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TravelVu and TravelViewer in Trondheim

Testing Travelviewer, a Travel Survey reporting assistance program

Report

Trondheim – September – 2020

NTNU
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1 Contents

2 Introduction

2.1 TravelViewer - data for low-carbon sustainable transport systems

In September 2018, Trivector started an international project aiming to test the travel survey app TravelVu in four locations outside of Sweden. The app has previously been used in several research projects in Sweden and Norway. NTNU was invited to join the project and be responsible for data collection in Norway.

Travel survey data is important – it provides data on how people travel. This is data used by transport planners and the transport authorities to keep track of travel patterns and changes in these patterns over time, or as a reaction to more specific changes in transport services. Travel survey data is in important source of information to efficiently make strategies to meet carbon targets, improve air quality, making right investment decisions, and is the main input data in developing transport models.

With co-financing from Climate-KIC within their demonstrator program, this project is demonstrating the use of the TravelVu app in 4 countries; Denmark, Norway, Germany and Italy. The project has developed a dashboard to view details of local travel surveys online, and thus be able to access data and download reports. The new travel survey service is named TravelViewer. The project started September 2018 and ends September 2020.

2.2 SmartRVU

NTNU stated the SmartRVU project in 2016 searching for new methods to carry out travel surveys in collaboration with the Norwegian Public Roads Administration, has used TravelVu in several pilot projects.

Traditionally the Norwegian national travel surveys have been carried out with a wide range of background questions regarding person, household, car ownership and details about trips. The burden of the respondents is beyond acceptable with an average duration of interviews in the 13/14 survey of 23 minutes. The more trips, the longer time on the phone. Thus, from 2017 the respondents also could report their information on a web-based platform. Although this probably reduced some of the burden for the respondents, the results show suspicious results, and a still declining response rate, down to 16%, from 20% in 13/14.

The goal of Smart RVU is thus to collect data in a smart way, enhancing the data quality while reducing the burden on the respondents. A Travel Survey should require not more than 2 minutes of the respondents' time. This is an ambiguous goal, and we are not there yet, but we believe that a Smartphone app, like TravelVu, is part of the solution to get there.

2.3 TravelVu

TravelVu collects two types of data, 1) information about the respondent and 2) travels.

2.3.1 Information about respondents

Information about respondents is important for three main purposes:

- Controlling the representativity of the sample in the survey. Thus, we ask for gender, income, education to reveal if the sample is skewed compared to the overall population. The normal procedure is to weight up underrepresented groups and weight down overrepresented groups.
- Comparing travel possibilities and patterns between groups of the population because it is expected that various groups have different travel possibilities and behavior.
- Following the development in travel behavior over time, also within and between groups.

Within the SmartRVU project our approach has been to reduce the background questions to a minimum, especially around details regarding car ownership. This has been collected in traditional surveys to detect trends over time among the general population. It is expected that such information in the future can be provided from car owner databases. Other databases could also contribute with other background information, but currently it is strictly regulated. Ideally the travel survey could start with the respondent allowing downloading public information about him or her, and just confirm or correct the information. That would probably save a lot of time for them.

2.3.2 Information about trips

The TravelVu app uses sensors in smartphones to identify how people are travelling, prompting them on how they have travelled with an easy-to-use interface where users can review their trips and correct where necessary.

TravelVu tracks peoples' movements and the respondent states what is done at any stop in movement, whether it is e.g., waiting for a bus, parking the car or stops which is interpreted as part of a trip, or doing an activity, like being at work, shopping or leisure activity which is interpreted as a trip purpose.

TravelVu saves information about each person, meaning that if the respondents revisit a site, TravelVu suggest the same activity there as before. This learning process makes it easier to correct days, if the collection period is several days and the respondent corrects days consecutively.

Data from TravelVu is prepared in files with different aggregation levels. Either one whole round trip is one observation, including all stops for several travel purposes in a trip chain, for instance starting from home and ending at home. Alternatively, each trip is one observation, with one trip purpose. The last option is one trip component is one observation, which is the most disaggregated level. Normally, the middle category is the reported unit, meaning one movement from one place to a destination with a trip purpose, which is the definition of a trip.

In addition to the trip files the data also includes tracking which can be viewed in a GIS. The location of the traveler is reported with a frequency of 2 Hz, which imply that if the phone has wifi-connection, the tracks are quite accurate.

2.3.3 Advantages with TravelVu

The main advantage with TravelVu is that the respondent burden is lower than traditional methods. They install the app, answer the background questions and specify trip purpose and correct mode if necessary. Using TravelVu for only day, the respondent will have to specify trip purposes for most, or all the trips. Using it several days the app remembers trip purposes for locations visited earlier, which makes the burden smaller for consecutive days. The app suggests mode for the trips based on speed and accelerometer in the phone. Given that the app suggests the right mode, no corrections for mode are necessary.

Because the respondent burden is highest for correcting the first day and reduced the following days, it is tempting to ask the respondent to use the app for several days. The advantage is that we get more data from each respondent, however they may lose motivation to participate if the total burden gets too high.

The data about trips from TravelVu are expected to be complete and correct, more so than with traditional data collection methods. It should cover all trips during the day, given that the respondents bring their phone along when travelling. In traditional Travel survey, when respondents report their trips, it is not possible to also ask about the chosen route for the trips, it takes too much time and is hard to remember for the respondent. Because TravelVu relies on tracking, the route choice is also part of the collected data, giving detailed information about all travel time components, including walking time, parking time, waiting time etc, and accurate measurements of distances travelled.

2.3.4 Disadvantages with TravelVu

Identifying where people are, through tracking combined with information of purposes on locations, gives a lot of information about the respondent; where they live and work. This might compromise their privacy. Norwegian Centre for Research Data enforces the GDPR regulations about which data can be collected, how the data can be analyzed and stored. It is necessary to get approval up front to start collecting data, and this can be a lengthy process. At NTNU, we have initiated a process to anonymize data, which will make it possible to extend the use of data without compromising the privacy of participants in a survey.

