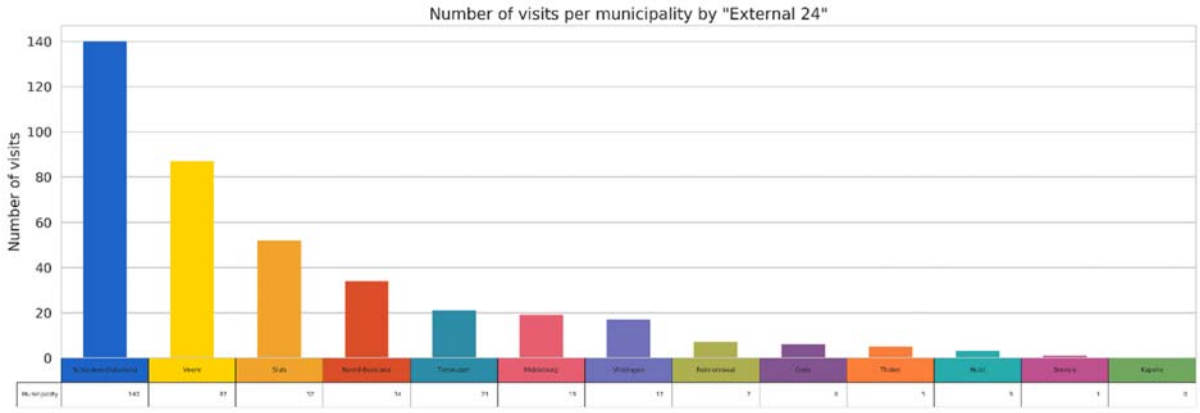


Figure 80 Local trip destinations for the 'External 24' profile

Figure 81 shows a modal split for all the trips made within the Zeeland region (Zeeland appears either as the trip origin or destination location) and assigned to the 'External 24' sub-cluster. One can notice that almost two thirds of these trips were made by car, around 21 % by foot and 14 % by bike.

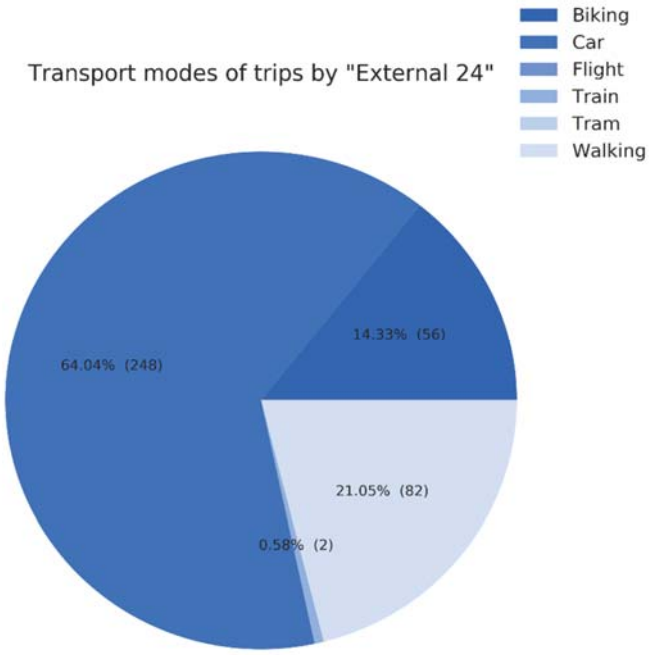


Figure 81 Modal split for 'External 24' sub-clusterr

View on the observed trip purposes (Figure 82) shows that most of the identified trip purposes were related to the 'travel' itself, followed by the visits to restaurants and shops. The least of the recognised trip purposes referred to the sport and educational activities. Figure 83 illustrates the geographical distribution of these trip's destinations, colour coded by the trip purpose.

