Improving the internal logistics of the cargo terminal

Baltic Loop, WP 3

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Introduction

Background of the research

The research was done as part of the Baltic Loop project. The goal of the Baltic Loop project is to reduce the transit time for people and goods as well as CO2 emissions on three west-east corridors from Örebro in Sweden to St. Petersburg in Russia. The northern corridor passes through Turku, the middle through Tallinn and the southern through Riga to St. Petersburg. The project aims to reduce traffic barriers as well as the impact of bottlenecks on these corridors in order to intensify traffic. (Baltic Loop 2021.)

Figure 1 The corridors of the Baltic Loop project

The Baltic Loop project was looking for a modern and contemporary general cargo terminal operator as a partner, where the data desired for the project could be collected and measured. DB Schenker's terminal was selected as a partner at Avanti in Lieto. In August 2020, a terminal was opened in Avanti, which is their second largest terminal in Finland. The terminal size is 14,000 m2 in, in addition to which there is 3,300 m2 of unheated storage for long and heavy goods. In addition, there is a 500-m2 wing for loading vans. There is also a 50m long line for sorting packages with a capacity of 4,500 packages per hour. There are 106 loading doors in the terminal.

There are 41 electronic load-handling devices in the DB Schenker terminal. Of these, 20 are counterbalanced forklifts; there are two pallet trucks for moving two pallets, 4 pallet trucks for moving one pallet, 11 pallet trucks for walking, two stackers and two pick-up trucks. (DB Schenker 2021.)

Objectives of the research and the research problem

The purpose of this study is to speed up the transit time of goods inside terminal gates. The aim is to find out where and how much time is spent in the various terminal functions and how the goods travel inside the terminal. The aim is to eliminate unnecessary work and movement in the movement of goods and to make proposals for speeding up the transit time of goods in order to speed up the flow of goods to the end customer. The purpose of this work is not only to provide DB Schenker Oy with proposals for speeding up the goods, but also to present proposals related to the Baltic Loop project for speeding up the lead times of the goods in the terminal area. Meaning that no matter whose terminal it is. Accelerating the transit time of goods at the terminal will increase the efficiency of the use of working time and the terminal will be able to handle larger volumes. This creates productivity, ecology and gives the terminal a competitive advantage over other competitors.

Transport unit loading and loading times were not studied in this research. Those times depends on many factors, such as the quality, shape, weight, quantity of the goods and the arrival of the goods on their own plot at the terminal. In addition to this, the professionalism of the loader has a great importance for the time-spent loading. The optimal layout of the terminal was also not addressed in this research.

Research methods

The data collection of the study was carried out with a positioning system developed by Noccela Ltd. Thirty anchors were installed in the DB Schenker terminal to cover the entire terminal for data collection. The cargo handling equipment at the terminal was equipped with tags that sent a signal to the anchors in real time. This made it possible to analyze certain desired time intervals using computer software (see Appendix 1). The data collection phase of the study began in February 2021, when monitoring equipment for the collection of statistical data was installed in DB Schenker's terminal in Lieto as well as in the goods handling equipment inside the terminal were tagged. At the same time, observation visits were started for the internal logistics of the terminal and making the overall picture. Terminal staff were interviewed based on the survey and the interviews were recorded. There were 15 terminal employees interviewed, which corresponds to about 25% of all terminal employees. In this study, the results of staff interviews are presented so that the respondent is not identified and the responses to the interviews were recorded.

Previous studies

Previous studies for the development of terminal internal logistics using the method used in this study were not found, in which the distance and time traveled by machines and shipments are measured using tracking devices.

Timo Hukki studied the use of forecasts as part of internal logistics resourcing in 2019. The study found that forecasts are relatively accurate, but daily forecasts cannot be used in labor resourcing (Hukki 2019). Micael Laaksonen did a master's thesis on the development of internal logistics in a logistics center in 2017. He states that the terminal needs information displays as well as touch screens to be installed on forklifts so that the employee can do his job better and more transparently (Laaksonen 2017). Jussi Puputti studied the impact of automation and digitalisation on future internal logistics in 2020. In conclusion, he notes that the importance of automation and digitalization will be emphasized in terminals in the future (Puputti 2020). Rikke Kujala studied the use of RFID technology in internal logistics in his thesis in 2019. Her conclusions were that the use of RFID technology has been low and prevalence slow. This is because there is no standard, the price is high and there is no guarantee of a return on investment. She also noted that there would be significant benefits for using RFID technology, but still recommends utilize the barcode. (Kujala 2019.) Tomas Kučera researched the development of the warehouse ERP system and cost savings in 2017. In the study, his conclusions were that developing an ERP system by reading barcodes saves time and money (Kucera 2017). Marek Karkula studied the criteria for the selection of internal logistics simulation models in logistics facilities in 2014. In conclusion, he notes that terminals need modern and efficient internal logistics systems. He also stated in his study that it is best for a forklift driver to take the next job close to the end of the previous one so that idling is kept to a minimum. (Karkula 2014.) Anna Wronka researched the LEAN idea in logistics in 2016. Her conclusions were that the LEAN idea model is well suited for logistics in both indoor and outdoor logistics. Changing the mindset of employees and the commitment of management to this are the foundation of everything and determine the result. (Wronka 2016.)

Implementation of the study

The research collected data using statistical and qualitative methods. The data collection phase of the study began in February 2021 and ended in May 2021. Data were collected through a location system, observation visits, and staff interviews. Transport unit loading and unloading times were not studied in this research. The time of this depends on many factors such as, for example, the quality, shape, weight, quantity and arrival of the goods on their own plot. In addition to this, the professionalism of the loader is a big factor in the time-spent loading. The optimal layout of the terminal was also not addressed in this study.

Data collection using a positioning system

The data collection of the research was carried out with a positioning system developed by Noccela Oy. In February 2021, monitoring equipment was installed in DB Schenker's terminal in Lieto and tags were placed to the goods handling equipment inside the terminal. Thirty anchors was installed in the DB Schenker terminal to cover the entire terminal for data collection. The monitoring devices were installed on all the machines in the terminal and in addition the tags were attached to the pallets arriving at the terminal. A total of 70 tags were used. Noccela uses the Ultra-Wide Band (UWB) as its technology and its own High-performance Ranging (HRP) positioning method. The anchors use tags to collect the information and send this information to the cloud, where the actual calculation and analysis is performed. The data can also be sent to third-party applications using a programming interface (API). The Noccela tag does not need to be read, but the location sign for that the goods have arrived or left. The appendices show an example of what information can be obtained from the system (see Appendix 1). (Noccela Oy 2021.)

Tags were also installed on packages arriving at the terminal, mainly on pallet goods. A total of 71 of these were installed on two different days. This therefore means that the sample was very small for the proportion of goods passing through the terminal on a daily basis. The survey results therefore make generalizations about the details based on individual observations.

Lines from three different categories were selected for the study. The first included consignments arriving at the terminal from Sweden and the second was consignments arriving at the terminal from the Turku area and neighboring municipalities in Turku. These shipments continued transport to different parts of Finland. The third category to be examined included packages leaving Helsinki and Tampere for export. Some of these left the terminal the same evening. The lines to be examined were the monitoring of packages of transport units unloaded at the terminal from Sweden and the Turku area, the destinations of which were Helsinki, Tampere, Seinäjoki and Kuopio. In addition to this, tags were also placed in other directions, but this research addressed these only at a general level.

Data collection trough observation and interviews

At the same time, in February 2021, when the positioning system was installed, observation visits to the terminal began. The aim of these visits was to form an overall picture of the terminal's internal logistics. Observation visits were made to the terminal six times. The days were usually Wednesday or Thursday because on these days, the terminal was operating normally and the weekend effects were not reflected in the flow of goods.

During the observation visits, the movement of the goods from the terminal gate to the transport unit leaving was examined. Observations were made for general piece goods and household appliances. Household appliances are included separately because these are handled by a

different forklift. The interview was conducted using the ideals described by Hirsjärvi and Hurme (2001) for the interview. Terminal staff were interviewed according to pre-prepared questions. There were 10 questions and the interviews were recorded. In this study, the results of staff interviews are presented so that the respondent is not identified. The interviews were conducted on two different days and at different times. One during the morning and another during the afternoon. A total of 15 terminal employees were interviewed. These employees were randomly selected for interview from among those on duty. The management approved the interviews. The interviews were given voluntarily, anonymously, and the responses to the interviews were recorded. One interview lasted an average of 7 minutes.

Results

Data generated by the positioning system on the transport route Sweden Helsinki

The study monitored the movement and time of 16 different packages at the terminal on the transport route Sweden-Helsinki on two different days; 6 May 2021 and 19 May 2021 (see Appendix 1 for examples of the data produced). Incorrect measurement results came from the two packages being tracked. These are not included in the results.

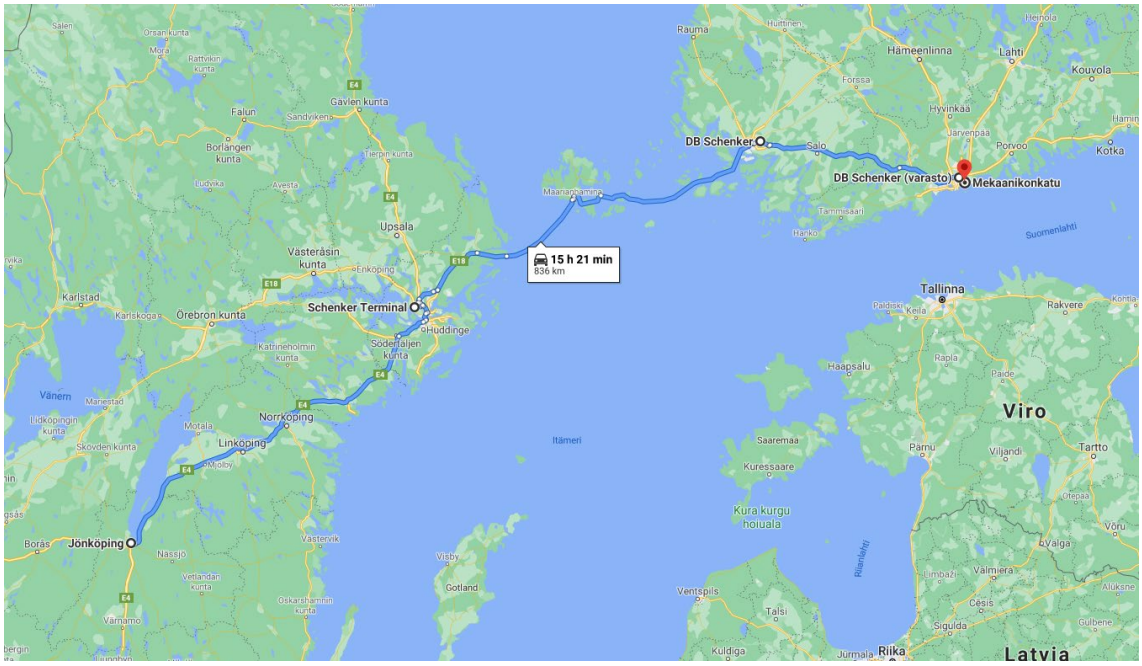
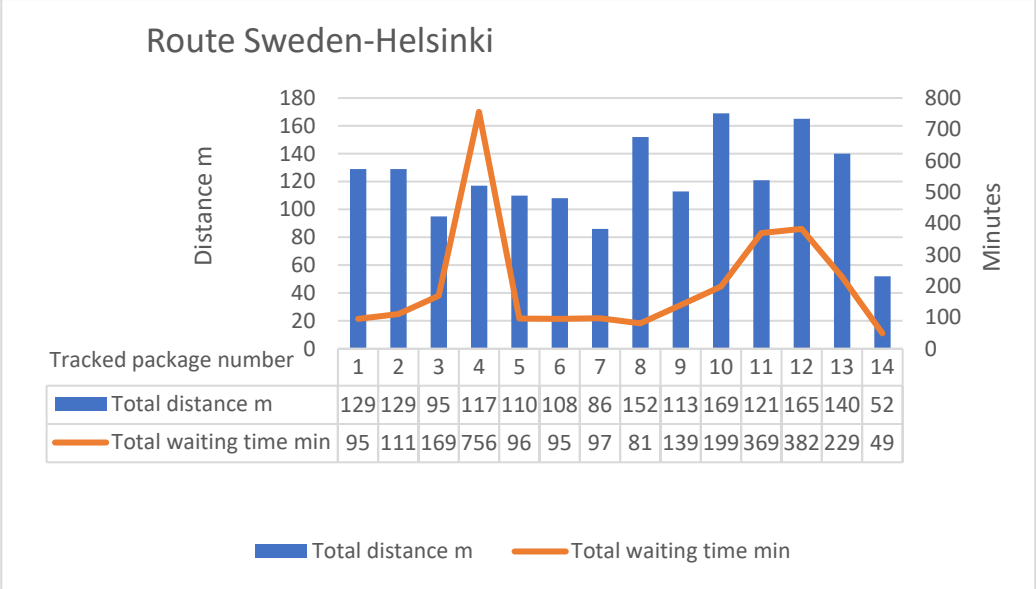