Practical obstacles to using TravelVu is battery drainage on the mobile phone. In our experience the phone needed more frequent charging when using TravelVu, at least once a day. Another requirement is that the respondent must own a Smartphone and routinely carry it along when traveling.

Although the respondent burden is perceived as less than with traditional methods, the respondent still must correct days, which means purpose and mode, and delete, add, split and join trips if these aren't correct. One possibility for the respondent, if the day needs a lot of corrections, is to submit (validate) the day without corrections, but tag it as not correct.

2.3.5 Suggested improvements

Ideally the burden on the respondents should be as low as possible. Completing the initial survey in our pilot took 1-2 minutes. Some of this information could probably be collected from other

sources, databases containing home address, income level, educational level, car ownership etc. This is not possible within the current regulations.

Correcting the days and submit them seems to be the dominant response burden. If the app learning algorithm improves, the burden on the respondents could be reduced. As it is the app learns purposes at location, which means that the respondent does not need to specify purpose more than once for each location. Learning modes could also be implemented, for instance, if the tracking follows a PT route, and the speed is following the route table, it is likely that the respondent is on the bus. Also, the difference between electric bike and conventional bike, is possible to reveal through ownership data and speed in uphill parts of the route.

Another possibility is if the app learns trip purposes from map data or across respondents. That would reduce the burden with entering purposes for all trips to new locations.

2.4 Testing TravelViewer

As part of the project, Trivector has developed a dashboard tool named TravelViewer. In the dashboard, organisations will be able to view details of their travel survey online and be able to access data and download reports. The main purpose of this report is to show the potential of using TravelViewer to illustrate results from the survey in Trondheim fall 2019.

The tested version of TravelViewer is a first version of the tool. Our general impression is that the TravelViewer dashboard tool is very useful to get an overview of collected data and show key numbers from the TravelVu app data. Experienced researchers would otherwise use a statistical software to produce similar overviews.

The advantage of using a statistical software is that the researchers are in control of their preparation of data, giving more flexibility to exclude, correct and weight data. TravelViewer is easy to use but comes with less flexibility in the tested version.

3 Travel survey from Trondheim

3.1 Facts about Trondheim

Trondheim is the third biggest city in Norway, behind Oslo and Bergen. Total number of people with their home address in Trondheim fall 2019 was close to 200 000. In addition, approximately 40 000 students live in Trondheim. The population is expected to grow to 210 000 by 2030 and to 220 000 by 2040[1]. At the same time, Miljøpakken[2] is responsible for projects intended to reduce climate gas emissions through investments in mobility projects to promote green transport solutions. The goal is to reach zero growth in personal car traffic.

Travel surveys are important to monitor the development in travel behavior.

[1] https://www.ssb.no/
[2] https://miljopakken.no/

3.2 Data collected in the TravelViewer project, fall 2019

Table 1: Facts about data from Trondheim

Information	
Collection time period	14.10.2019 - 11.11.2019
Number of respondents	869
Number of reported days	8662
Response rate, invitation letter	4 %

3.3 Recruitement strategies

The SmartRVU project has several strategies to recruit respondents to participate in travel surveys. These are described in Tørset and Svaboe (2020) including details about recruitment strategies and success rates for the pilot fall 2019. The goal was to recruit 1000 respondents for the Pilot fall 2019. Recruitment strategies specific for the fall survey included:

(1) letters to a random sample (10 000 persons)
(2) crowdsourcing (social media and article in local newspaper)
(3) personal recruitment (flyers, handouts, a limited number of phone calls)

3.4 Representativity and weights

The TravelVu data was compared to the resident data base from Statistics Norway, presented in Table 2.

Table 2: Age groups from the residence data base Trondheim2019[3], Statistics Norway

Age groups	Men	Women	Total	%
18 - 24	11 279	10 422	21 701	15,2 %
25 - 44	34 477	30 543	65 020	45,4 %
45 - 64	23 102	22 743	45 845	32,0 %
65-70	5 067	5 430	10 497	7,3 %
Total	73 925	69 138	143 063	100 %
%	51,7 %	48,3 %		

The TravelVu data had distribution in age groups as presented in Table 3 with 48 % men and 52 % women.

[3] Trondheim municipality, before Klæbu joined

Table 3: Age groups from the Trondheim pilot fall 2019 n= 871

From Travelviewer		
18 - 24	96	11 %
25 - 44	386	44 %
45 - 64	326	37 %
65-70	63	7 %
Total	871	

In TravelViewer we set target distribution as reported from Statistics Norway, regarding gender and age groups. TravelViewer calculated weights and these are used in presentations given in chapter 3.5.

3.5 Main results from Trondheim fall 2019

The presentation is made with 869 out of 882 respondents. Number of corrected days are 8662, but with 13 fewer respondents, probably number of corrected days included in the presentation is somewhat fewer as well.

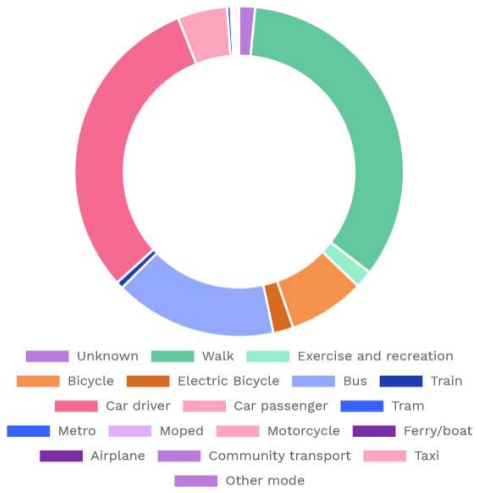
3.5.1 Key numbers (Overview):

- **4,6 trips** per person and day
- **31 km** per person and day
- **111 minutes** per person and day

