TUAS data collection: Corridor 1, E18 Finland Turku/Naantali – Helsinki - Vaalimaa

[WP3 Technical solutions along the corridors: GoA 2020]

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Figure 1: [Intelligent traffic sign on E18 Turku-Helsinki. (Tieyhtiö ykköstie 2016.)]

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1. Introduction

This deliverable document is presenting background, sourcing and initial analysis of traffic data collection on European route E18 in Finland.

Traffic data collection is an activity of Baltic Loop Project WP3, technical solutions along the corridors. Turku University of Applied Sciences (TUAS) is in the project partner organization in charge of data collection on *E18 in Finland on the route Port of Turku / Port of Naantali (FIN) – Helsinki (FIN) – Vaalimaa (FIN/RUS border)*. As the roles, responses and Trans-European east-west traffic corridors in the Baltic Loop Project are decided, *E18 route Örebro (SWE) – Stockholm / Kapellskär (SWE) - Port of Turku / Port of Naantali (FIN) – Helsinki (FIN) – Vaalimaa (FIN/RUS border*) is the northernmost of three east-west corridors investigated in the project, and the route is numbered to be corridor 1 in the project coding and terminology.

The purpose of traffic data collection is to find, combine and analyse traffic data on the corridors to further research in the project. One of the main objectives in the project is to define current state, objects to be improved and suggestions to development within traffic infrastructure, highway and junction capacity, travel time as well as its predictability and reliability, intelligent traffic solutions, traffic safety level and heavy cargo transport oriented services on the corridors. To achieve the objectives mentioned above, it´s necessary to collect and form the data with relevant indicators

and qualitative comments and conclusion. The collected traffic data is also definitely usable in upcoming project activities (accessibility of ports, terminals, logistics centers in the hinterlands of E18 Finland route) managed by TUAS ja Åbo University (AU).

The data is presented in the attached excel file “TUAS DATA COLLECTION”

2. Corridor description and segments

Total length of European route E18 (corridor 1) in Finland on the route Port of Turku / Port of Naantali (FIN) – Helsinki (FIN) – Vaalimaa (FIN/RUS border) is 361 km. In the data collection activity, the route is divided into 13 segments by multiple quantitative and qualitative indicative criteria: Traffic infrastructure type and capacity, major cities, towns and junctions, traffic volume, risk of congestion and delays in the travel time. The reason to divide the route into the certain segments is, that the indicators mentioned above remarkably differ from each other between the segments – traffic flow throughout whole the corridor 1 is far from homogenous and even-distributed.

The corridor segments with general introductory information and initial separation criteria are presented west to east in this document below and attached excel file and visualised in the map below.