Figure 2Example route Jönköping - Helsinki

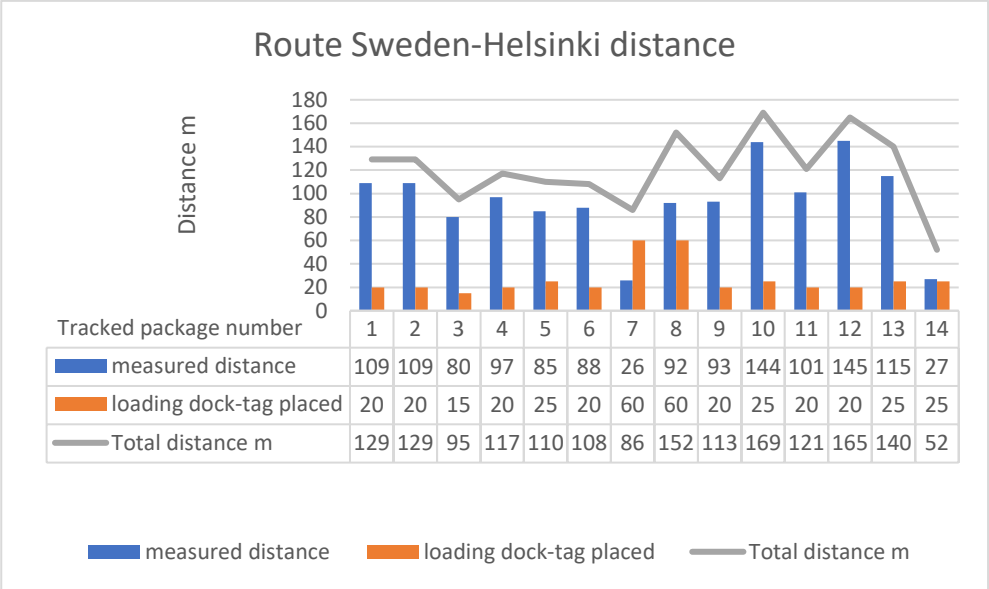
Table 1 Total waiting times and distance traveled at the terminal by package



Tracked package number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Total distance m	129	129	95	117	110	108	86	152	113	169	121	165	140	52
Total waiting time min	95	111	169	756	96	95	97	81	139	199	369	382	229	49

Distance at the terminal

Table 2 Measured distances at the terminal



Tracked package number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
measured distance	109	109	80	97	85	88	26	92	93	144	101	145	115	27
loading dock-tag placed	20	20	15	20	25	20	60	60	20	25	20	20	25	25
Total distance m	129	129	95	117	110	108	86	152	113	169	121	165	140	52

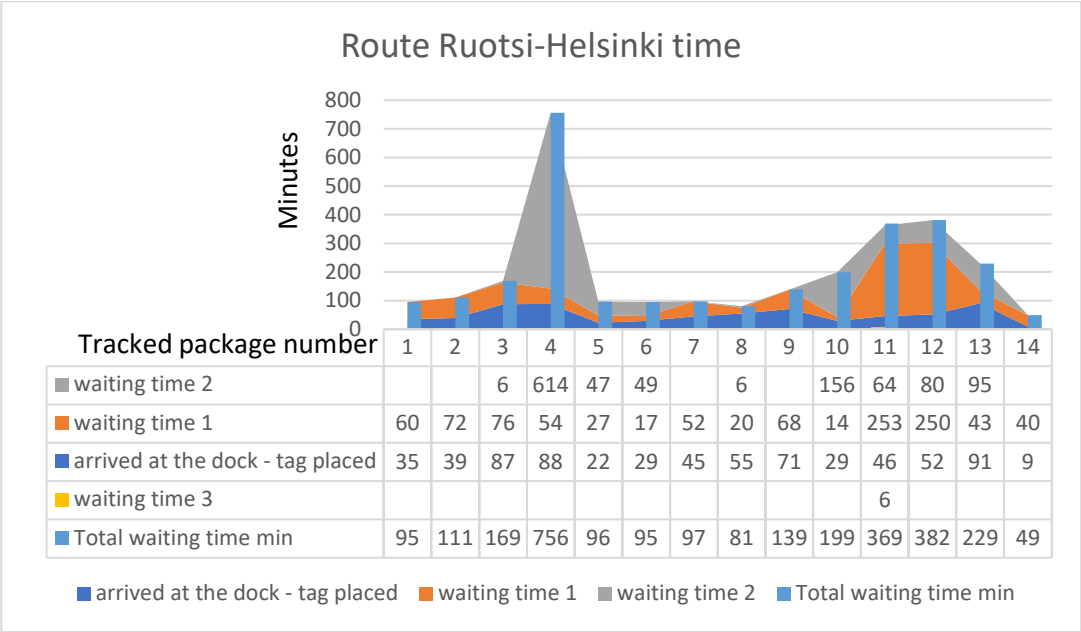
The average distance between the loading dock and the unloading site was 26 meters and the median was 20 meters. Here the range was between 15-60 meters. The length of the range was 45 meters and the standard deviation was 14 meters.

After the unloading site, the packages were transferred to their own plots. The average distance for this transfer was 94 meters and the median was 95 meters. The range was between 26-145 meters. The length of the range was 119 meters and the standard deviation was 34 meters.

In total, the above distances on the package averaged 120 meters and the median 119 meters. The range was between 52-169 meters. The length of the range was 117 meters and the standard deviation was 31 meters.

Time in terminal

Table 3 Measured time in terminal



Tracked package number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
waiting time 2			6	614	47	49		6		156	64	80	95	
waiting time 1	60	72	76	54	27	17	52	20	68	14	253	250	43	40
arrived at the dock - tag placed	35	39	87	88	22	29	45	55	71	29	46	52	91	9
waiting time 3											6			
Total waiting time min	95	111	169	756	96	95	97	81	139	199	369	382	229	49

The time from the arrival of the transport unit to the terminal, the start of unloading and the transfer of the packages to the unloading site took an average of 50 minutes and the median was 45 minutes. Here, the range was between 9-91 minutes and the length of the range was 82 minutes. The standard deviation was 26 minutes.

The package remained in place at the unloading site for an average of 74 minutes and the median was 53 minutes. Here, the range was between 14-253 minutes and the length of the range was 239 minutes. The standard deviation was 78 minutes.

The package remained in place before loading on to the next transport unit on its own plot for an average of 124 minutes and the median was 64 minutes. The range was between 6-614 minutes and the length of the range was 608 minutes. The standard deviation was 189 minutes.

The total package time at the terminal (excluding package transfer, where time was relatively small) averaged 204 minutes and the median was 125 minutes. The range was between 49-756 minutes and the length of the range was 707 minutes. The standard deviation was 189 minutes.

Data generated by the positioning system on the transport route Sweden Tampere

The study monitored the movement and time of nine different packages at the terminal on the transport route Sweden-Tampere on two different days; May 6, 2021 and May 19, 2021 (see

Appendix 1 for examples of the data produced). Incorrect measurement results came from one of the monitored packages. This is not included in the results.

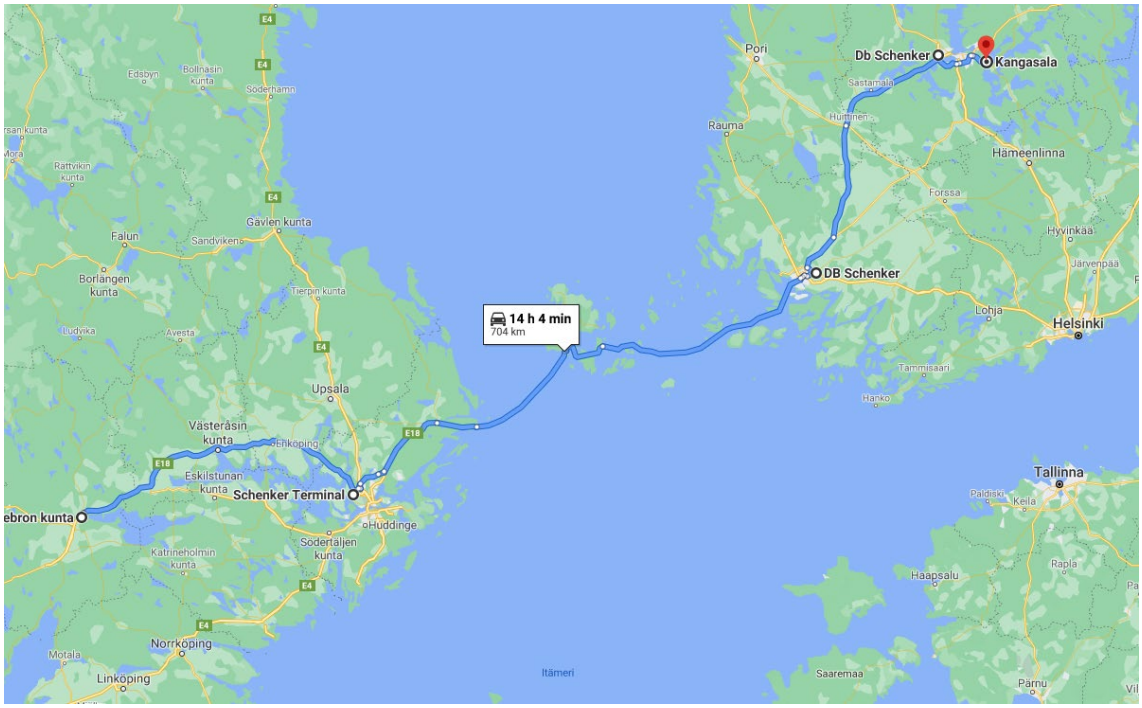
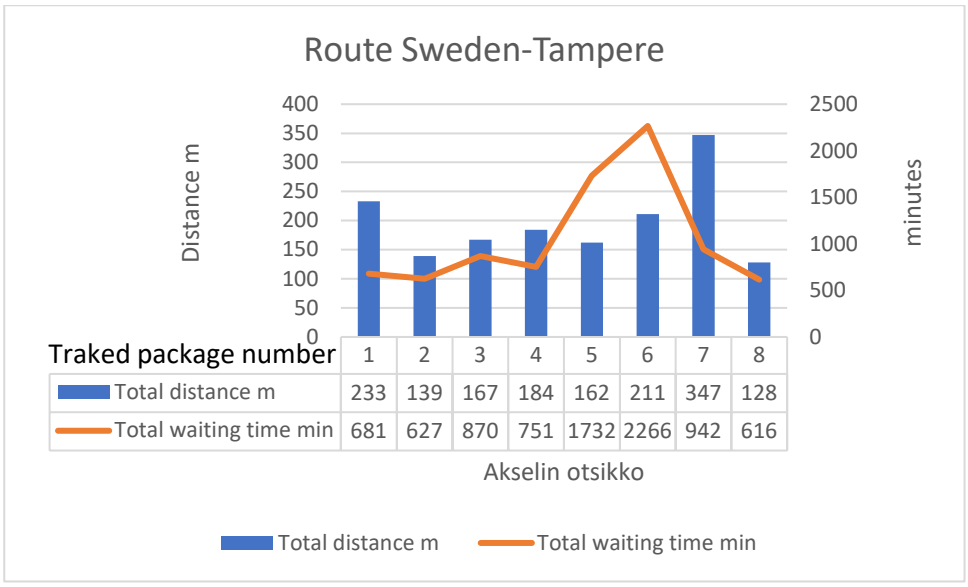


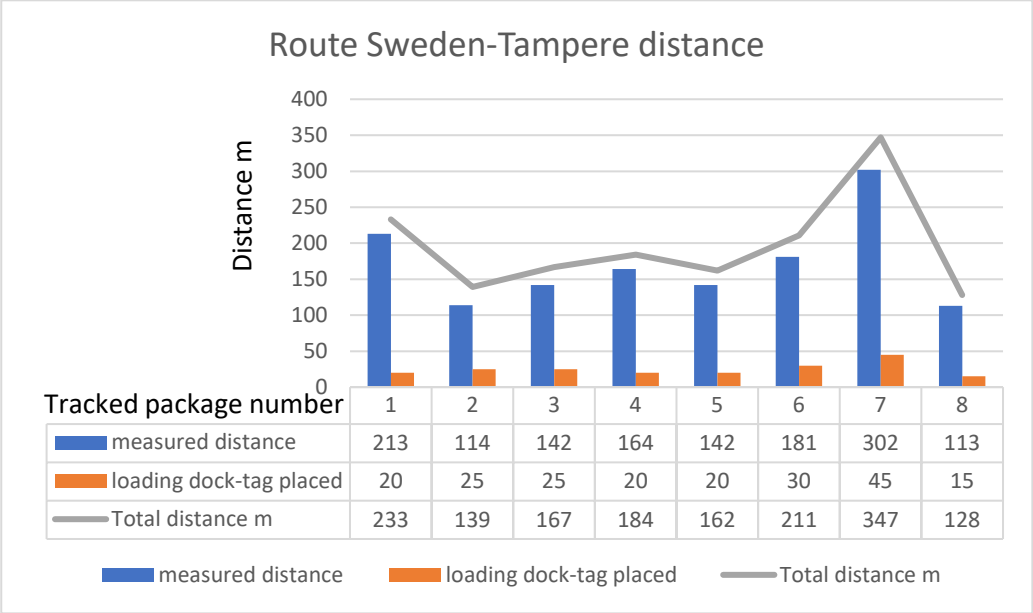
Figure 3 Example route Örebro - Tampere

Table 4 Total waiting times and distance traveled at the terminal by package



Distance at the terminal

Table 5 Measured distance at the terminal



Tracked package number	1	2	3	4	5	6	7	8
measured distance	213	114	142	164	142	181	302	113
loading dock-tag placed	20	25	25	20	20	30	45	15
Total distance m	233	139	167	184	162	211	347	128

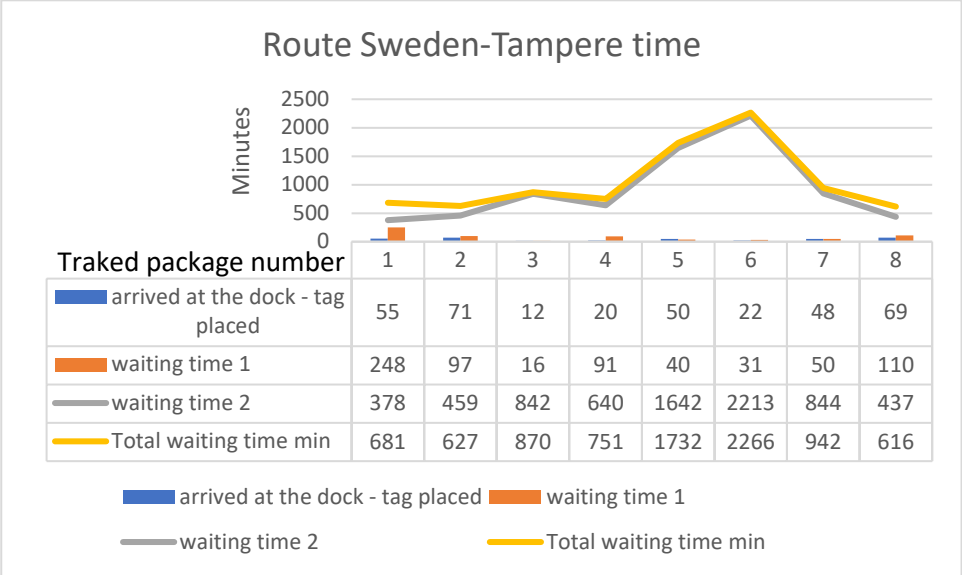
The average distance between the loading dock and the unloading site was 25 meters and the median was 23 meters. Here the range was between 15-45 meters. The length of the range is 30 meters. Standard deviation 9 meters.