Week 1 14-19/10 Tu-Su	• **5,0 trips** per person and day • **31 km** per person and day • **123 minutes** per person and day
Week 2 20-26/10 Mo-Su	• **4,8 trips** per person and day • **30 km** per person and day • **127 minutes** per person and day
Week 3 27-31/10 Mo-Fr	• **4,5 trips** per person and day • **33 km** per person and day • **101 minutes** per person and day
Week 3 1-2/11 Sa-Su	• **4,9 trips** per person and day • **37 km** per person and day • **113 minutes** per person and day
Week 4 2-9/11 Mo-Su	• **4,6 trips** per person and day • **34 km** per person and day • **108 minutes** per person and day
Week 5 10-11/11 Mo-Tu	• **4,1 trips** per person and day • **32 km** per person and day • **87 minutes** per person and day

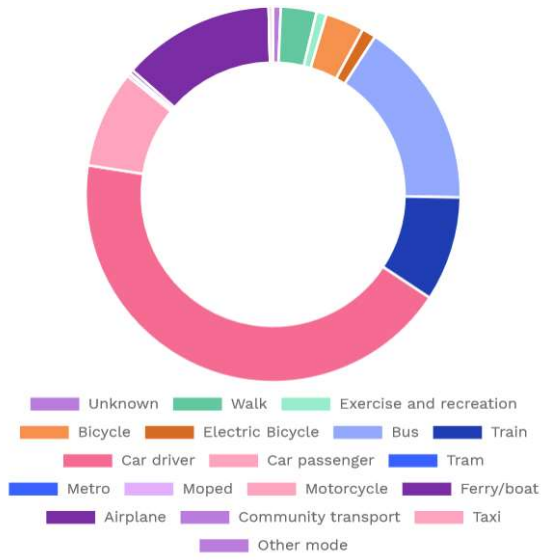
3.5.2 *Trips*

The trips are first presented without aggregating the mode or activity specifications (see Figure 1 and Figure 2).



Model	Avg trip rate	%
Unknown	0,07	**2 %**
Walk	1,57	**34 %**
Exercise and recreation	0,08	**2 %**
Bicycle	0,35	**7 %**
Electric Bicycle	0,09	**2 %**
Bus	0,74	**16 %**
Train	0,03	**1 %**
Car driver	1,43	**31 %**
Car passenger	0,23	**5 %**
Tram	0,02	0 %
Metro	0,00	0 %
Moped	0,00	0 %
Motorcycle	0,00	0 %
Ferry/boat	0,00	0 %
Airplane	0,01	0 %
Community transport	0,00	0 %
Taxi	0,01	0 %
Other mode	0,01	0 %
Total	4,64	100 %

Figure 1: Modal split by number of trips



Model	Avg distance	%
Unknown	0,2	**1 %**
Walk	1,0	**3 %**
Exercise and recreation	0,3	**1 %**
Bicycle	1,0	**3 %**
Electric Bicycle	0,4	**1 %**
Bus	5,0	**16 %**
Train	2,8	**9 %**
Car driver	13,3	**43 %**
Car passenger	2,6	**8 %**
Tram	0,1	0 %
Metro	0,0	0 %
Moped	0,0	0 %
Motorcycle	0,0	0 %
Ferry/boat	0,1	0 %
Airplane	4,1	**13 %**
Community transport	0,0	0 %
Taxi	0,1	0 %
Other mode	0,0	0 %
Total	**30,9**	**100 %**