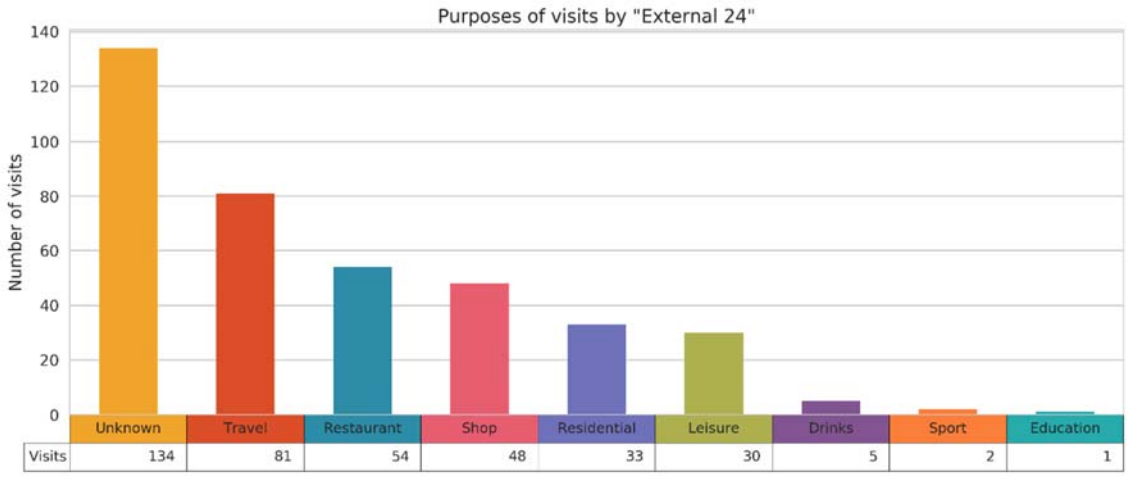


Figure 82 Trip purposes distribution

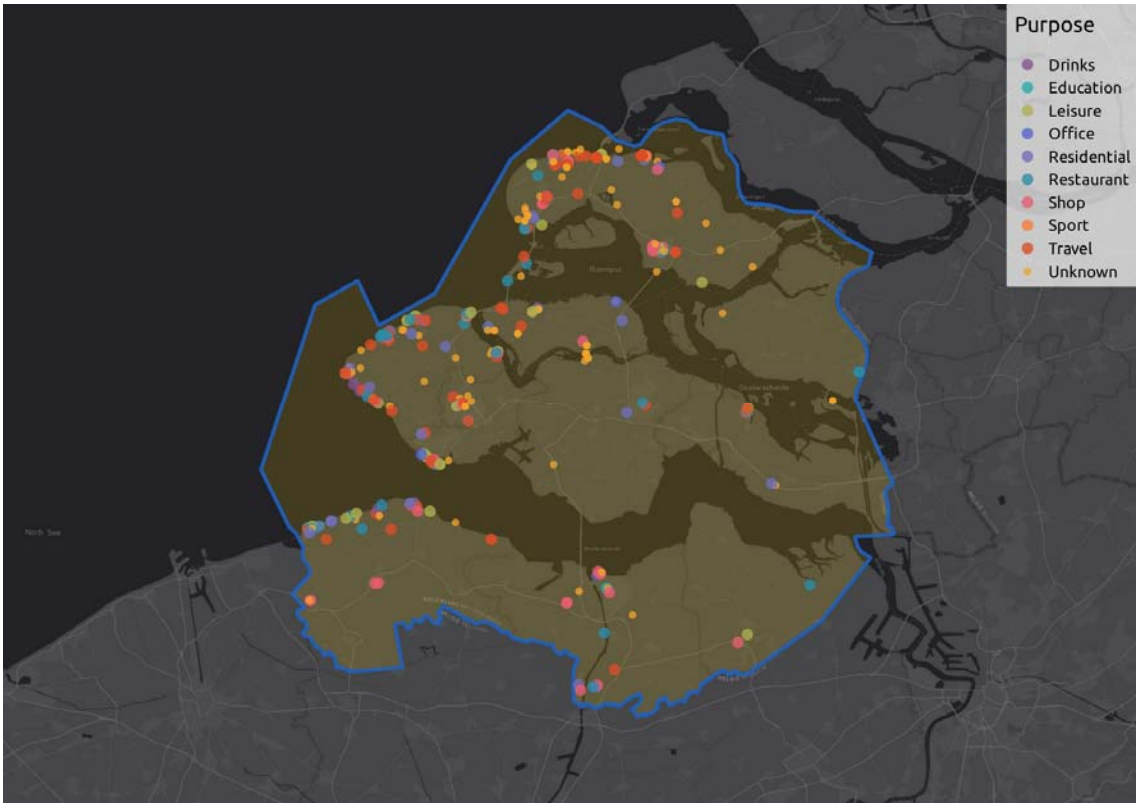


Figure 83 Geographical view of the trip purpose destinations

9 CONCLUSIONS

The report gives an overview of the main findings from the new Zeeland app pilot study. The report is based on the data collected from 1 505 app users, which recorded 124 725 trips and 151 612 trip legs.

Results show that most of the users started using the app while already in the Zeeland area and that most of the users spent less than two day in the region. In addition, weekends seem to be the most frequent periods when users arrived and/or left the region. On a monthly level, number of app users grow the most during the August and September.

Our results also indicate the presence of two main user clusters within the dataset. 'Internal' user cluster that envelops all the users for whom only trips within the Zeeland region were observed and the 'External' users cluster that envelops other users. The 'External' users cluster is further divided intofour sub-clusters. 'External 24' sub-cluster, those who spent less than 24 h in Zeeland region in only one occasion. 'External long', those who spent longer than 24 h in Zeeland region in only one occasion. 'External recurring', those for whom multiple trips in and out the Zeeland region were observed and 'External unsorted' the rest of the users within the 'External' cluster. For each of these clusters we give a detailed insight into their observed mobility behaviour. Some of the results indicate that the 'External long' and the 'Internal' user clusters are more prone to take a walk. The other two sub-clusters, although they both have quite high share of car related trips, exhibit different pattern when it comes to the use of bikes and the 'External recurring' sub-cluster has almost equal share of bike usage as the 'External long' and the 'Internal' clusters, while the bike share is the lowest for the ' External 24' sub-cluster.