After the unloading site, the packages were transferred to their own plots. The average distance for this transfer was 171 meters and the median was 153 meters. The range was 113-302 meters. The length of the range is 189 meters. Standard deviation 62 meters.

In total, the above distances on the package averaged 196 meters and the median was 176 meters. Range 128-347 meters. The length of the range is 219 meters. Standard deviation 70 meters.

Time at the terminal

Table 6 Measured time at the terminal



The time from the arrival of the transport unit to the terminal, the start of unloading and the transfer of the packages to the unloading site took an average of 43 minutes and the median was 49 minutes. Here, the range was between 12-71 minutes and the length of the range was 59 minutes. The standard deviation was 23 minutes.

The package remained in place at the unloading site for an average of 85 minutes and the median was 71 minutes. Here, the range was between 16-248 minutes and the length of the range was 232 minutes. The standard deviation was 74 minutes.

The package remained in place before loading into the next transport unit on its own plot for an average of 932 minutes and the median was 657 minutes. The range was between 378-2213 minutes and the length of the range was 1835 minutes. The standard deviation was 657 minutes.

The total package time at the terminal (excluding package transfer, where time was relatively small) averaged 1061 minutes and the median was 811 minutes. The range was between 616-2266 minutes and the range was 1650 minutes. The standard deviation was 607 minutes.

Data generated by the positioning system on the transport route Sweden Seinäjoki

The study monitored the movement and time of 4 different packages at the terminal on the Swedish-Seinäjoki transport route on two different days, 6 May 2021 and 19 May 2021 (see Appendix 1 for examples of the data produced). Incorrect measurement results came from one of the monitored packages. This is not included in the results.

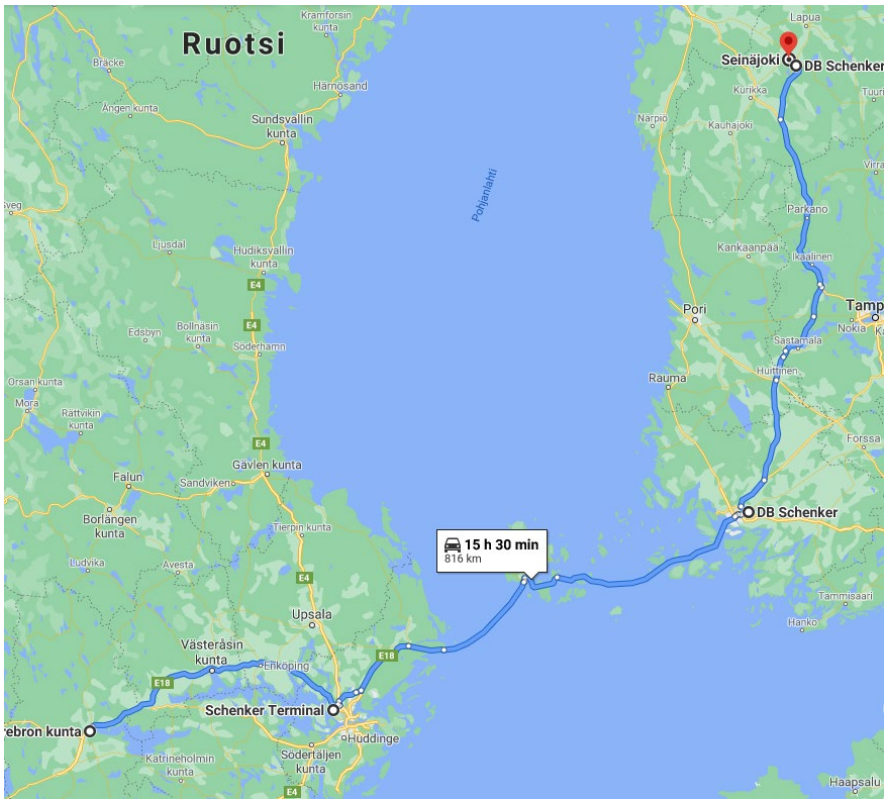
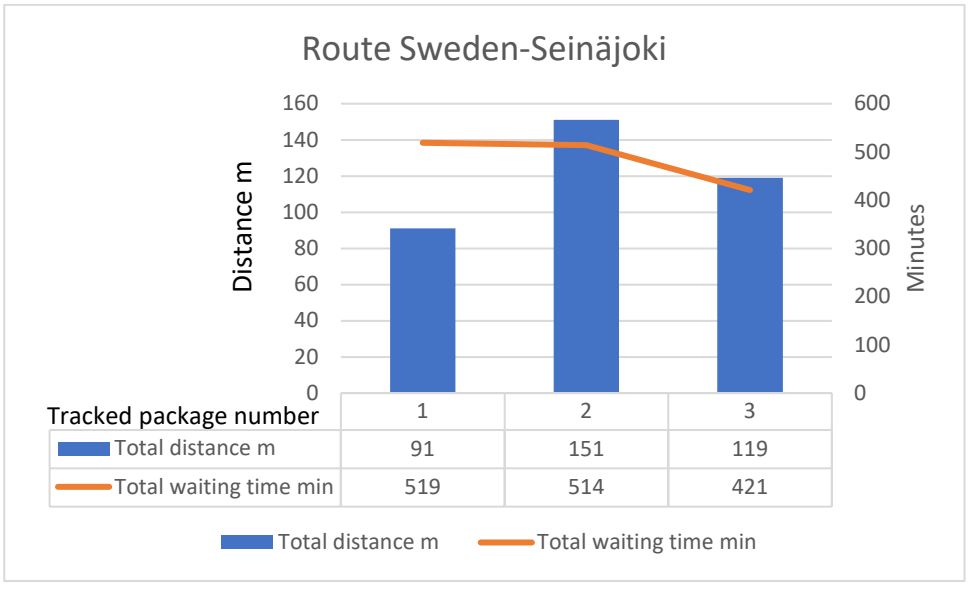


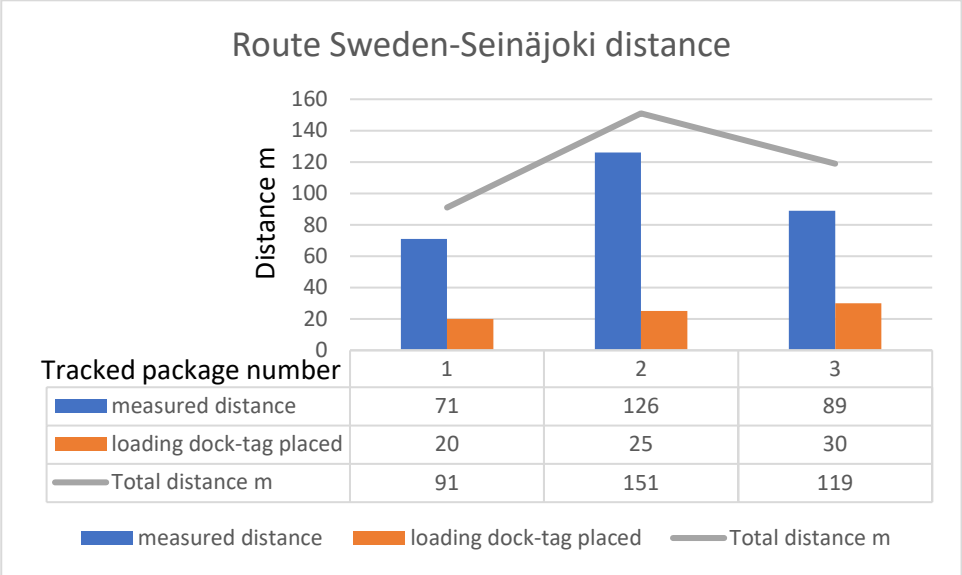
Figure 4 Example route Örebro-Seinäjoki

Table 7 Total waiting times and distance traveled at the terminal by package



Distance at the terminal

Table 8 Measured distance at the terminal



Tracked package number	1	2	3
measured distance	71	126	89
loading dock-tag placed	20	25	30
Total distance m	91	151	119

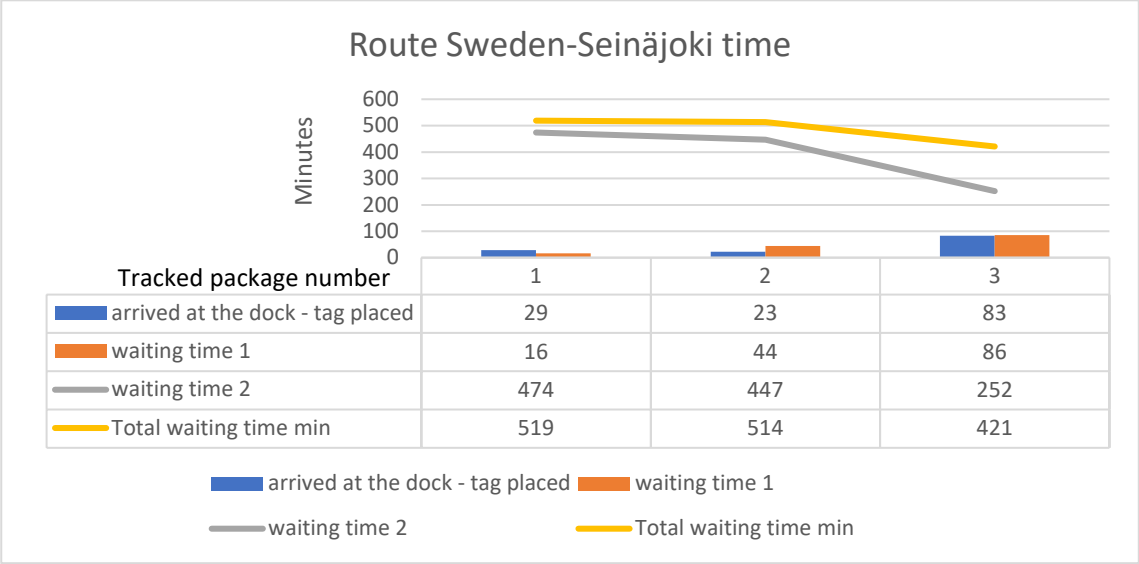
The average distance between the loading dock and the unloading site was 25 meters and the median 25 meters. Here the range was between 20-30 meters. The length of the range is 10 meters. Standard deviation 5 meters.

After the unloading site, the packages were transferred to their own plots. The average distance for this transfer was 95 meters and the median 89 meters. The range was between 71-126 meters. The length of the range is 55 meters. Standard deviation 28 meters.

In total, the above distances on the package averaged 120 meters and the median was 119 meters. Range was between 91-151 meters. The length of the range is 60 meters. Standard deviation 30 meters.

Time at the terminal

Table 9 Measured time at the terminal



Tracked package number	1	2	3
arrived at the dock - tag placed	29	23	83
waiting time 1	16	44	86
waiting time 2	474	447	252
Total waiting time min	519	514	421

The time from the arrival of the transport unit to the terminal, the start of unloading and the transfer of the packages to the unloading site took an average of 45 minutes and the median was 29 minutes. Here, the range was between 23-83 minutes and the length of the range was 60 minutes. The standard deviation was 33 minutes.

The package remained in place at the unloading site for an average of 49 minutes and the median was 44 minutes. Here, the range was between 16-86 minutes and the length of the range was 70 minutes. The standard deviation was 35 minutes.

The package remained in place before loading into the next transport unit on its own plot for an average of 391 minutes and the median was 447 minutes. The range was between 252-474 minutes and the length of the range was 222 minutes. The standard deviation was 121 minutes.

The total package time at the terminal (excluding package transfer, where time was relatively small) averaged 485 minutes and the median was 514 minutes. The range was between 421-519 minutes and the length of the range was 98 minutes. The standard deviation was 55 minutes.