Figure 2: Modal split by trip distance

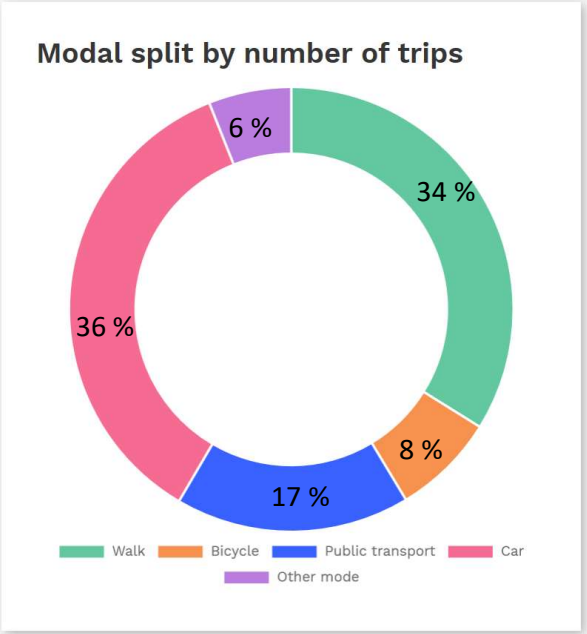


Figure 3: Mode split by number of trips

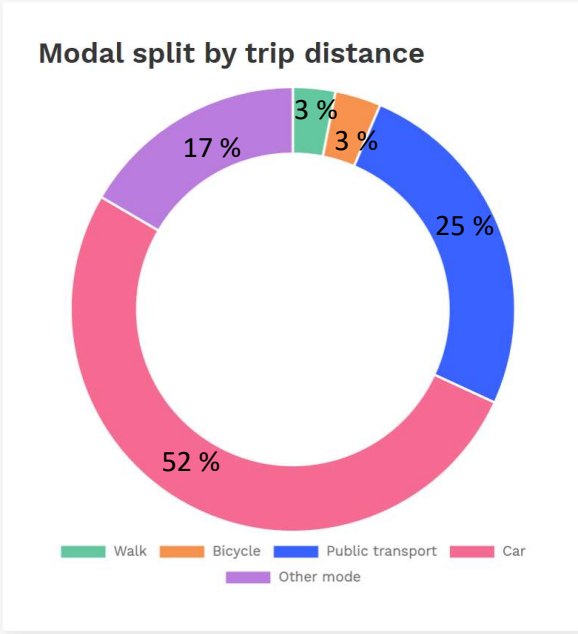


Figure 4: Mode split by trip distance

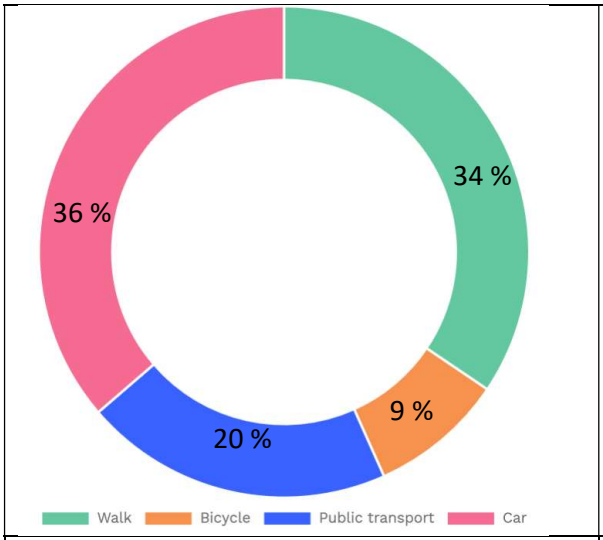


Figure 5: Mode split by number of trips for workdays (filter Saturday and Sunday)

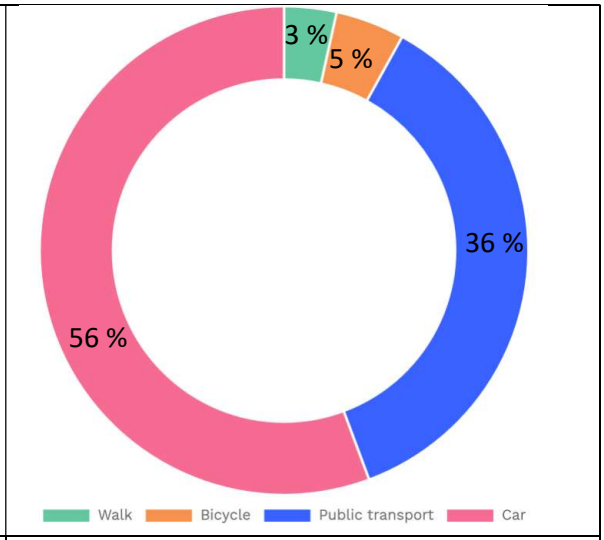


Figure 6: Mode split by trip distance for workdays (filter Saturday and Sunday)

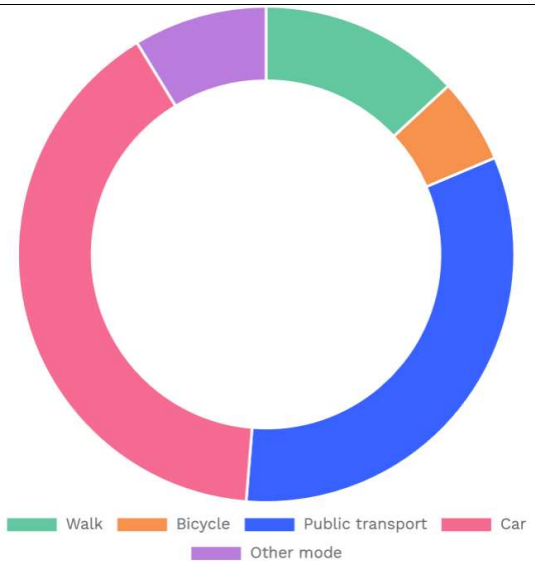


Figure 7: Modal split by trip duration

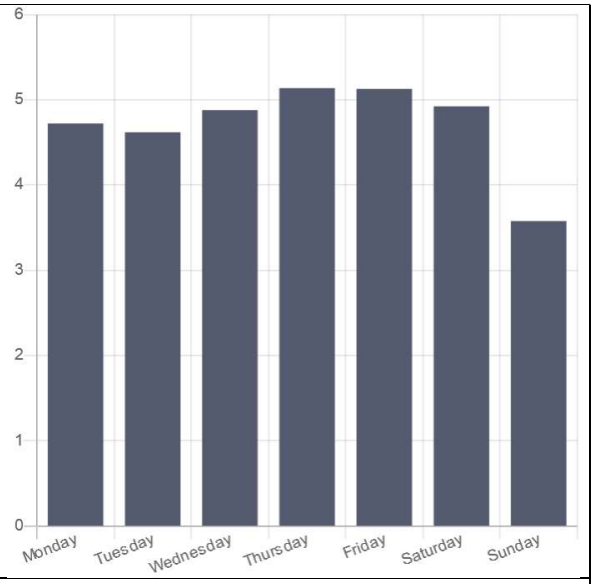


Figure 8: Number of trips per day of week

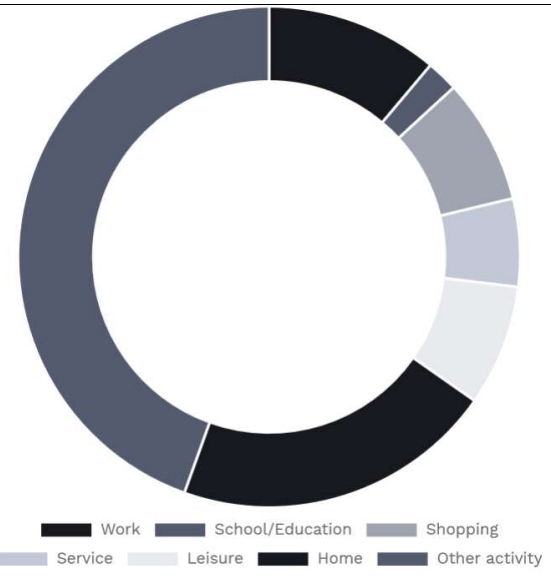


Figure 9: Activity distribution (per number of trips)