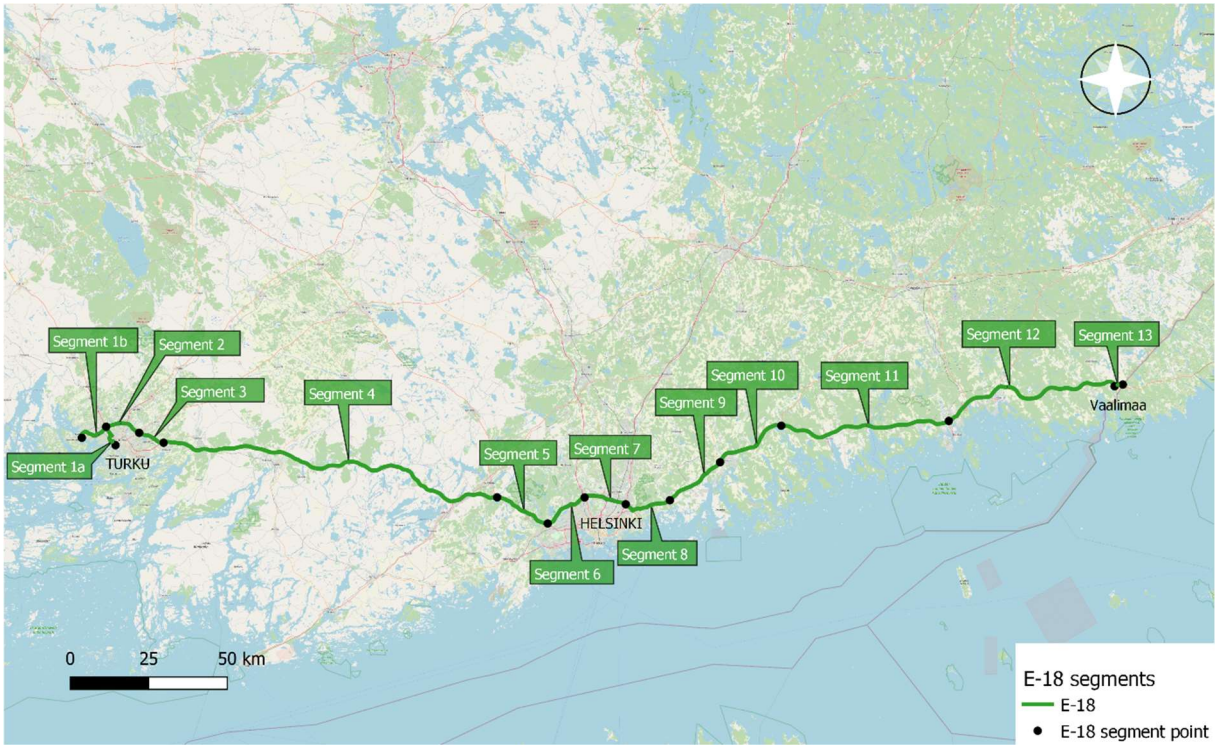

Figure 2. European route E18 (corridor 1) in Finland on the route Port of Turku / Port of Naantali (FIN) – Helsinki (FIN) – Vaalimaa segments in Finland visualised in a map.

Segments 1 to 6 are presented as parts of corridor 1a) (Turku/Naantali – Helsinki Ring III) in the attached excel file.

Segment 1a: Port of Turku – E18/E8 junction Raisio (9,2 km).

The first 6 km of E18 traffic infrastructure from Port of Turku are urban streets. Majorly 2 lanes per direction, traffic signals. The last 3 km to the end of segment 1a is motorway, 2 lanes per direction. (National Land Survey of Finland 2020.)

There is a shorter urban street network connection from Port of Turku to west end of Turku – Helsinki motorway via centrum of Turku. However, cargo traffic is guided by

static traffic signs to use E18 Turku ringway to enter and exit Port of Turku. It´s forbidden to drive through centrum of Turku with semitrailer, full-trailer and multi-trailer vehicle combinations with total length > 15,0 m. (Traffic Management Finland 2020.)

The segment is vulnerable to congestion and interference. There are regular daily traffic congestion (delays 10 to 15 min) in three sections: Streets close to Port of Turku Truck check-in and exit (around RO-PAX ferry departures and arrivals). Junction E8 / road 1851 in Turku Härkämäki (traffic signals) mon-fri 7:30 to 9:00 and 15:30 to 17:00. Junction E8 / E18 in Raisio (traffic signals, motorway exit traffic merging to urban traffic) mon-fri 7:30 to 9:00 and 15:30 to 17:00. (Traffic Management Finland 2020.)

Segment 1b: Port of Naantali – E18 / E8 junction Raisio (10,3 km).

Throughout segment 1b, major sections are urban streets and suburban roads, 1 to 2 lanes per directions. There are no interchange junctions on the segment, all the junctions are intersections with traffic signals or "yield" traffic signs. (National Land Survey of Finland 2020.)

The segment is vulnerable to congestion and interference. All the traffic congestion is common mon-fri 7:30 to 9:00 and 15:30 to 17:00, with total delays of 10 to 15 mins. E18 / Road 185 intersection with "yield" traffic sign. E18 Raisio Town center, several traffic signals, insufficient traffic capacity of street. Junction E8 / E18 in Raisio (traffic signals, motorway exit traffic merging to urban traffic). (Traffic Management Finland 2020.)

Segment 2: E18 / E8 junction Raisio – E18 / highway 10 junction Auranlaakso Kaarina (16,1 km).

Start of the segment in Raisio with its infrastructure and vulnerability is presented in the previous chapter.

East of Raisio centrum, the road infrastructure type is highway, two driving lanes per direction with interchange junctions. The driving directions are separated by central zone and railings. (National Land Survey of Finland 2020.)

In the east end of the section, there are common moderate traffic congestions and queuing (delays 5 to 10 min) mon-fri 7:30 to 9:00 and 15:30 to 17:00. The reason to congestions in the east end (highway 10 junction is), that east of the junction separated driving directions with mid-railing will end and 2 lanes per direction will be merged into 1 lane per direction. (Traffic Management Finland 2020.)

The bottleneck in the east end of segment 2 mentioned above is already started to be expanded. New improved highway with two driving lanes per direction, separated driving directions and interchanges are under construction, completed in 10/2021. Before the new highway is completed, regular congestions occur due to road construction with temporary traffic arrangements and decreased speed limits.

In several junctions on the segment, the acceleration and exit lanes are too short with merging and exit traffic problems and queuing.