Data generated by the positioning system on the transport route Sweden-Kuopio

The research monitored the movement and time of 6 different packages at the terminal on the transport route Sweden-Kuopio on two different days, 6 May 2021 and 19 May 2021 (see Appendix 1 for examples of the data produced). Incorrect measurement results came from one of the monitored packages. This is not included in the results.

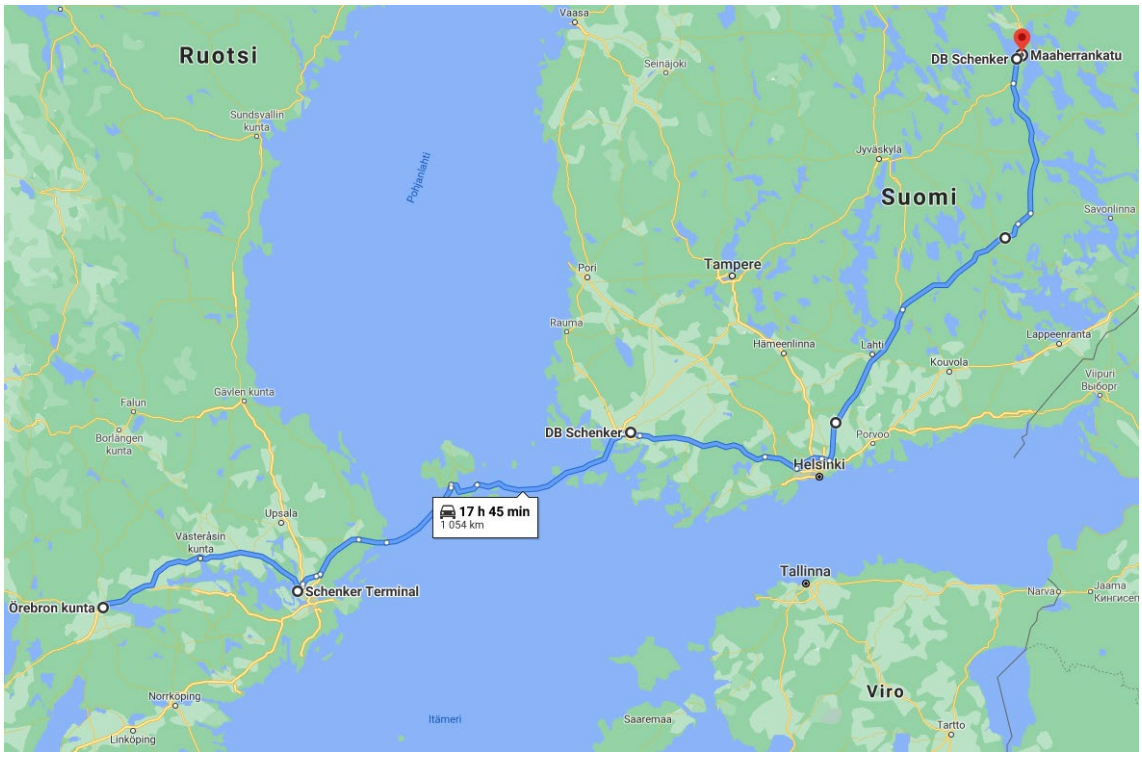
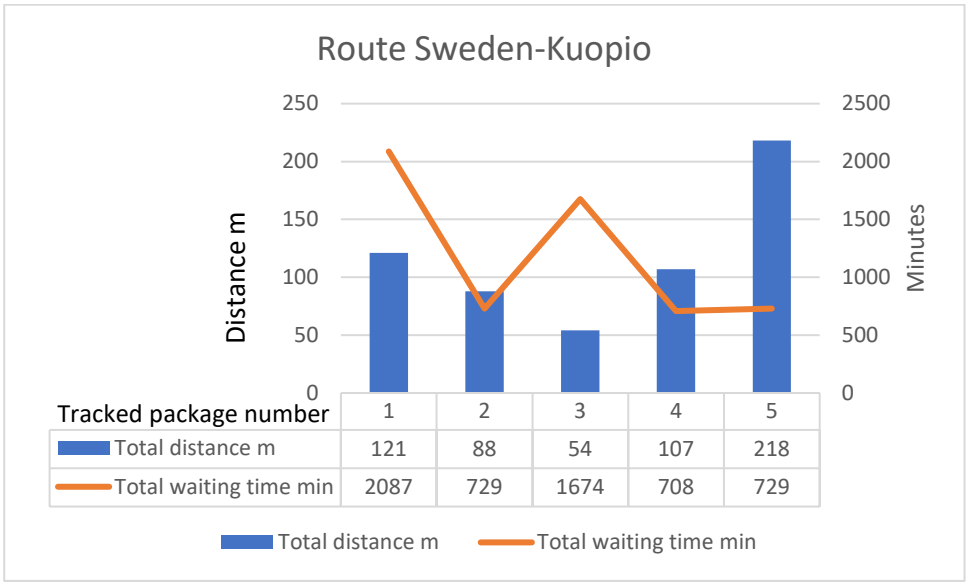


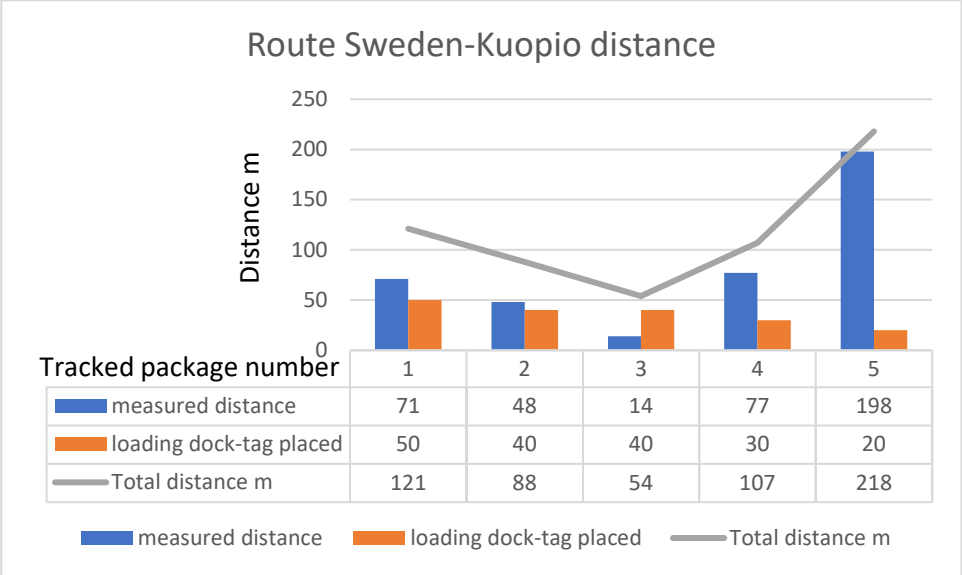
Figure 5 Example route Örebrö-Kuopio

Table 10 Total waiting times and distance traveled at the terminal by package



Distance at the terminal

Table 11 Measured distance at the terminal



Tracked package number	1	2	3	4	5
measured distance	71	48	14	77	198
loading dock-tag placed	50	40	40	30	20
Total distance m	121	88	54	107	218

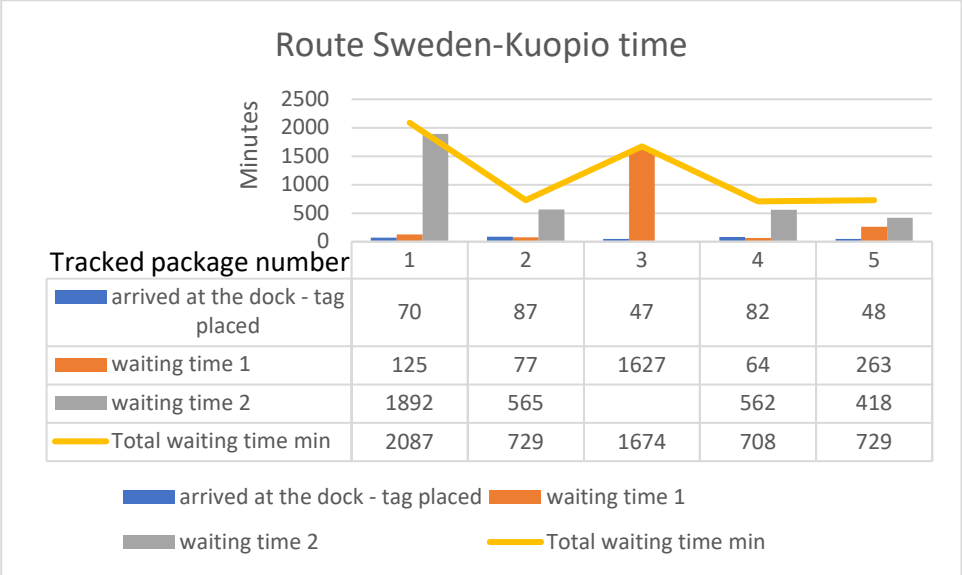
The average distance between the loading dock and the unloading site was 36 meters and the median was 40 meters. Here the range was between 20-50 meters. The length of the range is 30 meters. Standard deviation 11 meters.

After unloading, the packages were transferred to their own plots. The average distance for this transfer was 82 meters and the median was 71 meters. The range was between 14-198 meters. The length of the range is 184 meters. Standard deviation 70 meters.

In total, the above distances on the package averaged 118 meters and the median was 107 meters. Range between 54-218 meters. The length of the range is 164 meters. Standard deviation 61 meters.

Time at the terminal

Table 12 Measured time at the terminal



Tracked package number	1	2	3	4	5
arrived at the dock - tag placed	70	87	47	82	48
waiting time 1	125	77	1627	64	263
waiting time 2	1892	565		562	418
Total waiting time min	2087	729	1674	708	729

The average time from arrival of the transport unit to the terminal, start of unloading and transfer of packages to the place of unloading was 67 minutes and the median was 70 minutes. Here, the range was between 48-87 minutes and the length of the range was 39 minutes. The standard deviation was 19 minutes.

The package remained in place at the unloading site for an average of 431 minutes and the median was 125 minutes. Here, the range was between 64-1627 minutes and the length of the range was 1563 minutes. The standard deviation was 673 minutes.

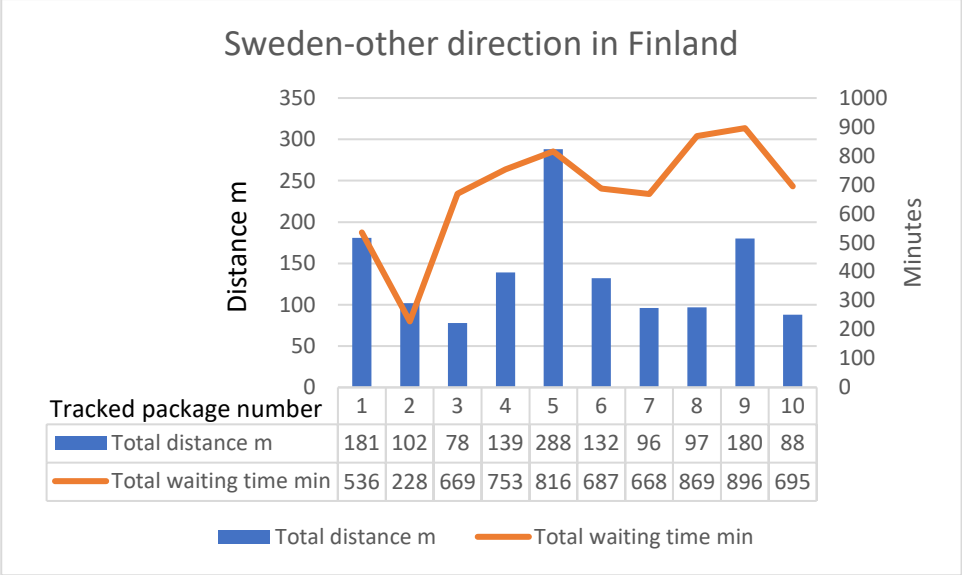
The package remained in place before loading into the next transport unit on its own plot for an average of 859 minutes and the median was 564 minutes. The range was between 418-1892 minutes and the length of the range was 1474 minutes. The standard deviation was 692 minutes.

The total package time at the terminal (excluding package transfer, where time was relatively small) averaged 1185 minutes and the median was 729 minutes. The range was between 708-2087 minutes and the range was 1479 minutes. The standard deviation was 651 minutes.

Data generated by the positioning system on the transport route Sweden-other directions in Finland

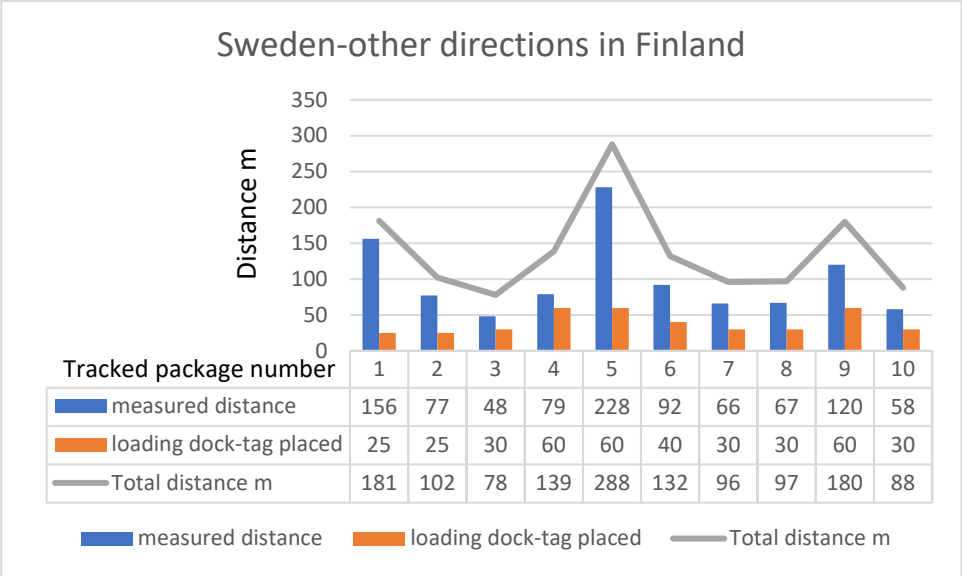
The research also monitored the movements and time of 11 different packages at the terminal on the transport route Sweden-other directions in Finland on two different days, 6 May 2021 and 19 May 2021 (see Appendix 1 for examples of the data produced). Incorrect measurement results came from one of the monitored packages. This is not included in the results.