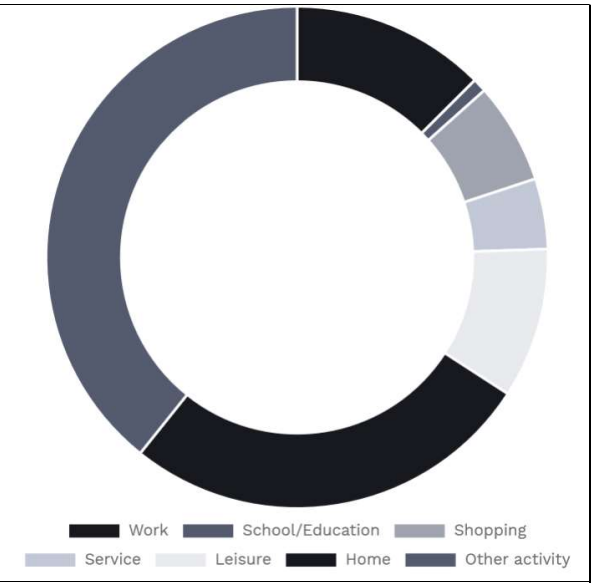


Figure 10: Activity distribution (per trip distance)

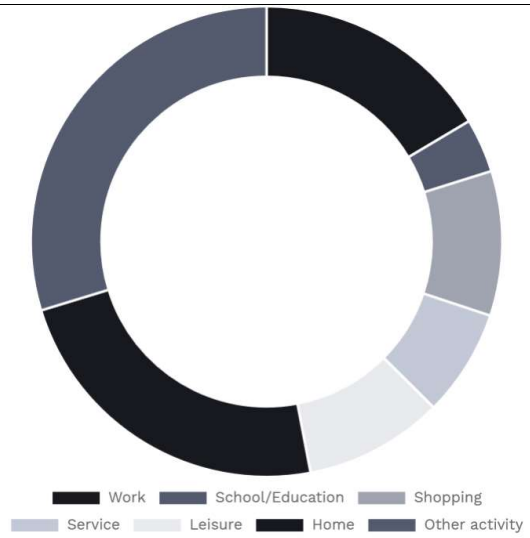


Figure 11: Activity distribution (per trip travel time)

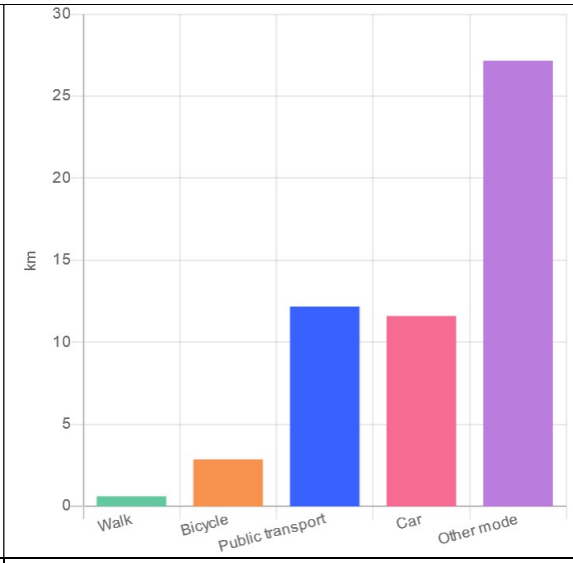


Figure 12: Average distance per trip

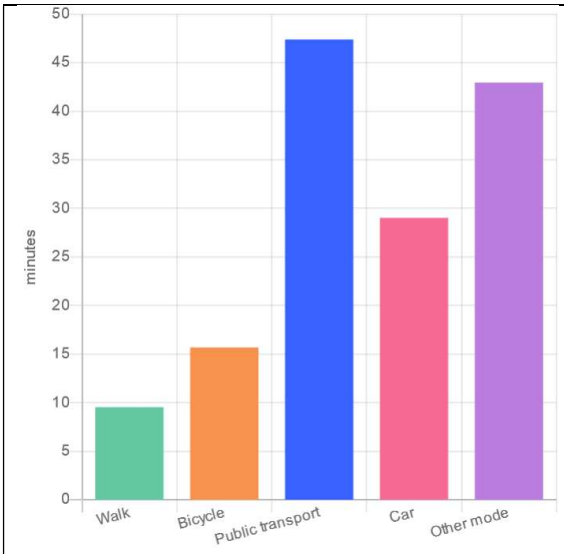


Figure 13: Average travel time per trip

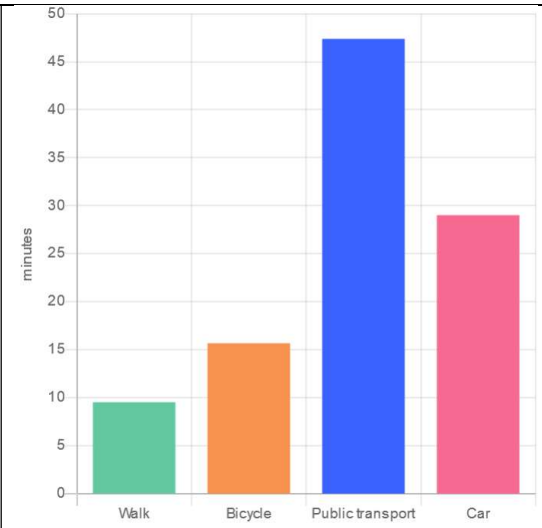


Figure 14: Average travel time per trip (filter Other)

3.6 Questionnaire

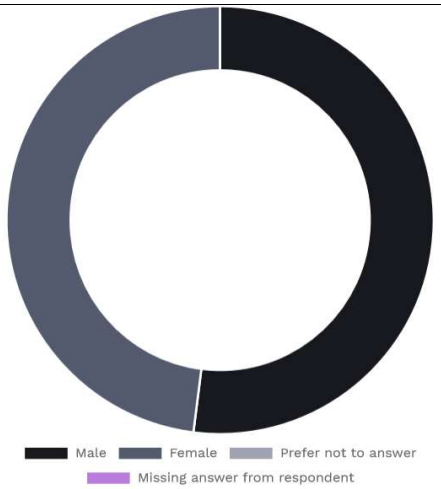


Figure 15: What is your gender?