Segment 3: E18 / highway 10 junction Auranlaakso Kaarina – E18 Turku Ringway / Helsinki motorway junction Kaarina East (8,5 km).

Throughout the segment, new improved highway with two driving lanes per direction, separated driving directions and interchanges are under construction, completed in 10/2021. Before the new highway is completed, regular congestions occur due to road construction with temporary traffic arrangements and decreased speed limits.

Segment 4: E18 Turku Ringway / Helsinki motorway junction Kaarina East – E18 / Highway 2 junction Vihti Palojärvi (113,0 km).

This segment is a long rural motorway segment between Turku and Helsinki. There are two driving lanes per direction throughout the segment.

Majorly, traffic flow on the segment is fluent because of modern motorway type, less than critically high number of vehicles per time unit and capacity as well as intelligent traffic management signs on the motorway. Travel times throughout the segment are rather reliable and predictable. However, in the east end of segment 4, where highway 2 traffic is merging to E18, there is daily queuing with slight delays mon-fri 7:00 to 8:30 and 16:00 to 17:00. There are also several motorway tunnels between Muurla and Lohjanharju. It´s not uncommon to close tunnels due to maintenance and repair operations, if one tunnel is closed, both the driving directions are guided to one tunnel with 1+1 lane arrangements and low speed limits. On the tunnel section and east of it, there are intelligent traffic management signs (road conditions, congestions, accident, estimated travel time). (Traffic Management Finland 2020.)

Segment 5: E18 / Highway 2 junction Vihti Palojärvi – E18 Ring III West junction Espoo (17,9 km).

This segment is quite a busy commuting route to Helsinki Region. Throughout the segment, highway type is motorway with two lanes per direction. (National Land Survey of Finland 2020.)

Because of high traffic volume and only two lanes per direction, there is regular queuing and delays of 5 to 10 minutes mon-fri 7:00 to 8:30 (east direction) and 15:30 to 17:00 (west direction). The closer to Helsinki, the slower traffic flow. Intelligent traffic management signs (road conditions, congestions, accident, estimated travel time) are available throughout the segment. (Traffic Management Finland 2020.)

Segment 6: E18 Ring III West junction Espoo – E18 / E12 Ring III junction #39 (15,2 km).

This segment is a part of the farthest ringway (Ring III) of Helsinki. The closest ringway of Helsinki (Ring I) is the other option to pass Helsinki metropolitan area without urban driving. However, Ring III is taken into account of more detailed investigation, because long-haul traffic in east-west direction is guided to drive via Ring III as a part of E18

route by traffic signs. Ring III is also serving multiple logistics, industrial and business centers in Espoo and Vantaa – e.g. several domestic distribution centers as well as Finnish domestic and international hub airport Helsinki-Vantaa are located close to Ring III. (National Land Survey of Finland 2020.)

Ring III road type on segment 6 is a highway with separated driving directions, 2 to 3 lanes per direction. All the junctions are interchange. (National Land Survey of Finland 2020.)

More regular traffic congestion occurs on the eastern half of segment 6 (city of Vantaa administrative area) of the section. The highway standard in Vantaa area is older and partly insufficient to the current traffic flow. On the western half (city of Espoo administrative area) the highway standard is modern with higher capacity. Average delays 5 to 10 mins mon-fri 7:00-9:00 and 15:30-17:00. (Traffic Management Finland 2020.)

Segments 7 to 13 are presented as parts of corridor 1b) (Helsinki Ring III – Vaalimaa FIN/RUS border crossing station) in the attached excel file.

Segment 7: E18 / E12 Ring III junction #39 – E18 / E75 Ring III junction (13,3 km).

This segment is absolutely the busiest one on E18 route in Finland. The busiest traffic observation point on the segment is located around Helsinki-Vantaa airport west junction (shopping mall Jumbo). Average daily traffic flow at the point is almost 94 000 vehicles per day. At the busiest point, there are 4 to 5 lanes per driving direction. All the junctions are interchange type. (National Land Survey of Finland 2020; Finnish Transport Infrastructure Agency 2019.)

Almost throughout the segment, there is one bus/taxi/cargo lane per direction. Only busses, taxis and cargo vehicles allowed to drive on the lane during daily peak hours. There are also several separated bus stop traffic channels at junctions. (National Land Survey of Finland 2020; Traffic Management Finland 2020.)

