

A.2. Data Collection

To obtain the order picking data, the **WMS** is consulted for the logs of pick events. Next to dealing with incoming customer orders and handling pickruns, the **WMS** also continuously registers pick events conducted by order pickers in log files. The voice picking equipment enables the continuous registration of pick events. For this research, the log files from the 1st of December 2017 until the 10th of December 2017 are available. Based on the knowledge and expertise of process experts, it is assumed that the data of this period is representative of the activity in the system during the rest of the year. The data is not likely to be influenced by peak periods such as holidays or extreme situations like the current worldwide pandemic.

A.2.1. Data Description

The log file of a single day covers the data from 00:00h until 24:00h, usually containing over 100,000 events. Every row in the log file contains a single pick event equal to the pick of a single order line. For every single pick event, there are a lot of information features available. **Table A.2** provides an overview of a preselected number of features that might be relevant. Next to this information, a warehouse layout with **SKU** locations is available. This layout allows to trace back the position of an **SKU** in the warehouse, which enables distance calculations between items in a pickrun.

Table A.2: Preselected Features Order Picking Data

Code	Definition	Format
<i>Key</i>	Pick event identifier	Integer (e.g. 821876216)
<i>SKU</i>	Unique identifier of required product	Integer (e.g. 425455)
<i>Location</i>	Pick location number	Characters & Numbers (e.g. AY09111; aisle AY, rack 91, warehouse number 11)
<i>Original_Case_Qty</i>	Number of required SKU	Integer (e.g. 4)
<i>Update_Case_Qty</i>	Number of picked SKU	Integer (e.g. 2)
<i>Transaction_Date</i>	Date of pick event	Date (year/month/day)
<i>Transaction_Time</i>	Time of pick event	Time (hour:minute:second)
<i>Container</i>	Unique identifier of picklist of pick event	Integer (e.g. 9949409)
<i>Customer</i>	Unique identifier of customer order of pick event	Integer (e.g. 642)
<i>List_ID</i>	Unique identifier of pickrun of pick event	Character & Integer (e.g. L63304514)
<i>Work_Group</i>	Type of customer	Category (e.g. regional or national)
<i>User_ID</i>	Unique identifier of order picker	Integer (e.g. 400202)

Note: Case study warehouse is specified as number 11, thus every location number ends with 11.

A.2.2. Data Exploration

To derive the intuition behind the order picking data, general statistics for each day in the data set are presented in **Table A.3**. The number of order lines indicates the workload of that specific day. It is commonly known that supermarket consumer behavior is

dependent on the day of the week, which also influences the workload division in the order picking data. Generally, it can be assumed that, especially on Saturdays, most grocery shopping is done, followed by Sundays and Fridays, whereas Mondays and Tuesdays are the least busy. The inverse effect can be seen in [Table A.3](#), since supermarkets generally order a day or two before the products are needed. This explains the lower number of order lines picked during the weekends. As can be seen, there is not a significant deviation in customer orders per day, which is caused by the fact that every supermarket tends to order regularly to avoid empty shelves.

Table A.3: General Statistics Order Picking Data

Date	Amount				
	Customer Orders	Pickruns	Picklists	Order Lines	Cases
Friday, Dec 1	348	1590	3425	157,136	183,589
Saturday, Dec 2	324	1553	3451	130,505	172,892
Sunday, Dec 3	329	1316	2882	92,292	137,197
Monday, Dec 4	386	1423	2903	105,529	150,701
Tuesday, Dec 5	397	1773	3939	140,367	200,370
Wednesday, Dec 6	383	1670	3769	161,163	192,955
Thursday, Dec 7	388	1739	3975	166,357	203,670
Friday, Dec 8	340	1598	3530	146,588	184,903
Saturday, Dec 9	323	1593	3646	139,707	195,980
Sunday, Dec 10	211	871	1979	75,263	96,395