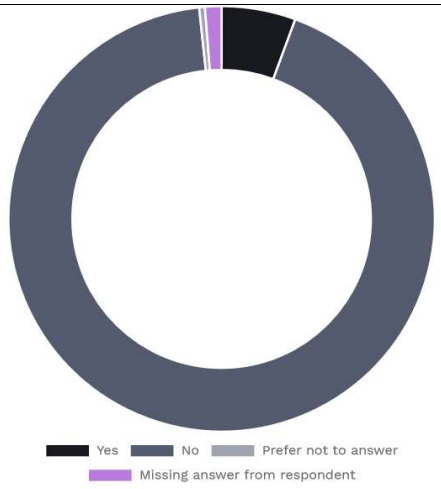


Figure 16: Do you have more than one address?

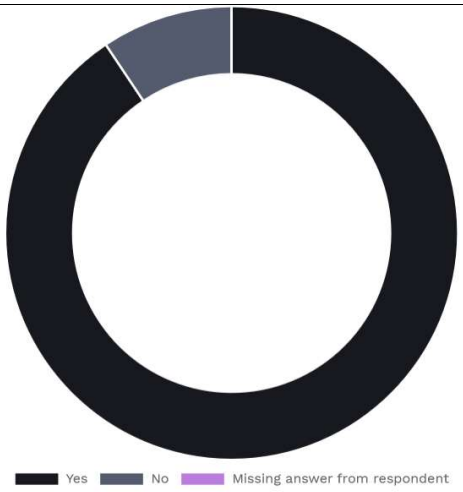


Figure 17: Do you have a driver's license for car?

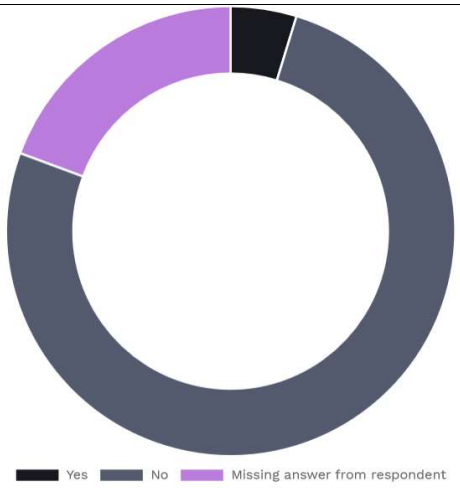
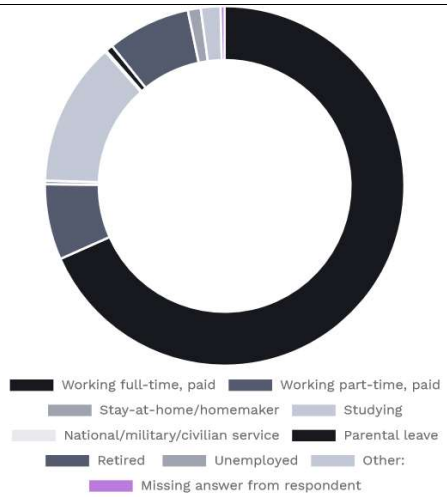
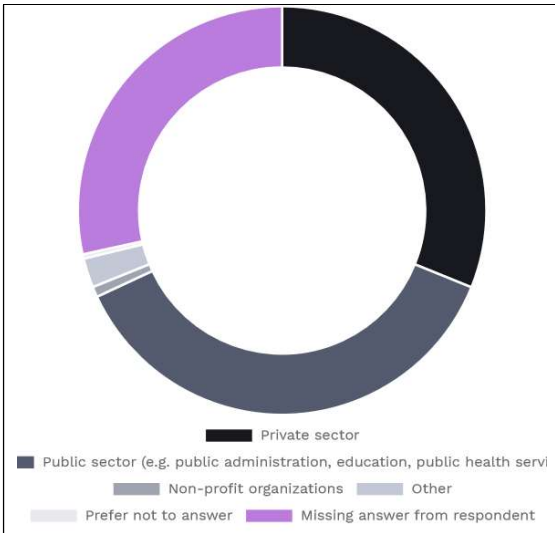


Figure 18: Are you a member of a car-sharing scheme?



Employment	%
Working full-time, paid	68 %
Working part-time, paid	7 %
Stay-at-home/homemaker	0 %
Studying	13 %
National/military/civilian service	0 %
Parental leave	1 %
Retired	8 %
Unemployed	1 %
Other:	2 %
Missing answer from respondent	0 %

Figure 19: What is your main occupation?



Sector	%
Private sector	31 %
Public sector (e.g. public administration, education, public health services)	37 %
Non-profit organizations	1 %
Other	2 %
Prefer not to answer	0 %
Missing answer from respondent	28 %

Figure 20: In what sector do you work?

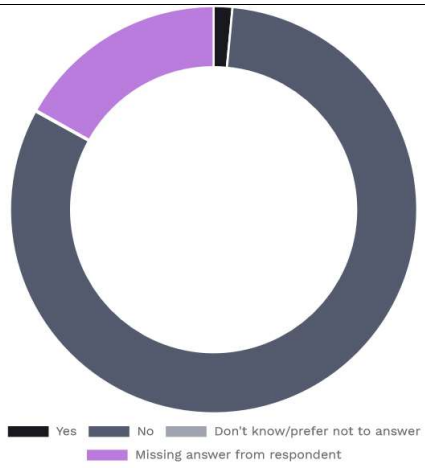


Figure 21: Are you a commercial driver?

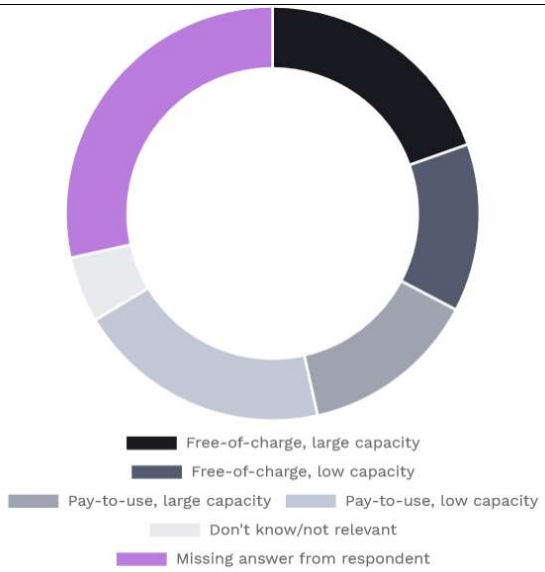


Figure 22: What best describes the parking conditions at/close to your place of work?