The most common bottlenecks on the segment are: The busiest junction (Airport west, Jumbo), multiple traffic flows are merging to one ringway in one multi-channel junction. E18 Ring III / E75 junction. In the latter junction, the major problem is, that there are three sequential junctions (Porttipuisto / Ikea, E75 and old E75 (road 140) very close to each others with too short acceleration and exit lanes and traffic merging areas. Delays of 10 to 20 mins occur mon-fri 07:00-09:00 and 15:30-17:00. (Traffic Management Finland 2020.)

Segment 8: E18 / E75 ring III junction - E18 junction #56 Sipoonlahti (15,2 km).

There are two different highway segment types on segment 8: The western part is E18 Ring III between E75 and Helsinki – Vaalimaa motorway junctions. The eastern part is E18 motorway between Ring III junction and junction #56 Sipoonlahti. Ring III segment is a highway with 2 to 3 driving lanes per direction, speed limit 80 km/h. On the eastern motorway segment, there are majorly two driving lanes per direction with a few separate bus lanes and bus stop connections, speed limit 100 to 120 km/h. (National Land Survey of Finland 2020; Traffic Management Finland 2020.)

The most vulnerable junctions on the segment are located in the west end of segment (E18 / E75 ring III junction) and presented above in chapter “segment 7”. In the junction E18 ring III / motorway E18/7, the congestion type, severity, direction and reasons are totally unsimilar between morning and afternoon peak hours. In the morning (mon-fri 7:00 to 8:30), there is a high number of commuting traffic with passenger cars and buses on highway 7 westbound to Helsinki, and the peak direction is westbound. In the afternoon (mon-fri 15:30 to 17:00), the commuters are driving on highway 7 east of Helsinki, and a lot of long-haul transportation from ring III are merging to the main traffic flow in the junction E18 ring III / motorway E18/7. Average delays in travel time during on the segment are 5 to 10 minutes on peak hours to peak direction. (Traffic Management Finland 2020.)

Segment 9: E18 junction #56 Sipoonlahti - E18 junction #60 Porvoo West (19,8 km).

This segment is a motorway segment on the eastern commuting region of Helsinki. There are two driving lanes per direction, speed limit 100 to 120 km/h.

On the segment, the average daily traffic flow is not critically high to traffic capacity by infrastructure type. During morning and afternoon peak hours, there is typically slight to moderate queuing and it is often impossible to achieve driving speed up to speed limit with passenger cars. However, during most of the peak hours, the traffic flow is typically running with driving speed of 80 to 90 km/h, which is not delaying heavy cargo transport. In certain exceptional cases (dangerous weather conditions, accidents and holiday traffic on weekends and holiday eves), there is more severe congestion throughout the section. (National Land Survey of Finland 2020; Traffic Management Finland 2020.)

Segment 10: E18 junction #60 Porvoo west - E18 / Highway 6 junction #65 (23,8 km).

This segment is a rural motorway segment beyond metropolitan and commuting areas of Helsinki. Traffic infrastructure type is a modern and fluent motorway, two lanes per direction, speed limit 100 to 120 km/h. (National Land Survey of Finland 2020; Traffic Management Finland 2020.)

On segment 10, the major long-haul transportation flows have typically three origins or destinations east of the segment: International transportation between Finland and Russia via Vaalimaa border crossing station, domestic / international / transito transport to port of Haminakotka and domestic / international land / multimodal transport to inland regions of South-Eastern Finland (e.g. the major regional distribution centers within grocery and industry in South-Eastern Finland as well as international railway cargo hub are located in Kouvola on highway 6, not in Kotka).

Because average daily traffic on the section is far from critically high to traffic capacity by infrastructure type, the daily traffic flow is typically smooth and fluent. The only slight bottleneck on the section occurs in the east end of the section (junction E18 / Highway 6 Koskenkylä). The reason to queuing is, that the exit ramp to highway 6 is not very

capable because traffic is queuing on highway 6 (1 + 1 lane highway). However, this kind of problem occurs typically only on friday afternoons and holiday eves to direction east, because a lot of vehicles and are driving to highway 6 to have holidays in Eastern Finland.

Segment 11: E18 / Highway 6 junction #65 - E18 / Highway 15 junction #74 Kotka Kyminlinna (54,0 km).

This segment is a rural motorway segment beyond metropolitan and commuting areas of Helsinki. Traffic infrastructure type is a modern and fluent motorway, two lanes per direction, speed limit 100 to 120 km/h. Average daily traffic throughout the section is low to moderate, and remarkable queuing exist only in exceptional cases (dangerous weather and road conditions, accidents). (National Land Survey of Finland 2020; Traffic Management Finland 2020.)

Segment 12: E18 / Highway 15 junction #74 Kotka Kyminlinna - E18 Vaalimaa FIN/RUS border crossing station (61,0 km).