Table 13 Total waiting times and distance traveled at the terminal by package



Distance at the terminal

Table 14 Measured distance at the terminal



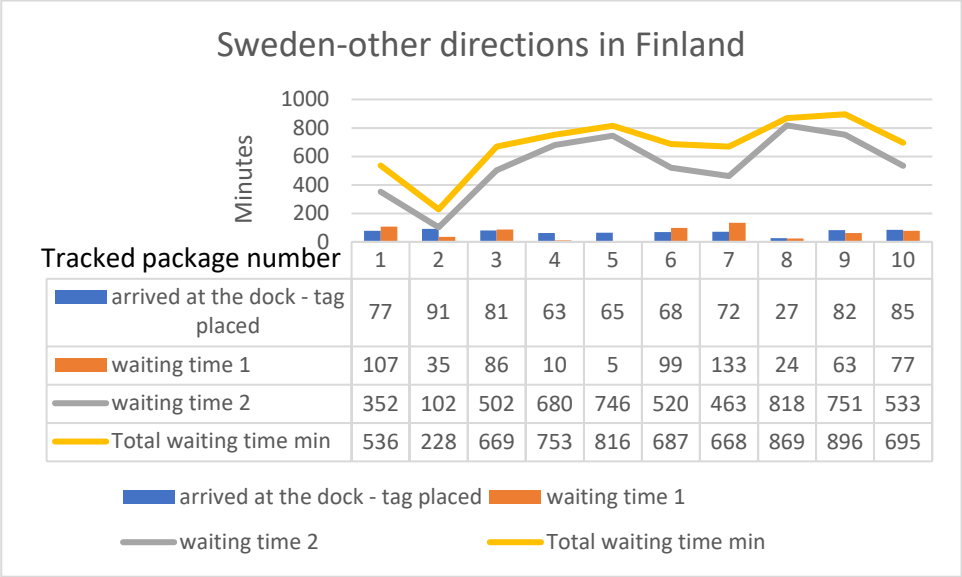
The average distance between the loading dock and the unloading site was 39 meters and the median 30 meters. Here the range was between 25-60 meters. The length of the range is 35 meters. The standard deviation was 15 meters.

After unloading, the packages were transferred to their own plots. The average distance for this transfer was 99 meters and the median was 78 meters. The range was between 48-228 meters. The length of the range is 180 meters. The standard deviation was 55 meters.

In total, the above distances on the package averaged 138 meters and the median was 117 meters. Range between 78-288 meters. The length of the range is 210 meters. The standard deviation was 64 meters.

Time at the terminal

Table 15 Measured time at the terminal



Tracked package number	1	2	3	4	5	6	7	8	9	10
arrived at the dock - tag placed	77	91	81	63	65	68	72	27	82	85
waiting time 1	107	35	86	10	5	99	133	24	63	77
waiting time 2	352	102	502	680	746	520	463	818	751	533
Total waiting time min	536	228	669	753	816	687	668	869	896	695

The time from the arrival of the transport unit at the terminal, the start of unloading and the transfer of the packages to the unloading site took an average of 71 minutes and the median was 75 minutes. Here, the range was between 27-91 minutes and the length of the range was 64 minutes. The standard deviation was 18 minutes.

The package remained in place at the unloading site for an average of 64 minutes and the median was 70 minutes. Here, the range was between 5-133 minutes and the length of the range was 128 minutes. The standard deviation was 44 minutes.

The package remained in place before loading into the next transport unit on its own site for an average of 547 minutes and the median was 527 minutes. The range was between 102-818 minutes and the length of the range was 716 minutes. The standard deviation was 216 minutes.

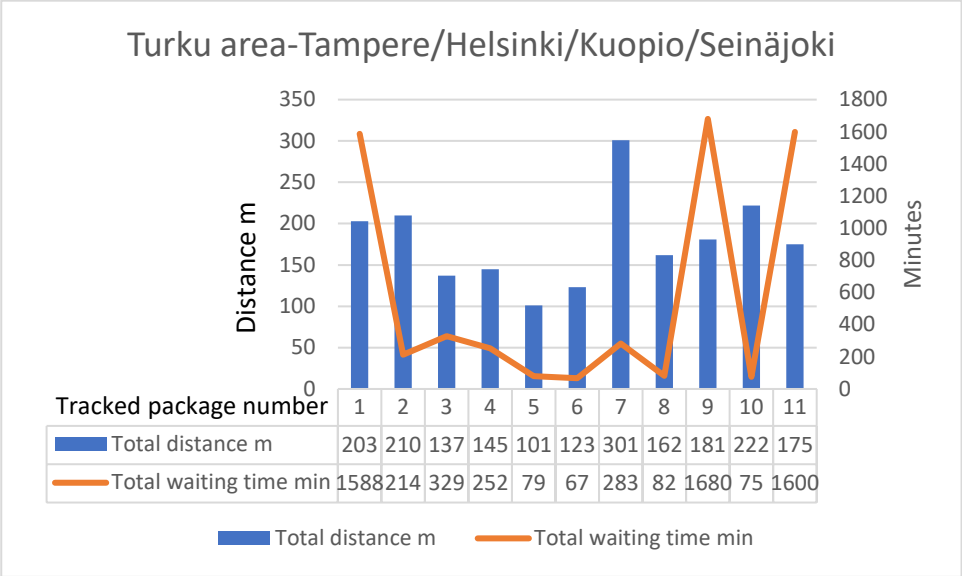
The total package time at the terminal (excluding package transfer, where time was relatively small) averaged 682 minutes and the median was 691 minutes. The range was between 228-896 minutes and the length of the range was 668 minutes. The standard deviation was 191 minutes.

Data generated by the positioning system on the transport route Turku area-Tampere/Helsinki/Kuopio/Seinäjoki

The research monitored the movement and time of 12 different packages in the terminal on the transport route Turku region-Tampere / Helsinki / Kuopio / Seinäjoki on two different days, 6 May

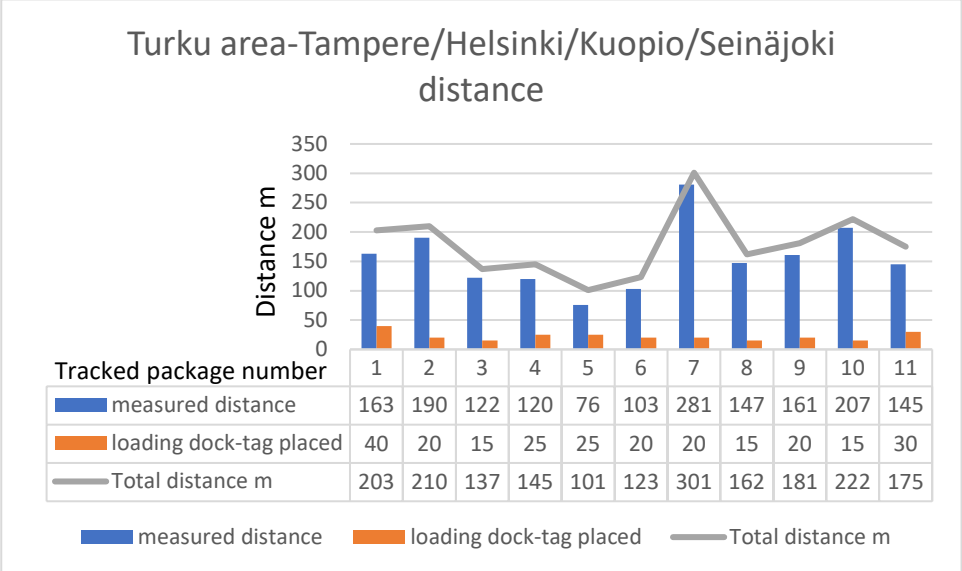
2021 and 19 May 2021 (see Appendix 1 for examples of the data produced). Incorrect measurement results came from one of the monitored packages. This is not included in the results.

Table 16 Total waiting times and distance traveled at the terminal by package



Distance at the terminal

Table 17 Measured distanced at the terminal



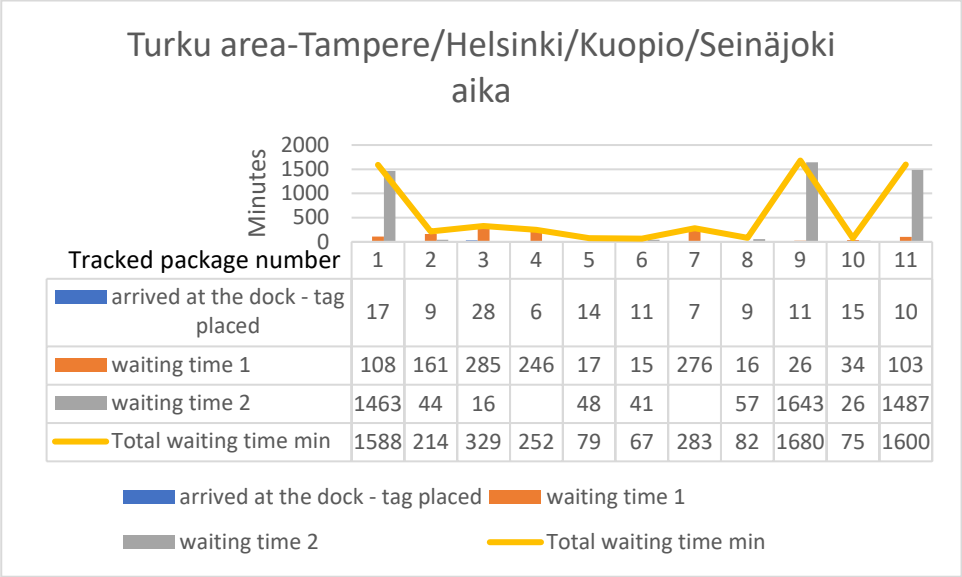
The average distance between the loading dock and the unloading site was 22 meters and the median was 20 meters. Here the range was between 15-40 meters. The length of the range was 25 meters and the standard deviation was 8 meters.

After unloading, the packages were transferred to their own plots. The average distance for this transfer was 156 meters and the median 147 meters. The range was between 76-281 meters. The length of the range was 205 meters and the standard deviation was 56 meters.

In total, the above distances on the package averaged 178 meters and the median was 175 meters. Range between 101-301 meters. The length of the range was 200 meters and the standard deviation was 55 meters.

Time at the terminal

Table 18 Measured time at the terminal



Tracked package number	1	2	3	4	5	6	7	8	9	10	11
arrived at the dock - tag placed	17	9	28	6	14	11	7	9	11	15	10
waiting time 1	108	161	285	246	17	15	276	16	26	34	103
waiting time 2	1463	44	16		48	41		57	1643	26	1487
Total waiting time min	1588	214	329	252	79	67	283	82	1680	75	1600

The time from the arrival of the transport unit at the terminal, the start of unloading and the transfer of the packages to the unloading site took an average of 12 minutes and the median was 11 minutes. Here, the range was between 6-28 minutes and the length of the range was 22 minutes. The standard deviation was 6 minutes.

The package remained in place at the unloading site for an average of 117 minutes and the median was 103 minutes. Here, the range was between 15-285 minutes and the length of the range was 270 minutes. The standard deviation was 108 minutes.

The package remained in place before loading into the next transport unit on its own plot for an average of 536 minutes and the median was 48 minutes. The range was between 26-1643 minutes and the length of the range was 1617 minutes. The standard deviation was 748 minutes.

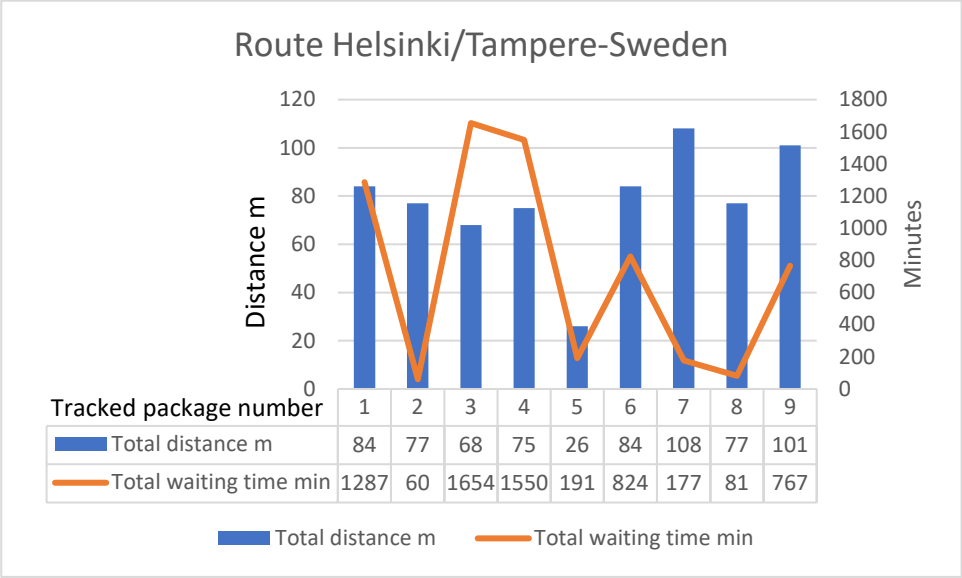
The total package time at the terminal (excluding package transfer, where time was relatively small) averaged 568 minutes and the median was 252 minutes. The range was between 67-1680 minutes and the range was 1613 minutes. The standard deviation was 683 minutes.

