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IMPROVING THE FLOW OF PARTS IN THE DISTRIBUTION CENTRE OPERATED BY A GLOBAL LOGISTIC SERVICE PROVIDER

MASTER THESIS SUMMARY

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List of abbreviations

Abbreviation	Description
DGR	Dangerous Goods
FIFO	First In, First Out
GS	Ground store
HB	High-bay
HU	Handling Unit (box, crate, pallet or tote)
LSP	Logistic Service Provider
ML	Miniload
OG	Oversized goods
Packdesk	Packing desks
Recdesk	Receiving desk (also known as booking station)
SAP	System Application Program
WCS	Warehouse Control System

Master thesis summary

The transport and logistics industry is one of the world's largest industries. A world without transport is unimaginable in our daily lives and logistics is just as indispensable, since it manages the flow of transport. In our research, we analyse the flow of parts and warehousing processes of a global logistic service provider. The warehouse where we conduct our research operates in the spare parts business. The response time is therefore crucial in providing the best service to the end customer while the quality has to be maintained. In fulfilling the demand, the company aims to deliver the right parts, at the right time, with the right quantity and guaranteed quality in the most efficient way. Efficient movement and storage of parts is necessary to reduce expenses, while quantities increase and the overall quality level is retained. To meet the previously mentioned requirements, the warehousing processes need to perform optimally. However, improving the warehousing processes is not as easy as it seems.

The warehouse contains a tangle of (highly) automated processes, which makes the content of the research even more challenging. The variety in products is a second challenge. Some parts are as small as the palm of your hand, while some parts can fill a classroom. In processing these parts, we distinguish the following five major warehousing processes: (1) receiving, (2) storage, (3) picking, (4) packing and (5) shipping. Parts arrive at the warehouse at the receiving docks of the inbound section. After receiving, the parts are stored in one of five storage zones: (1) the miniload (ML), (2) the high-bay (HB), (3) the oversized goods zone (OG), (4) the ground store (GS) or (5) the dangerous goods zone (DGR). As soon as a part is needed for a delivery, the part is picked. If all parts belonging to an order are picked, the order moves to the packing department. Based on the type of transport, the order is packed and eventually loaded for dispatch by the shipping department

All warehousing processes vary in time and require specific knowledge and experience. In addition, a precise indication of when and how many parts will arrive and leave the warehouse is lacking, causing disproportionate burdens in the processes. Moreover, disproportionate burdens in the processes cause unwanted fluctuations in the current flow of parts and the required workforce per department. The company wants to avoid this problem and its consequences while dealing with highly automated storage systems. Therefore, the goal of our research is to explore opportunities for logistical improvements by analysing the flow of parts and warehousing processes from inflow (i.e., inbound), to storage, till the outflow of parts (i.e., outbound). We define the main question of our research as:

"How can the company improve their warehousing processes to create a more stable flow of parts in the warehouse?"

The analysis of the processes involve the identification of what kinds of problems arise and where to locate improvements in the processes. To gather the necessary information, we collect data from both the SAP and WCS systems and interview employees with different responsibilities throughout the organisation. The data provides the most valuable insights into the performance of the processes. From the analysis, we select a top three of problems which are the most important in order to address:

1. Movements of parts;
2. Sequencing of parts to process;
3. Meeting internal and external due dates.

The movement of parts is actually a problem that arises in all processes of the different departments. Problematic is that there is currently no view on the movements and which movements should have a higher priority than others. This is moreover not a problem of one department but concerns all movements from inbound, to storage, to outbound. A related problem of the movement of parts concerns the sequencing of parts to process. Waiting parts should be processed First In, First Out (FIFO). However, in reality the processing of parts is not according to the FIFO method. Also, we see that all problems could lead to a delay in the process. Moreover, fluctuations in processing times, causes difficulties in the prediction of when parts are processed entirely. In short, meeting the internal and external due dates is a challenge for both the inbound and outbound sections.

Based on our analysis of the processes and the data, we design a conceptual model that forms the basis for a simulation model. With the simulation model, we are able to visualise the layout of the warehousing processes and the flow of parts through these processes. Next, we implement experiments in the simulation model that expedite the flow of parts. The experiments are based on three different factors and focus on improving the identified three core problems. The three factors that we chose for our experiments are: (1) the processing times, (2) the sequencing of waiting parts and (3) the amount of staff members working.

The processing times vary highly per process and contain a lot of outliers. We adjust the processing times in our model such that the outliers that highly influence the length of processing and waiting times are eliminated. The sequencing of waiting parts focuses on how the parts are processed. We already mentioned that the parts are currently processed according to FIFO. Processing the parts according to FIFO is inefficient in this situation, since the parts have to be stored in one of five different storage zones. The idea is therefore to process the parts at a station that is dedicated to parts that move to a specific storage zone, for example a station that solely handles ML parts. Taking into account the previous mentioned experimental factors, the amount of staff members working can increase, decrease or remain the same compared to the current situation. The throughput of parts depends on the number of people working but also on the technical capacity of a department.