This segment is the easternmost motorway segment of E18 route Finland. The motorway is opened to traffic in 2016 and has a modern standard with fluent and safe geometry and junctions as well as intelligent traffic management systems. (Traffic Management Finland 2020.)

In the west end of the segment, the average daily traffic is locally higher due to commuter traffic in Kotka region (approx. 32 000 vehicles per day between the busiest junctions). Therefore, during the peak hours and close to the busiest junctions, there is typically slight to moderate queuing and it is often impossible to achieve driving speed up to speed limit with passenger cars. However, during most of the peak hours, the traffic flow is typically running with driving speed of 80 to 90 km/h, which is not delaying heavy cargo transport. The easternmost 35 km of motorway are really still with averagy daily traffic of 4 000 to 5 000 vehicles. In the east end where E18 motorway ends 2 km west of FIN/RUS border, there is slower traffic infrastructure

(Roundabout, last mile highway with speed limit of 60 km/h, border crossing station and truck parking area), where the traffic flow depends on number and type of border-crossing vehicles and capacity of customs operations. (Traffic Management Finland 2020.)

Segment 13: E18 Vaalimaa FIN/RUS border crossing station

Vaalimaa is the busiest border crossing station between Finland and Russia. At the border crossing station, Vehicles must stop. There is passport and visa control to all the passenger as well as vehicle and cargo control (transportation and vehicle documents and permissions, load securing, axle and total masses, etc.). The border crossing station is open 24/7/365. (Customs of Finland 2020.)

At Vaalimaa, there is a large parking and waiting area targeted to trucks and trailers. In early 2000´s before the truck park was opened, border crossing station capacity increased and E18 motorway to Vaalimaa completed, there were enormous truck and trailer queus (queue lenth up to 60 km, waiting times of several days). (Customs of Finland 2020; Traffic Management Finland 2020.)

3. Data collection by type and source

With reference to *Work Package 3 Technical solutions along the corridors* meetings, the common traffic data indicators throughout all the three corridors and managed by defined partners in charge have decided to be the following:

A. amount of all traffic (absolut average number of vehicles/day)
B. peak hour (absolute average number of cargo vehicles/day and what time)
C. amount of passenger traffic (amount of daily average; number/day)
D. amount of heavy load transportation (absolute average number of cargo vehicles/day)

E. travelling times for trucks between sectors (average travelling time between points)

The data indicator A to E by corridor 1 segment are presented in the attached excel file on tab “main data”.

In addition to the main data indicators, the project partners in charge of data collection per corridors and segments were guided to create and develop optional data indicators to make data collection more reliable and genalized. The optional data indicators could be decided by remarkability, avaibility and own interests and expert areas of partner organizations and authors. Based on the criteria mentioned above, the following optional data indicators (presented in the attached excel file on tab “optional data”) have been created and data collected by TUAS and the author:

F. Maximum amount of traffic on the segment (busiest intersection / data collection point, number of vehicles per day).
G. Highway + street type
H. Speed limits
I. Jucntion types
J. Bottleneck description
K. Other

The data collection methodology and sources as well as initial analysis and separation criteria are presented below in alphabetical order of indicators.

A. amount of all traffic (absolut average number of vehicles/day)

Amount of all traffic (average number of vehicles per day; ADT) is a crucially relevant traffic data indicator due to several reasons. The amount of all traffic compared to infrastructure type and capacity (street / road / highway type, number of lanes, junction

types, traffic management systems, etc.) is strongly mirroring, whether the traffic flow during or even beyond peak hours is fluent, queuing or moderately or severely slow or stopped, is the traffic infrastructure vulnerable or not, and as a real important issue also: what is the number of vehicles, cargo and passengers passing the segment and facing any conceivable negative or unexcepted effects on travel time?

The amount of all traffic throughout E18 route Finland is collected from Finnish Transport Infrastructure Agency (2019) electronic traffic volume maps. Finnish Transport Infrastructure Agency is collecting, maintaining and disseminating multiple forms of open traffic infrastructure data in Finland. A screenshot of the traffic volume map is presented in figure 2.

The traffic volume data in the traffic volume map is collected by sensors in the road / highway infrastructure. The numbers on the colored public road sections are presenting amount of all traffic per day in the map.