Data generated by the positioning system on the transport route Helsinki/Tampere-Sweden

The research monitored the movement and time of 9 different packages at the terminal on the Helsinki / Tampere-Sweden transport route on two different days, 6 May 2021 and 19 May 2021

(see Appendix 1 for examples of the data produced). There were no erroneous measurement results.

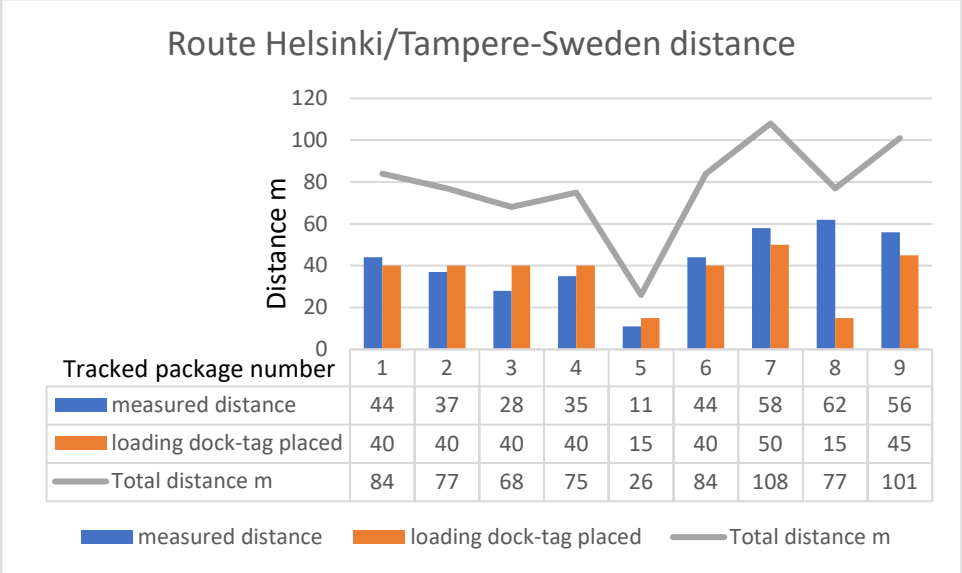
Table 19 Total waiting times and distance traveled at the terminal by package



Tracked package number	1	2	3	4	5	6	7	8	9
Total distance m	84	77	68	75	26	84	108	77	101
Total waiting time min	1287	60	1654	1550	191	824	177	81	767

Distance at the terminal

Table 20 Measured distance at the terminal



Tracked package number	1	2	3	4	5	6	7	8	9
measured distance	44	37	28	35	11	44	58	62	56
loading dock-tag placed	40	40	40	40	15	40	50	15	45
Total distance m	84	77	68	75	26	84	108	77	101

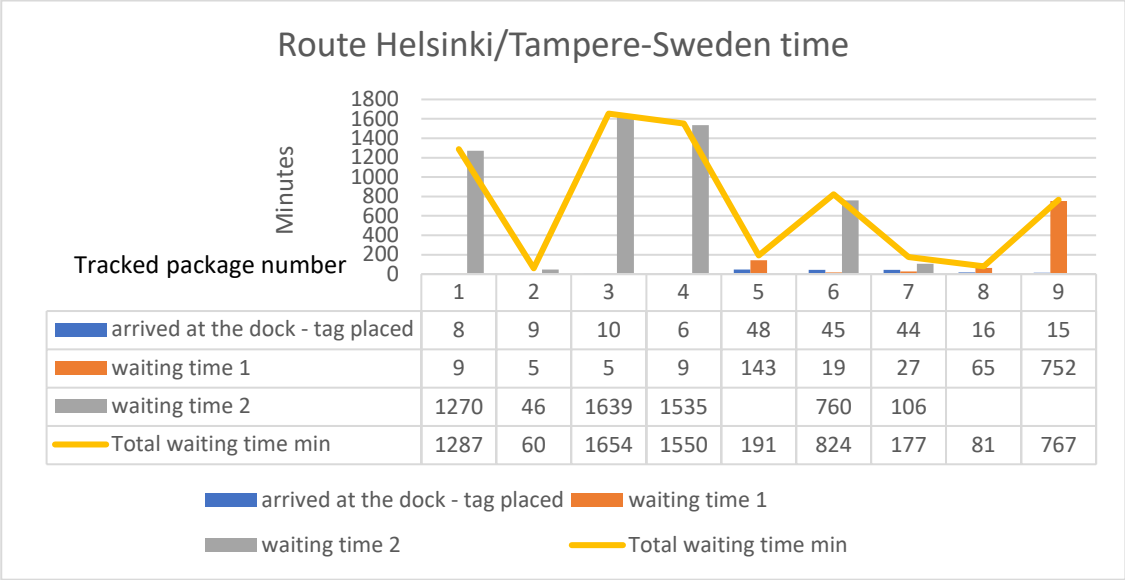
The average distance between the loading dock and the unloading site was 36 meters and the median was 40 meters. Here the range was between 15-50 meters. The length of the range is 35 meters. Standard deviation 12 meters.

After unloading, the packages were transferred to their own plots. The average distance for this transfer was 42 meters and the median was 44 meters. The range was between 11-62 meters. The length of the range is 51 meters. Standard deviation 16 meters.

In total, the above distances on the package averaged 78 meters and the median was 77 meters. The range was between 26-108 meters. The length of the range was 82 meters and the standard deviation was 23 meters.

Time at the terminal

Table 21 Measured time at the terminal



Tracked package number	1	2	3	4	5	6	7	8	9
arrived at the dock - tag placed	8	9	10	6	48	45	44	16	15
waiting time 1	9	5	5	9	143	19	27	65	752
waiting time 2	1270	46	1639	1535		760	106		
Total waiting time min	1287	60	1654	1550	191	824	177	81	767

The time from the arrival of the transport unit to the terminal, the start of unloading and the transfer of the packages to the unloading site took an average of 22 minutes and the median was 15 minutes. Here, the range was between 8-48 minutes and the range length was 40 minutes. The standard deviation was 18 minutes.

The package remained in place at the unloading site for an average of 115 minutes and the median was 19 minutes. Here, the range was between 5-752 minutes and the range length was 747 minutes. The standard deviation was 243 minutes.

The package remained in place before loading into the next transport unit on its own plot for an average of 892 minutes and the median was 1015 minutes. The range was between 46-1639 minutes and the length of the range was 1593 minutes. The standard deviation was 702 minutes.

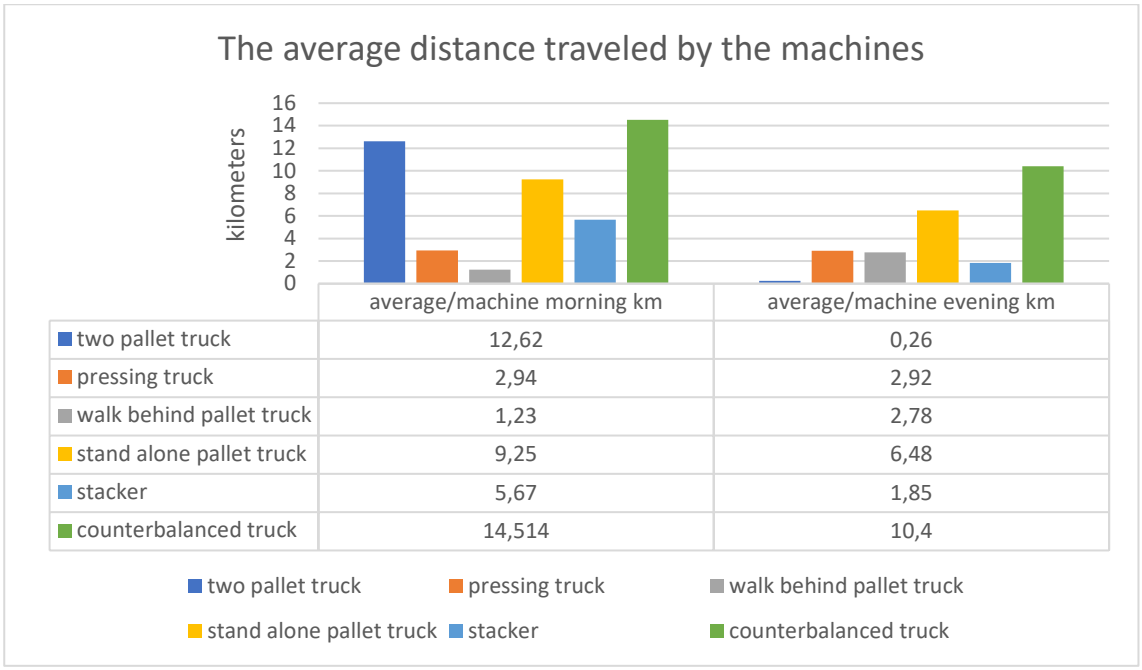
The total package time at the terminal (excluding package transfer, where time was relatively small) averaged 732 minutes and the median was 767 minutes. The range was between 60-1654 minutes and the length of the range was 1594 minutes. The standard deviation was 643 minutes.

Distance travelled by cargo handling machines

The distance traveled by the machines was measured from all weekdays in April at the DB Schenker terminal. Tracking was done in two time intervals, one in the morning shift at 02-09 and the other in the evening shift at 15-22. There were 11 counterbalanced trucks, 7 walk-behind pallet

trucks, 4 stand-alone pallet trucks, 3 pallet trucks, 2 stackers and 2 two-pallet pallet trucks which were monitored. The total distance traveled by all machinest was 8 717,14 kilometers in 21 working days (see Appendix 1 for examples of the data produced).

Table 22 The average distance traveled by planes is from the weekdays of April



	average/machine morning km	average/machine evening km
two pallet truck	12,62	0,26
pressing truck	2,94	2,92
walk behind pallet truck	1,23	2,78
stand alone pallet truck	9,25	6,48
stacker	5,67	1,85
counterbalanced truck	14,514	10,4

On average, counterbalanced trucks traveled a total of 159.66 kilometers during the weekday morning shift. One counterbalanced truck traveled an average of 14.51 kilometers in the morning and 2.07 kilometers per hour. The range for the total distance traveled by counterbalanced trucks was between 0.22 to 30.95 kilometers and the length of the range was 30.73 kilometers. On average, counterbalanced trucks traveled a total of 114.35 kilometers during the weekday evening shift. One counterbalanced truck traveled an average of 10.40 kilometers during the evening shift and 1.49 kilometers per hour. The range for the total distance traveled by counterbalanced trucks was between 0.68-26.28 kilometers in the evening shift and the length of the range was 25.60 kilometers.

On average, standing pallet trucks traveled a total of 37.00 kilometers during the weekday morning shift. One standing pallet truck traveled an average of 9.25 kilometers during the morning shift and 1.32 kilometers per hour. The range in the morning shift of standing pallet trucks was between 0.79-23.67 kilometers and the length of the range was 22.88 kilometers. On average, standing pallet trucks traveled a total of 25.93 kilometers during the weekday evening shift. One standing pallet truck traveled an average of 6.48 kilometers during the evening shift and 0.93 kilometers per

hour. The range for the total journey distance of the evening shift of standing pallet trucks was between 0.25-16.02 kilometers and the length of the range was 15.77 kilometers.

On average, walkable pallet trucks traveled a total of 8.59 kilometers during the weekday morning shift. One walkable pallet truck traveled an average of 1.23 kilometers during the morning shift and 0.16 kilometers per hour. The range in the morning shift of walkable pallet trucks was between 0.002-7.08 kilometers and the length of the range was 7.078 kilometers. On average, walkable pallet trucks traveled a total of 19.43 kilometers during the weekday evening shift. One walkable pallet truck traveled an average of 2.78 kilometers during the evening shift and 0.40 kilometers per hour. The range for the total journey distance of the evening shift of the walkable pallet trucks was between 0.004 to 8.90 kilometers and the length of the range was 8.896 kilometers.

On average, the two-platform pallet trucks (train) traveled a total of 25.25 kilometers during the weekday morning shift. One train ran an average of 12.62 kilometers during the morning shift and 1.80 kilometers per hour. The range for the trains in the morning was a total distance of between 4.97-22.08 kilometers and the length of the range was 17.11 kilometers. On average, the train traveled a total of 0.52 kilometers during the weekday evening shift. One train ran an average of 0.26 kilometers during the evening shift and 0.04 kilometers per hour. The range for the total distance traveled by train in the evening was between 0.002-8.78 kilometers and the length of the range was 8.778 kilometers.

