Executive summary

The goal of this thesis report is to discover the most optimal product allocation strategy for saturated distribution centers of any kind. Similar to the increasing demand for accommodation in attracting housing markets, where demand is high and where focus is on a small part of the supply, it is difficult to find the best combinations of products and locations in a distribution center when the number of free locations is limited. There are numerous product properties, location characteristics and counterproductive performance indicators that can impossibly be taken into account in the product allocation process by human operators, when looking for these combinations. This research tends to find out to what extend software is better able to do this job. The result of this research is a software based model that is able to combine all variables concerning product allocation.

Being a stand alone project, this thesis continues on the earlier conducted work of J. Jacquemijns in his thesis: "Process improvement to shorten the lead-time for the ACD division in the distribution center of L’Oreal located in Alphen aan den Rijn" (Jacquemijns, 2017); M.B. Driever in his thesis: "Optimization of an u-shaped distribution center layout" (Driever, 2017); R. van Zeeburg in his thesis: "Improving the efficiency of the detail-pick area at the L’Oreal distribution center" (van Zeeburg, 2015) and R. Westerbeek in his thesis: Design of a product allocation and storage strategy tool (Westerbeek, 2014). Also this research was requested by the department of operations of L’Oreal Benelux and is part of the continuous process of performance improvement.

Many examples of dissertations and theses in the field of distribution center logistics are available. Where the majority of the research focuses on concepts like routing, lay-out or automation, this research specifically focuses on product allocation strategies assuming a fixed distribution center lay-out. This thesis distinguishes itself from other research, since proposed changes in the process are to be implemented during ongoing operations.

This thesis is composed of five phases, following the five steps of a continuous performance improvement methodology. Phase one is the definition phase and contains an introductory and describes basic terminology used in this thesis. Also the problems related to the subject and the research questions are discussed in this part of the thesis. Phase two concentrates on the measurements that are performed during the project. Phase three analyses the current situation and is concluded with the KPI’s that are used to quantify the results. Phase four is the design phase and is subdivided in two parts. The first part describes the construction of the different alternatives for product allocation. The second part elaborates on the best alternative, depending on the goal and type of distribution center. Both phases three and four will focus on a specific part of the L’Oreal distribution center. Phase five evaluates the findings that have been found in the preceding phases. This last phase includes a generalization of the findings. After these five phases, the report will be concluded by answering the research questions, an assessment of the conducted work and recommendations for further research.

The data that is used in this research is predominantly collected during the internship at the department of operations at L’Oreal Benelux. Quantitative data is retrieved from the ERP-system and measurements on site. Interviews with the management team and employees of L’Oreal were held to gather information on specific preferences, where generalized information is collected by conducting an extensive review of both literature and earlier conducted theses. As an important part of the research, the collected data is analyzed by product allocation software that uses a multifaceted slotting approach. This model is also used to construct different alternatives and compare the alternatives with the current situation based on the composed KPI’s. These alternatives are partially constructed by analysis of literature and partially by brainstorm sessions with relevant parties. The product allocation strategy that was found to be best suited for the L’Oreal process was implemented during a validation case study in a part of the distribution center. The different outcomes per alternative were also used to generalize the findings for different types of distribution centers.
During the research it was found that human operated product allocation is the current limitation for performance improvement. Since human operators are not able to include all constraints, product properties and location characteristics, the allocation of products to locations is not optimized. This leads to inefficiencies in the process and lower than expected performances. An example is the increased chance of depleted product locations in the case of an allocation of a fast moving product to a small volume location. This will cause for an increase in replenishment moves and a higher chance for product location to be depleted. Depleted product locations form a substantial problem in the distribution process, since it causes orders to be delayed. Preventing depletion of product location is one of the priorities for the improvement of the performance at the L’Oreal distribution center. By allocating products based on software using the multifaceted slotting approach, all combinations of products and locations are considered and the most optimal situation is suggested. This causes for an increase in operational performance since the chance of depleted product locations is minimized. Because depleted product locations are the origin of operational errors, this minimization also reduces the expected amount of complaints by customers concerning incorrect or missing products. Generally, it was found that software is better able to determine the best distribution of products over locations than human operators since in any of the constructed alternative the theoretical productivity is higher than in the human operated situation.

However, a proposed slotting strategy causes the need for product re-allocations in the current slotting. Re-arranging the current slotting situation is associated with physical moves of products and numerous changes in the supportive information technology systems, like ERP-system and drivers. These changes are accompanied with the corresponding cost in time and labour and this creates the possibility that the benefits will not outweigh the costs. Therefore, rules have been set in this research for the amount of benefit that is needed compared to the cost, caused by re-allocations. The implementation of the allocation model has another advantage. The real-time physical positions of products in the distribution center become insightful for operators and supervisors. This advantage alone already makes the implementation of the results of this thesis worth the investment.

Further research is conducted into the realistic implementation of the model. Firstly, the principle of the daisy chain is embedded in the simulated product moves. This enables the distribution process to continue during re-allocation, since every product will have a official location at any time. Secondly, the total number of proposed product re-allocations is reduced by introducing restricted moves. Product moves that are more costly that the expected gain in performance are excluded from the simulation. Furthermore, the principle of order commonality was introduced to further increase the performance. This part of the simulation combines products that are often requested together, thus referred to as the peanut butter and jelly principle, and allocates them to product bins close to each other. This principle originates from association rule learning and is often applied in supermarket in reverse. Products that are often bought together in supermarkets are allocated to product locations far away from each other. In picking processes this principle can be used to allocated products close to each other.

From the research conducted in this thesis project, multiple recommendations for further research can be made. These fields for further research can be divided in research for L’Oreal specifically or research in general. For the L’Oreal distribution center, further research towards the replenishment process, maximum bin quantity, bin capacity increase and constrained product locations are recommended. Recommendations for further general research are those in the field of cost benefit analysis, distribution center lay-out and the number of boxes per picking tour for manual order picking processes.