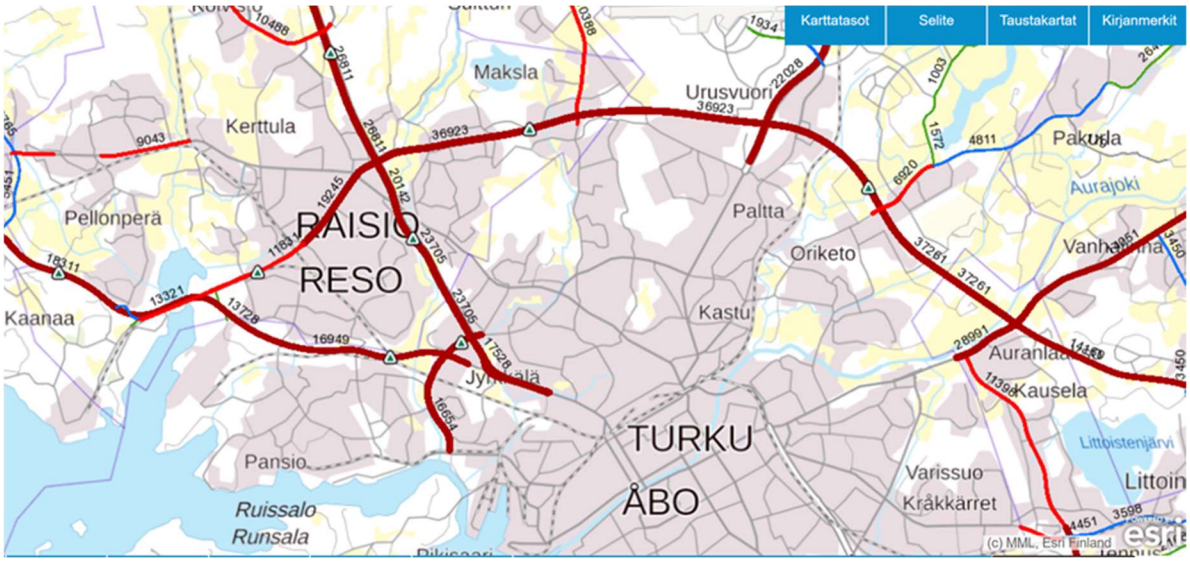

Figure 2: [Traffic volume map. (Finnish Transport Infrastructure Agency 2019.)]

B. peak hour (absolute average number of cargo vehicles/day and what time)

Absolute average number of cargo vehicles during the peak hour is an indicator with roles of both explained and explanatory variable. The indicator is explained by amount of all traffic per day (ADT, data indicator A.), percentage amount of traffic during the peak hour of all traffic per day, and absolute average number of cargo vehicles per day (data indicator D.) However, data indicator B. is also partly explaining, what is the quantitative significance of bottleneck to delays in cargo flow, if there are any delays on the section.

To trace data indicator B., automatic traffic measurement report books (*LAM-kirja*) managed by Finnish Transport Infrastructure Agency & Centre For Economic Development, Transport and the Environment, Finland (2018) was used as source material. The data in the book is collected from sensors in road infrastructure and supported by traffic cameras. In the report book mentioned above, there are detailed descriptions of traffic flow profile from measurement points: Traffic volume on weekdays mon-fri vs. full weeks, traffic concentration per vehicle type (passenger cars, vans, busses, trucks and different trailer combinations), percentage of heavy cargo vehicles, seasonal quantitative variety in traffic flow, time series diagrams about development of traffic volumes, variety between weekdays, hourly distribution with percentage peak hour vs. total daily traffic and traffic volume separated by driving directions.

To combine data into a relevant form of indicator B., the following calculations were made:

1) Percentage of heavy cargo transport * absolute average number of vehicles per day = Absolute average number of heavy cargo transport vehicles per day (equal to data indicator D.)

2) Absolute average number of heavy cargo transport vehicles per day * Percentage number of vehicles during the peak hour of absolute average number of vehicles per day = Absolute average number of cargo vehicles during the peak hour (data indicator B.)

A screenshot of traffic data report book is presented in figure 3.

Figure 3: [Automatic traffic measurement report book (LAM-kirja). (Finnish Transport Infrastructure Agency & Centre For Economic Development, Transport and the Environment, Finland 2018)]

C. amount of passenger traffic (amount of daily average; number/day)

Average amount of daily passengers is a variable explaining the following issues: How busy is the corridor section in terms of passengers? How many passengers can be delayed, is traffic flow is delayed on the section?

To define the average amount of daily passengers, the following data was sourced:

- Number of vehicles per type (busses vs. other vehicles separated). (Finnish Transport Infrastructure Agency & Centre For Economic Development, Transport and the Environment, Finland 2018.)
- Average number of passengers per vehicle by vehicle type (Finnish Transport Agency, Traffic and Land Use 2018).