On average, the pressing truck traveled a total of 8.81 kilometers during the weekday morning shift. One pressing truck traveled an average of 2.94 kilometers during the morning shift and 0.42 kilometers per hour. The range for the morning shift of the pressing truck in the total distance traveled was between 0.005-9.37 kilometers and the length of the range was 9,365 kilometers. On average, the pressing truck traveled a total of 8.75 kilometers during the weekday evening shift. One pressing truck traveled an average of 2.92 kilometers during the evening shift and 0.42 kilometers per hour. The range for the total travel distance of the evening shift of the pressing truck was 0.004-11.51 kilometers and the length of the range was 11.506 kilometers.

On average, stackers traveled a total of 11.33 kilometers during the weekday morning shift. One stacker traveled an average of 5.67 kilometers during the morning shift and 0.81 kilometers per hour. The range in the morning shift of stackers was between 1.89-22.32 kilometers and the length of the range was 20.43 kilometers. On average, stackers traveled a total of 3.70 kilometers during the weekday evening shift. One stacker traveled an average of 1.85 kilometers during the evening shift and 0.26 kilometers per hour. The range for the total travel distance of the evening shift of stackers was between 0.07 to 6.62 kilometers and the length of the range was 6.55 kilometers.

Result of interviews

The study interviewed 15 employees whose job duties included performing various terminal functions. The number corresponds to about 25% of terminal workers. They were asked 10 different questions anonymously. The interviewees had been involved in terminal operations for an average of 15 years and all had also worked in DB Schenker's old terminal near the Port of Turku.

The first question was what is good about the new terminal. Twelve employees replied that the volume and space are good. Seven employees responded that the lighting was good. Three employees responded that the new machines are good. Other things mentioned were better organization of waste management, clearer marking of plots, electric piers, cleanliness, all facilities in the same terminal compared to the old and modern facilities.

Second question was that were there something better in the old terminal. Four employees said directly no. Three employees mentioned the location to be better compared to their own commute. Three employees said half the distances were in favor of the old terminal. In addition, a denser work crew was mentioned (at different terminals), imported goods came to the terminal earlier, when there was not much hurry, the doors were open (easier passage), smoking in the terminal area, floor and seams, forklifts went faster.

The third question was which job is wasting the most time. Seven employees responded to the time it takes to drive long distances. In addition, due to the slower driving speed of the trucks, a lot of wasted time is wasted. In addition, it was mentioned that incoming units would come to the wrong end of the terminal and wait for the imported goods to be on their plot. Time is also overwhelmed by sorting general cargo by hand, reading barcodes, loading, and having many employees figure out the same things unknowingly.

Fourthly, it was asked whether you have to travel long distances with a load-handling device in the so-called empty run. Five employees said they were driving 10% of the run empty. Four employees said they were driving 11-20% empty. Two employees said they were driving 21-30% empty. One employee reported driving 31-40% empty. Two employees said they were driving 41-50% empty.

The fifth question was whether any type of goods is particularly problematic. Three employees replied that long items inside the terminal are problematic. Three employees replied that high goods are problematic. In addition, dangerous goods, poorly foiled goods, fragile packaging, tires, ATVs and others that are difficult to get to the truck's spikes were mentioned.

Sixth, it was clarified which things will go well during the working day. Six employees replied that everything is going well. Four employees mentioned that the team spirit is good between employees. Also mentioned were breaks, loading, being on the property on time, doing it yourself without constant supervision and clear roles.

The seventh question was what time is the busiest during your workday. Five employees replied that the busiest time is in the morning from 06:00 to 10:00. The same number, i.e. five employees, answered in the evening 17-21. In addition, mentions of busy time came during the departure home, from 02.30 and from 13.00 to 17.00 when the delivery trucks arrived.

Eighth, it was found out what the interviewee thinks is due to the rush. Four employees said the rush was due to the overlapping schedules of outgoing cars, which means that several cargo spaces have to be loaded at the same time. Five employees said the amount of goods was large relative to the labor force. It was also mentioned that goods can be waited for loading due sorting, departure times are late and thus the return load arrives late in the morning, other passengers have to be careful at the terminal, there are many steps to move one package (inspection, sorting, loading goods in a certain cargo space) and long-distance trucks have a late schedule.

Ninth, it was asked whether the employee receives clear instructions from management. Eight employees said yes. Three employees said the instructions are pretty clear. One employee said the instructions could be better. Two employees said that the work is clear in terms of experience and does not need instructions and the work is independent.

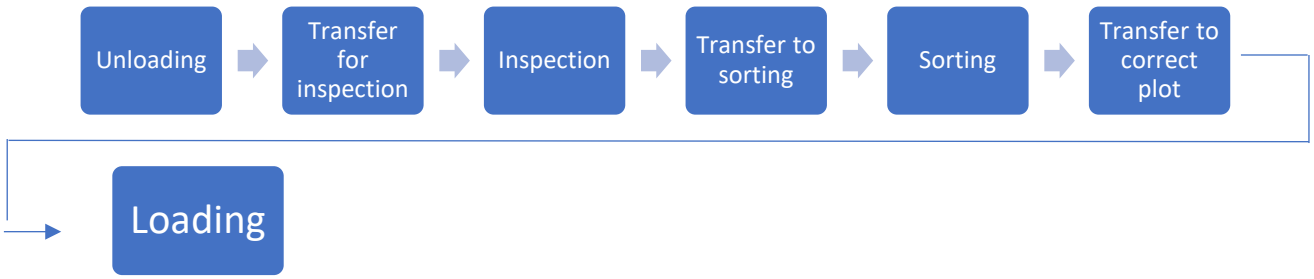
Lastly, they were asked how the work could be streamlined and whether the interviewee had any development suggestions. The most mentions (4 pieces) came from the need for more machines. Three mentions related to the need to increase the work force. Three hoped that work management would direct incoming loads to better locations to speed up unloading and spreading. Three mentions came that the flow of information between shifts and work management should be improved. In addition, mention was made of the lack of written instructions, the decentralization of arrival times for incoming loads, the increase in speed on machines, the maintenance and improvement of cleanliness, and the increase in work supervision.

Result of observation visits

Movements of general cargo in the terminal area

When the transport unit arrives at the terminal gate, the driver calls on the gate phone to the work supervisor, where the supervisors tells which platform they will drive to unload the load. If the transport unit has the right to drive in, the gate hardware reads the registration number and the boom opens. In this case, the driver decides for himself which platform to drive to unload. The terminal staff unloads the imported transport units when they arrive at the loading dock. The warehouse worker unloads the load in a free space near the loading dock using a forklift or other similar pallet transfer device. At this point, the tags are stuck to the packages and tracking begins. The terminal staff moves the goods to the right places according to the direction of departure. Some packages are checked to ensure that the shipping criteria are correct. The loader of the

outgoing load loads the packages to the next transport unit and at the limit set on the tag, the monitoring ends.



Pattern 1 Goods flow ath the terminal

Unloading of household appliances

Monitoring of the unloading of household appliances was carried out based on the findings in the terminal area. At the same time, the loading of three urgent pallets to Helsinki was observed. Loading was urgent as the unloading time for the customer was still the same day. Monitoring data on the unloading of household appliances is shown in Table 23.

Table 23 Unloading of household appliances from the truck and reloading of urgent appliances

Process	Time	Clock
Truck at the gate	0	8:15
Truck leaves the gate	0:00:30	8:15
Truck in hold	0:01	8:16
Truck goes around the corner	0:04	8:19
Truck at the dock 36	0:08	8:23
Unloading begins	0:11:12	8:26
Replacing the unloading machine	0:16:00	8:31
Unloading complete except urgent goods	0:40:00	8:55
Unloading complete	0:43:13	8:58
Urgent goods are put on pallets on the Helsinki plot	0:57:15	9:12
Urgent pallets in front of the Helsinki plot	1:00:30	9:15

Loader scans the barcodes from urgent goods	1:34:30	9:49
Urgent goods in the outgoing truck	1:37:18	9:52
Docks door closed and truck leaves	1:39:30	9:54

Unloading is smooth and unhurried. It takes half a minute to a minute to retrieve a single unit from a truck. The retrieval time is extended to just over two minutes in the event that the driver has to get out of the truck to move packages. As a whole, the movement of these shipments seems to work well and no unnecessary driving can occur due to the proximity of unloading and loading docks. However, the household appliances have to be lowered to the ground between sorting and picking up / spreading pallets. Disassembly is mostly done by pressing machine.

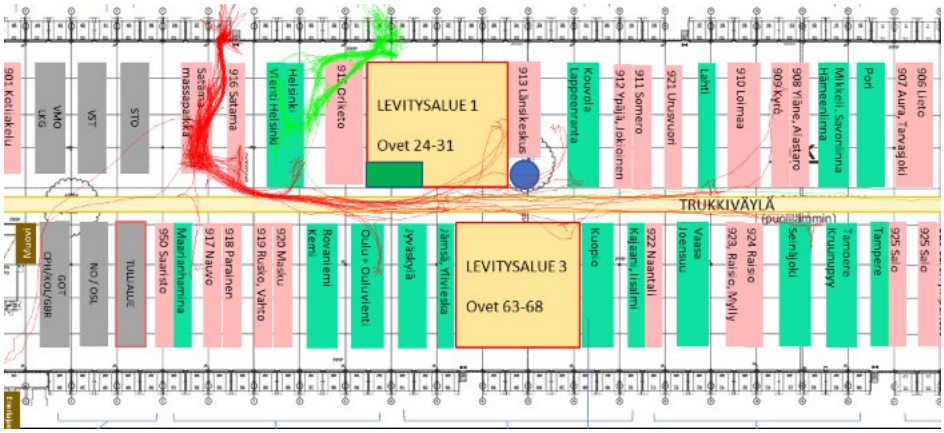


Figure 6 Red movements of the pressing machine used for unloading, loading and sorting. The movements of a forklift used for the same purpose in green.

Reliability of the research

The correctness of the conclusions is supported by the multidisciplinary nature of the study and the accuracy of the measured results. The amount of tracking of shipments in this study was about one percent of the daily throughput of goods. The purpose was to find goods coming from a certain direction that left the terminal in selected directions. This led to generalizations in the research based on individual observations. The overall picture gives the right direction to the conclusions. The sample of data collection for load handling equipment in the study was large. Here, the weekdays of each month were examined from each device. These provided reliable results on equipment movements. During the research, observation visits revealed that work tasks take place in a similar way each time. Although the number of some samples in the research was small, this effect was small in assessing the validity of the research.

Summary and reflection

The purpose of this research was to speed up the transit time of goods inside the gates of terminals. The aim was to find out where and how much time is spent in the various terminal functions and how the goods travel inside the terminal. The aim was to eliminate unnecessary work and movement in the movement of goods and to make proposals for speeding up the transit time of goods in order to speed up the flow of goods to the end customer. In the following summary and reflection, the research questions are addressed together in chronological order of goods movements and work transactions at the terminal.

The first task inside the terminal is to unload the arriving unit at the sorting point in the terminal. This may be one of the sorting areas in the example terminal or an empty area near the incoming unit. In particular, units from imports are unloaded near the loading dock, from where the packages are unloaded. Shortening this distance will significantly reduce the duration of unloading, as the research results show that it is in the range of 10-60 meters. For example, if 20 pallets are unloaded from the transport unit with a forklift 10 meters from the loading dock, the distance to the forklift will be 400 meters during unloading. If, on the other hand, the application area is 60 meters from the loading dock, that distance is already 1,200 meters, which is 3 times longer.

It took an average of 33 minutes to start unpacking and bringing the package to the sorting area. The average load from domestic was 13 minutes and from imports 54 minutes. The big difference is because the driver himself often handles the unloading of domestic loads, while the terminal worker unloads the load of units coming from imports. The employee may have another job before dismantling in progress and the difference may be due in part to that. In addition, the terminal worker expects instructions and papers from the management, who may also be busy during that time.

The next task is for the terminal staff to read the barcodes of the packages so that the information system receives information about the arrival of the package at the terminal. When terminal staff unloads transport units, they place the barcodes in essentially the same direction to make the reading of the barcodes smoother. If the driver unloads his load into the sorting area himself, he may leave the pallet, which way is best for him. This means that the barcodes may be in the “wrong” direction and the terminal worker will not be able to read the barcode without getting up from the load handler. Contrary to what Kučera (2017) has suggested, it was found in this work that chancing working methods in approach could save time. Terminal workers mentioned that time was wasted especially at this stage of the work.

In this sorting area, the load waits an average of 69 minutes to transfer to its own plot. During this time, the terminal worker or workers unload the incoming load, check the papers, read the barcodes or drive packages from the application area to their own plots.

The packages are then transferred to their own plots to await loading at the next transport unit. The research results show that the range in all of these is between 11-302 meters. In high-volume directions, for example to Helsinki, the median of this trip was 95 meters and the median of Tampere was 153 meters. While the median in Kuopio was 71 meters and the median in Seinäjoki was 89 meters.

On their own plot, packages wait an average of 485 minutes. The study found that the median of goods leaving for Helsinki was 64 minutes. This is due to the fact that several transport units depart from Helsinki from the observation terminal in question, while the median for the other directions was 556 minutes. The departure times for these outgoing loads are only in the evening between 8pm and 10.30pm. The investigation mostly monitored import loads arriving at the terminal in the morning and due to this, the goods waited a long time for loading.

The total distance for packages tracked inside the terminal averaged 127 meters with a range of 26-347 meters. It is noted here that the terminal is large and the travel distances of the load handling equipment are relatively long. Terminal workers said they were driving average 20% empty, which is a big waste of time and work efficiency due to long journeys. Heinrich (2018) writes on the same issue clearly urging the use of transport capacity.