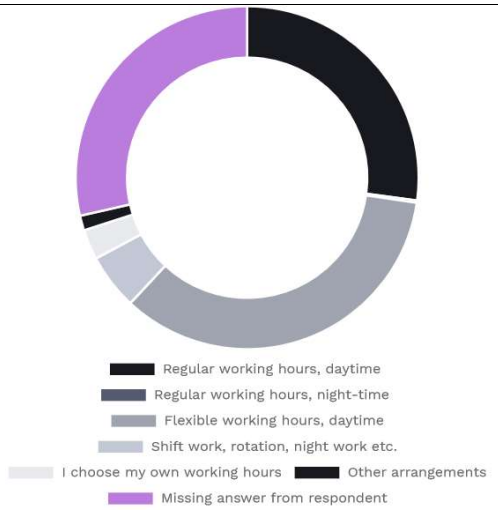


Figure 23: Are your working hours regular, flexible, shift-based or other?

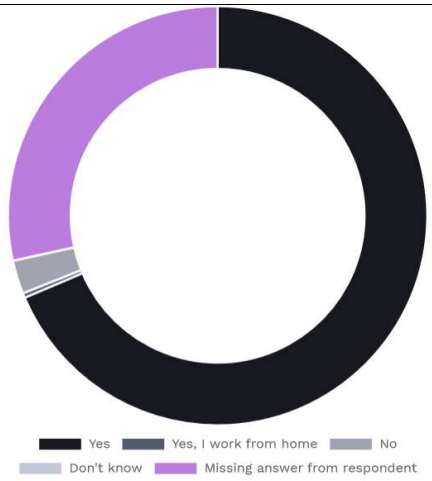


Figure 24: Do you have a set meeting place at work (a place you meet at least 50 percent of your working days in the course of one year)?

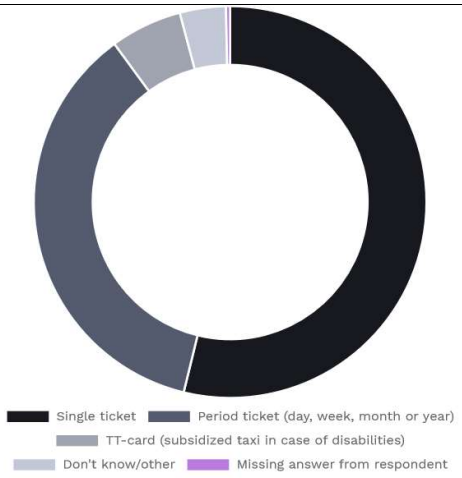


Figure 25: How do you pay for public transport?

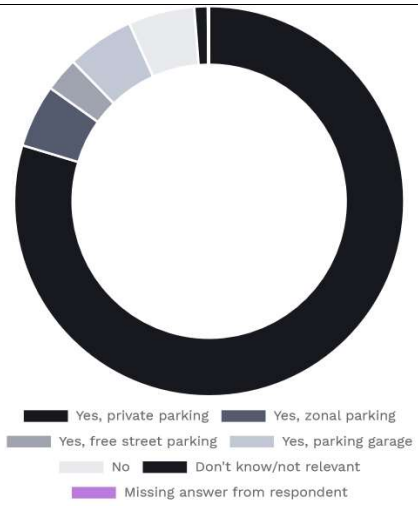
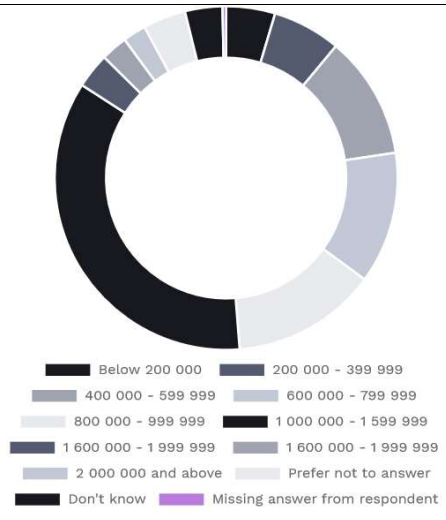
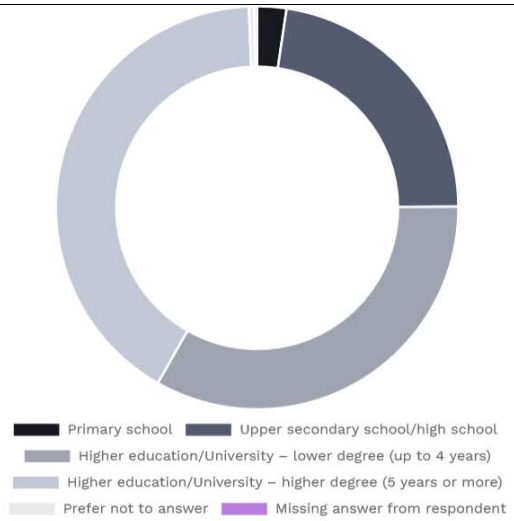


Figure 26: Do you have access to parking near your place of residence?



Income level	%
Below 200 000	5 %
200 000 - 399 999	6 %
400 000 - 599 999	12 %
600 000 - 799 999	12 %
800 000 - 999 999	14 %
1 000 000 - 1 599 999	35 %
1 600 000 - 1 999 999	3 %
1 600 000 - 1 999 999	3 %
2 000 000 and above	2 %
Prefer not to answer	4 %
Don't know	4 %
Missing answer from respondent	0 %

Figure 27: Could you state your household's level of income (NOK before tax)



Education level	%
Primary school	2 %
Upper secondary school/high school	23 %
Higher education/University – lower degree (up to 4 years)	33 %
Higher education/University – higher degree (5 years or more)	41 %
Prefer not to answer	0 %
Missing answer from respondent	0 %

Figure 28: What is the highest level of education you have completed?