Furthermore, for each municipality in the Zeeland region we give insight into origin and destination flows for the main transport modes. Thus, one can notice that municipalities Sluis and Schouwen-Duiveland have the most homogeneous trip characteristics, having more than 90% of trips that start and end within them. However, Borsele, Reimerswaal, Goes and Vlissingen have distinctively different pattern with more than 40% of trips that are external concerning the municipality area. Furthermore, the most of the local bike trips were made in the Schouwen-Duiveland and Veere municipalities, whereas notable number of non-local bike trips were made between the Veere and Middelburg (in both directions) and Veere and Vissingen. On the other hand, local car trips seem to be the most frequent in the Schouwen-Duiveland area, whereas the Schouwen-Duiveland and Veere exhibit significantly higher number of local car trips when compared to the rest of the province. The view of the relative number of car trips within the Zeeland region strongly highlighted that in some municipalities cars are mainly used for the regional travels. Probably this is the most notable for the Kapelle, where almost 80% of the times, a car was used for trips between different municipalities.

Rest of the report gives more details on four target location areas within the Zeeland region (Neeltje Jans, Schouwen-Duiveland, Nieuwvliet / Cadzand and Goes). Schouwen-Duiveland and Nieuwvliet / Cadzand exhibit international character of trips that, either, originate or end in these locations. In addition, Nieuwvliet/Cadzand and Neeltje Jans area exhibit quite similar transport mode usage patterns, Also, taking a look at the absolute values, the quantity of the observed walking trips utilized to reach/leave the Nieuwvliet/Cadzand area is remarkably high and comparable with the number of the car trips. This pattern seems to be unique for the Nieuwvliet/Cadzand area when compared to the other target locations.

The final group of insights is related to the 'External 24' user sub-cluster. Results indicate that users in this sub-cluster come from different national and international locations mainly by car. Also, the most frequent reasons for their trips were related to the 'travel' itself, followed by the visits to restaurants and shops. The least of the recognised trip purposes referred to the sport and educational activities.