In the research, the goods were inside the terminal for an average of 556 minutes. The average import load was 574 minutes and the average load in the surrounding areas was 252 minutes. The difference is due to the fact that import loads arrive at the terminal in the morning and loads from neighboring municipalities arrive in the afternoon / evening.

The monitored load handling machines moved a total of 8.60 kilometers per machine during the morning shift from 2 to 9 am and 6.00 kilometers between the evening shift from 3 pm to 10 pm. During the morning shift, all types of machines moved more than during the evening shift, with the exception of the walk behind pallet truck. Counterbalanced trucks clearly moved the most in both shifts.

Proposed operations and further studies

The purpose of this research was to speed up the transit time of goods inside the gates of terminals. The aim was to find out where and how much time is spent in the various terminal functions and how the goods travel inside the terminal. The aim was to eliminate unnecessary work in the course of the goods and to make suggestions for speeding up the transit time of the goods in order to speed up the flow of the goods to the end customer.

The first proposal concerns management measures. Currently, they are looking at the exterior of the cameras to see which loading docks are free and instructing the drivers to take the transport units to these vacant docks. In the future, I recommend the work management to do a tour inside

the terminal in the morning and see where there is empty space so that there is no long distance between the unit to be unloaded and the unloading site. This proposal could save pallet-handling time of 0.5-1 minutes per pallet. In addition, management should better investigate before loads so that transport units are unloaded closer to the places where the most goods are directed. This saves unnecessary driving back and forth in the terminal. For example, if there are ten pallets in the direction of Helsinki and ten pallets leaving all over Finland, these would be unloaded near the Helsinki site. This example could save one pallet handling time of 1-3 minutes.

The second proposal concerns the operation of drivers when unloading and the marking of application areas. Drivers should be instructed to leave the pallets “right way” in the sorting area so that the terminal worker does not have to get up from his machine to read the barcode. This takes about 10 seconds from the employee per pallet. In addition, I recommend marking the sorting areas with lines where the pallets should be left in order. This allows the terminal worker to pick up the pallet directly. In this connection, it should be noted that the passageways around the application area must also be kept clear so that the goods can be brought between the lines better.

The third proposal is to decentralize the departure time of transport units leaving the terminal. This would clarify the loader’s work tasks and the arrival of return loads back to the terminal at the same time. In this way, the so-called peak volume decentralized.

The fourth proposal concerns import loads. The start of unloading of these should be accelerated so that incoming goods have better time for onward transport, especially deliveries near the terminal. These incoming loads are already known the day before and thus the management should better plan the activities of the terminal workers in order to be able to better respond to the incoming import loads. I also suggest that import loads be unloaded and distributed by two terminal workers where possible. One would unload the load into the sorting area and the other would read the barcodes and distribute the packages to their proper plots. This would speed up the unloading and spreading of one unit and allow the driver to continue the next job or the load compartment to the next use.

Consideration of my suggestions will lead to significant operational changes, as my suggestions would save 0.17-3 minutes per pallet processing time. This could save 7,000 pallets in daily handling terminal for a total of 1,190 minutes in minimum. This means making the terminal more efficient, consuming less energy and making work safer. This means more work tasks for work management, but the overall savings are significant.

As a further study, it would be useful to find out how the times of departing and arriving units could be decentralized and how they affect peak times, their quantities of goods and the arrival of goods for onward transport. Another research proposal is to investigate the optimal layout of the terminal, taking into account the current volumes of goods for different transport directions, unloading areas

and occupational safety. A third proposal for further research is to explore RFID technology by utilizing read goods at a terminal. What would this cost and how much work would be speeded up and security of supply would be improved.

Sources

Baltic Loop 2021. About. Referred 16.6.2021. https://www.balticloop.eu/ > About.

DB Schenker 2021. Tietoa meistä. Referred 12.10.2021. https://www.dbschenker.com/fi-fi/tietoja-meista/ajankohtaista/26-miljoonan-investointi--db-schenker-avaa-liedossa-suomen-toiseksi-suurimman-terminaalinsa-642412

Heinrich Martin: Warehousing and transportation logistics: systems, planning, application and cost effectiveness. 2018. Kogan Page.

Hukki, T. 2019. Ennusteiden käyttö osana sisälogistiikan resursointia. 2019. Opinnäytetyö. Tekniikan ala. Jyväskylä: Jyväskylän ammattikorkeakoulu. Referred 6.6.2021. https://www.theseus.fi/bitstream/handle/10024/265687/Hukki%2c%20Timo.pdf?sequence=2&isAllowed=y

Karkula, M. 2014. Selected aspect of simulation modelling of internal transport processes performed at logistics facilities. Archives of Transport. Vol 30, No 2. Referred 12.6.2021. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=1fnDFZgAAAAJ&sortby=pubdate&citation_for_view=1fnDFZgAAAAJ:aqlVkmm33-oC

Kučera, T. 2017. Logistics cost calculation of implementation warehouse management system: A case study. Referred 10.6.2021. https://dk.upce.cz/bitstream/handle/10195/69936/LOGI_2017_Kucera.pdf?sequence=1&isAllowed=y

Kujala, R. 2019. RFID-tekniikan käyttö sisälogistiikassa. Opinnäytetyö. Sähkö- ja automaatiotekniikka. Helsinki: Metropolia. Referred 11.6.2021. https://www.theseus.fi/bitstream/handle/10024/161656/Kujala_Rikke.pdf?sequenc

Laaksonen, M. 2017. Sisälogistiikan kehittäminen logistiikkakeskuksessa. Diplomityö. Tuotantotalouden koulutusohjelma. Lappeenranta: Lappeenrannan teknillinen yliopisto. Referred. 11.6.2021. https://lutpub.lut.fi/bitstream/handle/10024/135064/Diplomity%c3%b6_Laaksonen_Micael.pdf?sequence=2&isAllowed=y

Noccela Oy 2021. Technology. Referred 10.6.2021. https://noccela.com/ > Technology > Products.

Puputti, J. 2020. Automatisaation ja digitalisaation vaikutus tulevaisuuden sisälogistiikkaan. Opinnäytetyö. Liiketalous ja logistiikka. Lappeenranta: LAB-ammattikorkeakoulu. Referred 13.6.2021. https://www.theseus.fi/bitstream/handle/10024/352711/Jussi_Puputti_opinnaytettyo.pdf?sequence=2

Wronka, A. 2016. Lean logistics. Journal of Positive Management. Vol 7, No 2, 55-63. Referred 13.6.2021. https://apcz.umk.pl/czasopisma/index.php/JPM/article/view/JPM.2016.012/12097

Appendix

serial_number	machine_type	tag_name	distance_mm	day	morning_shift
1000500990	trukki		17 780 759,64	1	TOSI
1000501169	trukki		16 311 337,73	1	TOSI
1000501192	trukki		27 255 173,55	1	TOSI
1000501762	trukki		12 635 920,03	1	TOSI
1000501080	trukki		23 614 024,52	1	TOSI
1000501000	trukki		30 954 433,27	1	TOSI
1000501195	lavansiirtovunuk		-	1	TOSI
1000501776	lavansiirtovunuk		1 875 170,12	1	TOSI
1000500707	lavansiirtovunus		10 470 847,61	1	TOSI
1000501145	lavansiirtovunuk		-	1	TOSI
1000501779	trukki		12 460 255,94	1	TOSI
1000502079	trukki		12 578 853,18	1	TOSI
1000500643	trukki		16 527 585,68	1	TOSI
1000501700	lavansiirtovunus		12 814 878,76	1	TOSI
1000501702	lapakone		3 999 812,10	1	TOSI
1000501771	lavansiirtovunuk		2 346 102,55	1	TOSI
1000501011	pinontatrukki		15 729 459,62	1	TOSI
1000501764	trukki		19 888 984,98	1	TOSI
1000501688	lavansiirtovunus		14 185 854,34	1	TOSI
1000500957	lavansiirtovunus		17 649 647,42	1	TOSI
1000500953	juna		22 083 156,04	1	TOSI
1000502024	juna		13 211 996,22	1	TOSI
1000500935	lavansiirtovunuk		735 161,68	1	TOSI
1000500644	trukki		23 799 620,33	1	TOSI
1000501734	lapakone		2 826 635,57	1	TOSI
1000501083	lavansiirtovunuk		663 017,98	1	TOSI
1000501160	lapakone		8 147 403,45	1	TOSI
1000504343	lavansiirtovunuk		1 368 043,45	1	TOSI
1000501762	trukki		22 728 321,24	2	EPÄTOSI
1000501779	trukki		18 959 095,85	2	EPÄTOSI
1000500990	trukki		21 579 422,42	2	EPÄTOSI
1000501169	trukki		18 183 318,59	2	EPÄTOSI
1000501000	trukki		13 372 201,47	2	EPÄTOSI

Figure 7 Data produced by Noccela in Excel

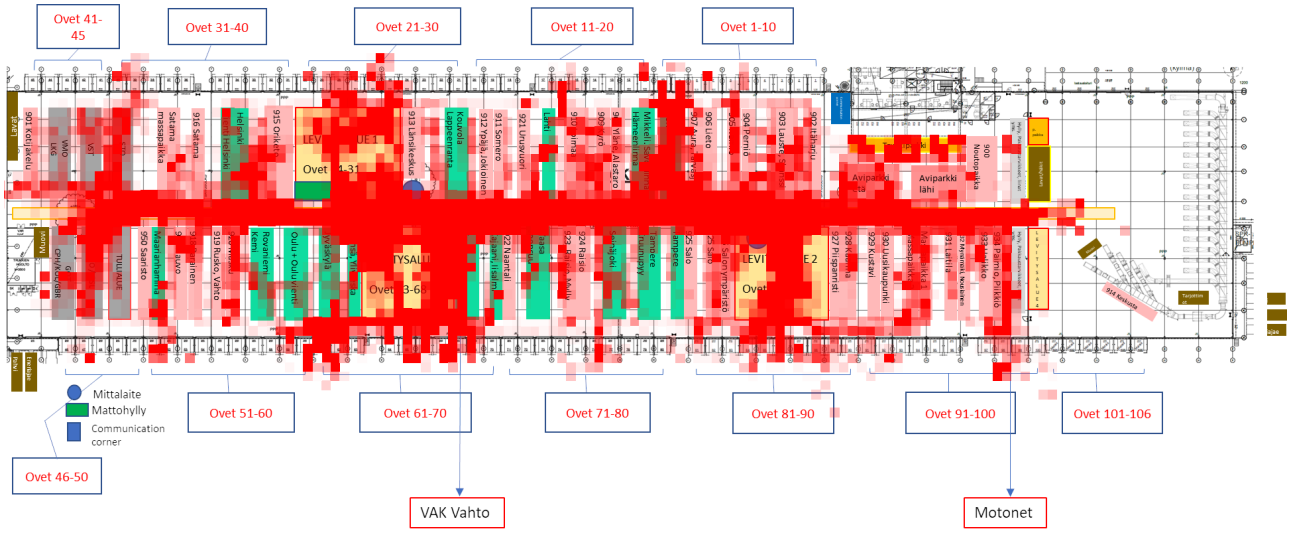


Figure 8 Heatmap produced by Noccela about the movement of trucks in the morning shift

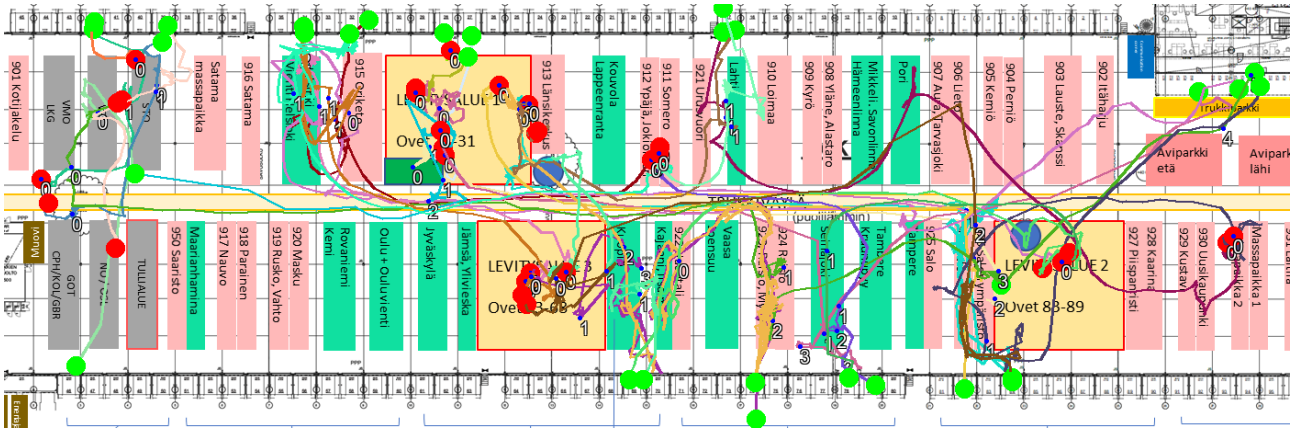


Figure 9 Movements of monitored shipments within the terminal

1000506102-Ruotsi-TRE-Eur

START (red): 2021-05-19T09:00:00+03:00
STOP (green): 2021-05-19T19:29:21+03:00
Distance: 213m
PAUSE POINTS:
0: 2021-05-19T09:00:25+03:00: 248 minutes
1: 2021-05-19T13:08:24+03:00: 35 minutes
2: 2021-05-19T13:43:48+03:00: 343 minutes

Figure 10 Information about being at a standstill and travel