4 Using TravelViewer

The project has developed a dashboard to view details of local travel surveys online, to access data and download reports. The new travel survey service is named TravelViewer.

4.1 Data to analyse with TravelViewer

Trivector provides access to the TravelViewer dashboard with the available surveys.
First you can state the true distribution of background variables. These can further be used to produce weights. We chose to weight using real distribution of gender and age groups.

The analysis gives results in three dimensions, as shown in Table 4. These results are weighted. The results can also be aggregated and filtered.

Table 4: Overview of result categories from TravelViewer

Results	
Overview, totals	4.6 trips per person and day 31 km per person and day 111 min per person and day
Trip statistics	Modal split (trips) Modal split (distance) Modal split (duration) Number of trips per day of week Activity distribution (trips) Activity distribution (distance) Activity distribution (travel time) Average distance per trip (mode) Average travel time per trip (mode)
Questionnaire statistics	Gender Number of Addresses (student, commuter) Driver's license Car sharing scheme Commercial driver Occupation Parking condition at work Work sector Working hours Fixed meeting place at work Public transport ticket category Parking condition at home Income Education

4.2 Respondents from Trondheim

For our purpose we excluded respondents below 18 years. The survey was initially only approved for people over the age of majority, by NSD[4]. We did not invite people over 70 to participate, because the penetration rate of smart phones among elderly is lower than for younger people. We also did not want to burden them with technical challenges.

4.3 Experiences with TravelViewer

4.3.1 Detailed information available for all

It is important to keep in mind that this report is evaluating the first version of the travel survey dashboard tool. The concept idea is that transport planners could have an easy to use platform to get an overview of travel behavior data collected by travel surveys. This way the planners get access to results from the survey a lot faster than previously, when they typically had to wait for official reports. A dashboard also opens for more specific results, which might not be included in reports from a travel survey. This could be details about travel pattern for specific groups, on specific days, usage of specific modes or travels within specific purposes.

Traditionally analyses of travel survey data are done in a statistical software program like SPSS, R or Stata. Researchers with access to the data can extract all kinds of specific information from the data set, without using TravelViewer. One advantage with using TravelViewer is that all, regardless of experiences with using statistical software, have the possibilities to get detailed information from the data set.

4.3.2 Prespecified statistics

Selected statistics for trips are specified in Table 2. It is possible to filter out data to select which days, trips or respondent group to exclude, and then get the prespecified results for the remaining trips. Generally, the chosen trip statistic is covering the most interesting and relevant results of a travel survey.

It is possible to aggregate mode and purpose categories. Figure 1 and Figure 3 gives the same results on mode distribution, but the latter has aggregated the modes in wider categories. The aggregation is also prespecified.

4.3.3 Practical issues with TravelViewer

As this was testing the first version of the dashboard, some of the issues mentioned here, might have been changed already.

- The dashboard seems unstable, the session sometimes ended unexpectedly. If it ends, sometimes the distribution for the population, used in weighting, had to be entered again.
- Using several weights (gender AND age) sometimes overloaded the calculation of weights. This might be due to server capacity issues.
- The language can be translated for all headings, questions and labels. However, there were many of these translations, and viewing them, saving them and uploading the translations were unintuitive.

[4] Norwegian Centre for Research data

- It would be useful to aggregate the modes in more flexible way. For instance, it was inconvenient that car driver and car passenger was one joint category.
- When aggregating activities, it should have been possible to adjust the main categories to match the national travel survey aggregates.
- It would have been useful to have a report on number of corrected respondent day per day of the survey period.
- In this report, for some of the results we have manually added %-labels on the distributions, in other we have added a table with the %-shares. This could have been an option in the dashboard.
- The weights calculated is interesting information and could be included.
- When presenting results, to increase the understanding of the results, it would have been useful to include number of respondents and trips for each distribution.

5 Reflections and suggested further development

The TravelViewer dashboard is a useful concept idea to help analyse TravelVu data. The opportunity to get an overview of the data set rather early and easily without previous knowledge about statistical software will probably be valued among transport planners and researchers.

The value of the dashboard could still be higher with further development. In this report some ideas are presented, which would make the dashboard tool more flexible and give even more valuable results.

5.1.1 Flexibility to upload arbitrary data

Now only data collected with TravelVu, and only in its original format, can be uploaded from a local Trivector server and be analysed with TravelViewer.

In a former data collection, we used TravelVu and three different Survey names to link respondents to recruitment method (spring 2019). We did this to measure the effect of recruitment methods. This meant that we have three data sets with the same format, same questions and for the same population. In the dashboard the only option now is to analyse the data separately. Merging the three databases and analyzing them jointly would have made it possible to use TravelViewer for the task.

We found a significant number of reported trips in the fall 2019 data set with unknown purpose. Looking at the tracking and other information about the respondent and destination of these trips, it should be possible to assign purpose to the trips, with a decent amount of certainty. We intend to correct the data set before we do further analyses of it. The corrected data set is not possible to analyse using TravelViewer in its current version.

If possible, any Travel Survey data set should be possible to upload to TravelViewer. Then Travel Surveys carried out with other methods could be analysed using the dashboard tool.

5.1.2 Using other parts of TravelVu data

TravelVu data have three levels of aggregation. What is currently used as reporting unit in TravelVIewer is “delresa” which corresponds to the normal definition of a trip. One of the strengths using TravelVu and tracking rather have the respondent state the time use for segments of their trips, is that the time and distance is measured more accurately. It would be useful to include in the TravelViewer tool a possibility to get information about the segments of the trips, for instance parking time, walking time from the parking area to the destination and travel time components for public transport passenger.

Another strength of TravelVu data compared to traditional travel survey methods is that the app gives information about chosen route. Heat maps for various modes is one way of utilizing this data to show the traffic intensity on different parts of the transport network.

6 References

NTNU

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