Finnish Transport Agendy has published a report “National Traffic Survey 2016” in 2018. In the survey, it was concluded by multiple passenger interviews and surveys as well as statistics from authorities and transportation operators, that the average number of passengers in passenger cars and vans in Finland is 1.33 (driver + 1/3 passengers). In the same survey, it was concluded that the average number of passengers is bus in Finland is 13.3.

An example calculation, how the average amount of passengers was calculated per section:

- Absolut average number of vehicles per day (A.) = 30 000
- Percentage of buses = 1,0 %

- Absolut average number of buses per day = 0,01 * 30 000 = 300
- Absolut average number of other vehicles than buses is equal to
  Absolut average number of vehicles per day minus absolut average number of buses per day = 30 000 – 300 = 29 700
- Average amount of passengers per day is equal to
  *Absolut average number of other vehicles than buses * 1,33 passengers per vehicle + Absolut average number of buses per day * 13,3 passengers per bus = 29 700 * 1,33 + 300 * 13,3 = 43 491 passengers per day*

D. amount of heavy load transportation (absolute average number of cargo vehicles/day)

Data collection methodology and sources or data indicator D. are explained in the second previous chapter, where collection of amount of cargo vehicles during the peak hour (data indicator B) is presented.

E. travelling times for trucks between sectors (average travelling time between points)

Unfortunately, average travelling time between points could not be collected with planned methodology on time. The travelling time data is currently missing (end of March, 2020).

It was planned and agreed within TUAS Baltic Loop research team and Finnish transportation operators who have agreed to be associated partners or stakeholders in the project, that to collect authentic travel time data, TUAS Baltic Loop team members and their students will travel in cargo vehicles of transportation operators across E18 Finland route in March 2020 with timing and tracking applications. However, the empirical time measurements were delayed due to COVID-19 pandemy. To prevent COVID-19 expansion, the transportation operators were not allowed to take extra passengers with their vehicles. The traffic flow situation during COVID-19 restrictions is also far from usual: On the other hand, number of vehicles on E18 route Finland has decreased 20 to 30 % in comparison to March 2019, and there is not traffic congestion in any typical vulnerable spot or section. On the other hand, E18 route Finland is running across three parallel administrative province regions in Finland: The province of South-West Finland (in the west), the Province of Uusimaa (in the middle) and the province of South-East Finland (in the east). From March 28th to April 19th, 2020, there are road closures with barriers and police and military patrols at all the provincial borders of Uusimaa. Only cargo transport as well as absolutely necessary passenger transport are allowed to cross the provincial border Despite the traffic flow across provincial borders of Uusimaa is significantly low during the closure, there can be remarkable delays at the closure checkpoints when vehicles are stopped to check permission and reason to cross the borders, which can make extraordinary delays to travel time.

The travel time data will collected later in 2020, after COVID-19 restrictions are ended.

F. Maximum amount of traffic on the segment (busiest intersection / data collection point, number of vehicles per day).

Maximum amount of traffic on the segment is a relevant indicator to find existing and potential bottlenecks. It was sourced from Traffic data map of Finnish Transport Infrastructure Agency (2019) in equal methodology to indicator A. (average amount of total daily traffic). Typically, the maximum amount of traffic on segments is located close to metropolitan areas, where two or more busy highways are merging with interchange junctions and regional commuting traffic is mixed with long-haul traffic.

G. Highway + street type

Indicator highway and street type is a mixed quantitative-qualitative indicator. The indicator is defined by the following criteria:

- Urban street / public road / highway / motorway
- Number of lanes per driving direction
- Driving directions separated / encountering

Highway and street type effects strongly in traffic capacity (vehicles per hour / day), speed, service level, reliability and predictability of traffic flow and traffic safety.

The highway and street type data was collected from Public open land use and infrastructure map (National Land Use Survey of Finland 2020).

H. Speed limits

Speed limits itself affect on target speed, average speed and actual speed of traffic flow. The speed limits were collected from open traffic situation data and speed limit maps of Traffic Management Finland (2020).

I. Junction types

The indicator is defined with the following options:

- Intersection vs. interchange
- Traffic control and yield regulations and technology: Traffic signals yes/no, “yield” traffic signs, roundabout, etc.
- What kind of highways / roads / streets are linked by the junction?

Junction types have been sourced from Public open land use and infrastructure map (National Land Use Survey of Finland 2020).

J. Bottleneck description

Bottleneck description is a qualitative free-of-form description about one or more bottlenecks on the segment. The description is sourced as a combination of indicators A to I, preliminary interviews of transportation operators and author´s own experience of driving across E18 route Finland with several different type of vehicles, times, dates and seasons.