For the three factors mentioned above, we define ranges that indicate the change with regard to the current situation. According to a full tactical design we implement the changes. In the full tactical design, we apply a first change to the current situation. If the new situation is improved compared to the current situation, the change is accepted and the new situation becomes the new default setting. From this default setting we again apply a change and compare if it yields an improvement. We repeat this step of applying new changes until all factors and ranges have been tested. Since the expected improvement is the largest when adjusting the processing times, we start with this factor.

In total, we design five different solutions that we implement as experiments in the simulation model. The results of the experiments show that the processes have the ability to perform better according to their performance measures. We changed the input values for the processing times of the model to indicate what influence the processing time has on the lead times. Changing the processing times, leads to a decrease in lead times of 17.78% at inbound and 26.80% at outbound. In the second experiment, we change the sequence of waiting parts. If we add a change in the sequence of waiting parts to this earlier change of processing times, we again see a decrease in the average lead time at inbound of no less than 11.71%. Last, we changed the amount of staff members of three kinds of packing desks. Decreasing the amount of staff members with one person does not change the total average throughput of the packdesks for small lines. The throughput of the packdesks for priority and small regular orders changes per desks, but the total throughput remains virtually unchanged (+1.71%).

Not so fortunate decisions regard the prioritisation of classified and kitted parts and the adjustment in the amount of staff members working at the put-away station for the ML. Prioritising classified and kitted parts leads to a decrease in throughput of 26.74% at the inbound section. Increasing the amount of staff members at the put-away station for the ML causes the throughput to increase and average lead- and waiting times to decrease. However, the idle time of the put-away station for the ML increases.

Based on the results of the implemented changes according to the full tactical design, we conclude that:

1. Adjusting the processing times reduces the lead time of products significantly because both the processing and waiting times decrease.
2. Changing the sequence of waiting parts from ‘First In, First Out’ to ‘sorting the parts to a specific buffer according to their storage area’ makes the flow of parts more efficient and reduces the fluctuation in the throughput per time unit.
3. Decreasing the amount of staff members working at the packing department with one person hardly affects the average throughput.

Overall, we conclude that the company must at least know what, when and how many parts they **expect** they must process in a given time unit. A starting point arises in making the internal flow of parts more efficient by indicating where parts need to go to in which time span. Furthermore, we recommend the company to:

- *Limit the fluctuation in processing times:*
  Limit processing times by processing parts that cause troubles apart from the 'normal' flow of parts. Issues that arise with parts during the process should be handled by specialised staff members such that the time needed to troubleshoot the problem is minimised.
- *Clearly indicate the actions to undertake and make sure that the staff knows what they need to do:*
  There should be a distinction in the processing of parts. By using specific places to store and process parts, the amount of work-in-progress can be monitored ad hoc for the five different storage zones. There is also a better overview of which parts should be moved and to which storage zone the parts should move. Moreover, we conceived two ideas together with supervisors and process experts to improve the movements of parts between departments and processes:
  a. *Use a special trolley or rack that temporarily stores totes for the ML before parts are moved to the put-away desk:*
     In this way, the order of processing is not disrupted of changed, overloaded put-away desks are avoided and the storing of parts is done more precise.
  b. *Unpack parts at the dock and move the parts according to their storage area to the right receiving desk:*
     Unpacking the parts saves a lot of processing time at the receiving desks. Other advantages are that the staff members learn about the different parts, the part can be sorted according to a storage location, damages are noticed earlier and a lot of unnecessary packing material is already removed.
- *Use the packing desk for priority orders also for the packing of other orders and make sure one staff member is assigned to the packing of the small line orders:*
  Effectively use the technical capacity in the warehouse. The packdesk for priority orders is often idle while an order could easily be packed on this station. The small lines contain relatively small and simple orders to pack which one person can handle.

We finalise our research with the indication of ideas for future work. We already analysed a lot of information but at some points the information is limited. To obtain this extra information, further research is necessary on the following subjects:

- *Dedicated buffers and receiving desks where parts are booked at the inbound section:*
  Staff members at the inbound section must be able to create a way to distinguish the put-away such that the parts can be sorted in to the correct buffer. Further research is therefore necessary to search for the best way to determine how the parts can be sorted in the best way. We already gave the advice to unpack the parts before placing them at the buffer sections
- *Division and layout of work stations:*
  Design the working environment of an employee in such a way that the handling is minimised. By assigning all materials, resources and space to a working place, an employee has all necessities within reach.
- *AGV for moving (empty) HUs and waste:*
  AGVs can be used for emptying the HBOUT station, since this concerns only a pallet movement to a next department. Another task for an AGV is the movement of trash to containers and picking up empty HUs.