The following criteria and issues have been taken into account when bottlenecks are described:

- Bottleneck location? Certain spot or longer segment?
- Capacity, type and performance of infrastructure vs. traffic flow at the bottleneck
- The reason, why do the bottlenecks occur?

Previously in this document, where corridor segments 1 to 13 are presented, there are several miscellaneous bottleneck descriptions in the segment presentation chapter.

K. Other

Other data is defined, if there has found any miscellaneous extra data relevant to traffic flow and infrastructure but beyond data indicators A to J. For example, the following data types are consideres as other data:

- Highway under construction, temporary traffic arrangements
- Bus lanes and public transport corridors
- Intelligent traffic management systems

Depending on the other data type, the source material has been one or more references mentioned in chapters data indicators A to J.

4. Conclusions, analysis and recommendations of further research.

The collected traffic data is majorly reliable, objective and authentic. In Finland, public authorities under administration of Ministry of Transportation and Communications Finland and Ministry of Economic Affairs and Employment Finland are constantly collecting, maintaining and disseminating detailed, reliable and topical open data on multiple platforms. Excellent open traffic and infrastructure data sources in Finland made data collection rather effortless.

However, a couple of data types were not collected in the most detailed and analytic way. Defining amount of passengers crossing E18 section was generous with only nationwide averages of passengers per vehicle type. At least utilization uf bus passenger capacity is varying very strongly throughout E18 route Finland, and the

actual number of bus passengers in any spot can be far from calculated value. However, it would have been very time-consuming and complicated to define exact actual number of bus passengers in all the sections, because bus passenger data in Finland is very decentralized between authorities, operators, bus line types and routes. Because number of passengers and delays in travel times of bus / passenger car passengers is currently agreed to be secondary indicator out of core objectives of this Work Package, any more detailed passenger statistics were not traced at this stage.

As mentioned in chapter 3 subtitle “E. average travel times between sectors”, the travel time data collection was delayed due to COVID-19 pandemic.

Currently, the most remarkable bottlenecks on E18 route Finland are located at the west end of the corridor (Port of Turku / Port of Naantali – Raisio), Turku Ringway between highway 10 and Helsinki motorway (under construction) and close to Helsinki metropolitan area. It will be discussed in the next steps of the project, how to extend the bottlenecks.

This traffic data collection is also usable and necessary to several upcoming activities in the project. In April – June 2020, rate and vulnerability of traffic congestion and heavy transport density on the corridor will be visualized to map applications by TUAS Baltic Loop project team. Connections from E18 and its junctions to major terminals, distribution and logistics centers, long-haul and international transportation customers and major Finnish Baltic Sea Ports will also be investigated by TUAS and ÅU. Current state and development ideas of long-term parking and rest areas of heavy transport besides E18 route Finland will also be analysed.

References

Centre for Economic and Development, Transport and the Environment, Finland (2020): Border crossing statistics of heavy cargo transport vehicles between Finland and Russia at Border Crossing stations in South-Eastern Finland. Traffic Management Finland. Referred 26.03.2020. http://www.ely-keskus.fi/documents/10191/20880579/Raskasliikenne+raja-asemilla+99-20+yht+helmikuu-20.pdf

Customs of Finland (2020): Statistics on Logistics. Referred 23.03.2020. https://tulli.fi/en/statistics/statistics-on-logistics

Finnish Transport Agency, Traffic and land use (2018). National Traffic Survey 2016. Statistics from the Finnish Transport Agency 1/2018. 113 pages and 3 appendices. ISSN-L 1798-811x (pdf), ISSN 1798-8128 (pdf), ISBN 978-952-317-513-6 (pdf).

Finnish Transport Infrastructure Agency (2019): Traffic volume map. ESRI Finland. Referred 24.03.2020. https://vayla.fi/web/en/maps-charts/traffic-volumes

Finnish Transport Infrastructure Agency & Centre for Economic Development, Transport and the Environment, Finland (2018): Automatic traffic measurement report book (LAM-kirja). Referred 24.03.2020. https://vayla.fi/documents/20473/23735/Varsinais-Suomi+2018+%28pdf%29.pdf/fd407099-39ec-41c4-b344-83fda171056a

National Land Survey of Finland. Public open land use and infrastructure map. Referred 23.03.2020. https://asiointi.maanmittauslaitos.fi/karttapaikka/

Tieyhtiö Ykköstie Oy (2016): Motorway E18 Lohja – Muurla. Referred 30.03.2020. http://www.ykkostie.net/index.html

Traffic Management Finland. Traffic situation. Referred 25.03.2020. https://liikennetilanne.tmfg.fi/?lang=fin