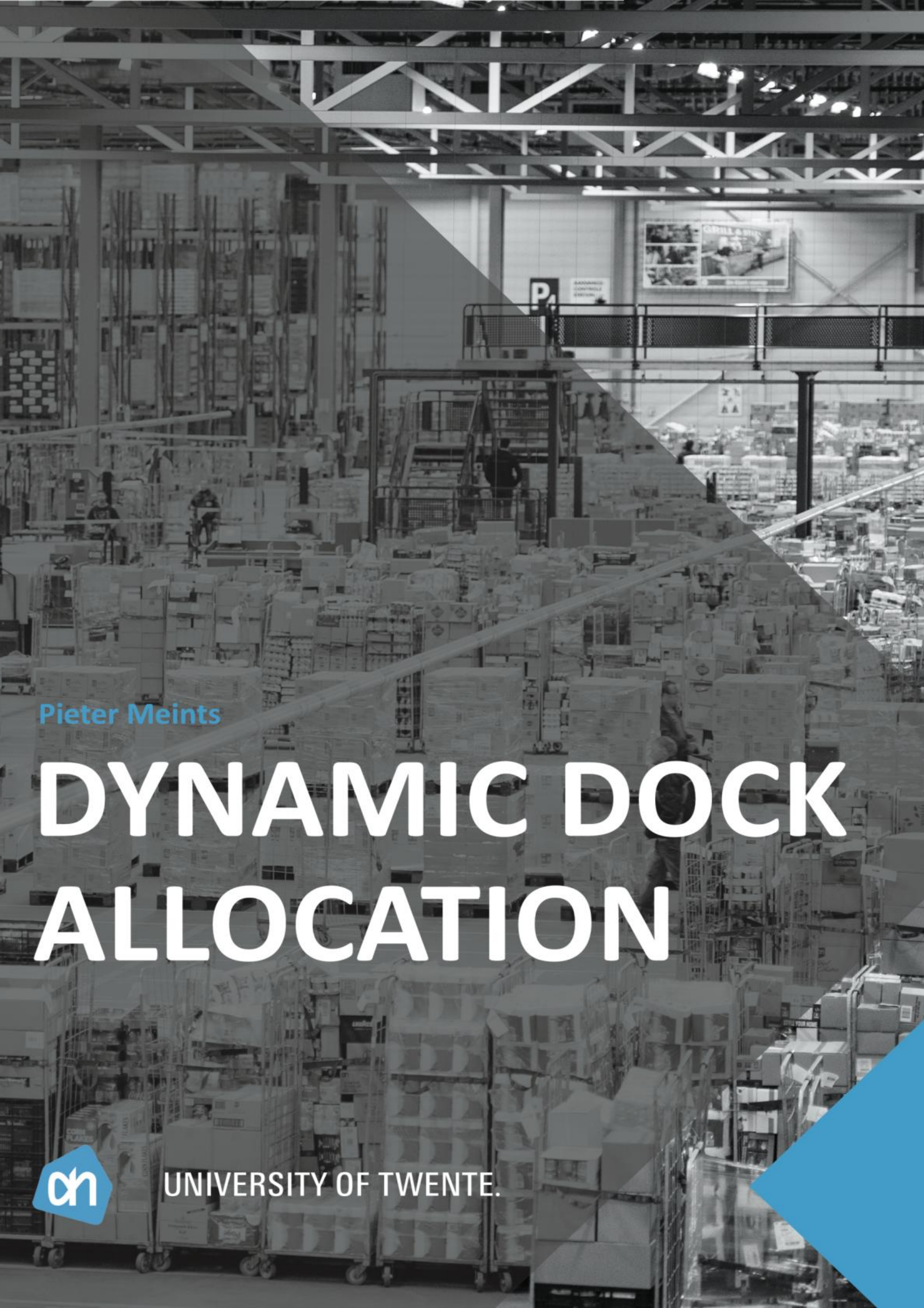

Pieter Meints

DYNAMIC DOCK ALLOCATION

UNIVERSITY OF TWENTE.

Dynamic dock allocation

Improving the dock and staging lane capacity
within the warehouses of Albert Heijn
by a dynamic allocation during the day.

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Met deze scriptie eindigt de reis die in fysieke kilometers minimaal 30.000 kilometer lang was, incluis het werk in de winkel zo'n 55uur in de week duurde en mij overal tussen Zaandam, Tilburg, Zwolle en Nieuwegein bracht om elke avond weer te eindigen in Enschede. Aniek, bedankt dat je er was als ik weer eens laat thuis was, geen vrij had in het weekend of weer eens je advies en hulp nodig had op creatief gebied.

Pieter
Mei 2015

Abstract

The docks and the staging areas behind the dock doors are essential to send and receive goods in warehouses (Figure 0.1) and easily become a bottleneck in a supply chain. Dynamic dock and staging lane allocation is an opportunity for a flexible manner of allocating docks and staging lanes. This means, allocation specific for each day of the week and depending on the three flows of goods: inbound, outbound and cross docking (transito). Such an allocation method is in contrast with the present way of dock and stage lane allocation in the warehouses owned by the Dutch retailer Albert Heijn. In this current situation the allocation is solely changed based on experience and feedback of the people working in warehouses. When changes are made the planning lasts for at least four successive months.

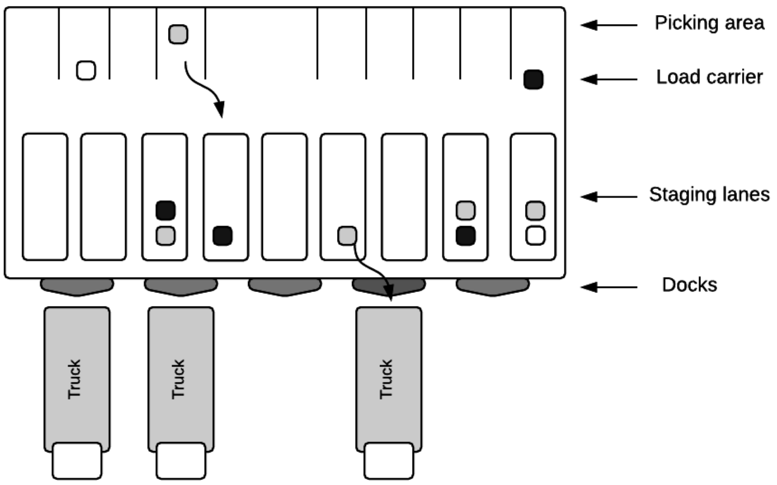

Figure 0.1: Warehouse of Albert Heijn

The following challenges make the dynamic allocation of docks and staging lanes of retail warehouses complex:

- High amount of loading and unloading moments 24 hours, 7 days a week;
- Fixed departure times to the stores;
- Combination of order picking and cross docking movements in the same building;
- Many different parties involved;
- Limitations in location, size and work convenience limit the options of available staging lanes to allocate.

This thesis is an academically grounded advice to Albert Heijn to move from static allocation towards dynamic allocation in their regional warehouses. These sites combine the break-bulk principle (order-picking) with cross-docking and within the same warehouse this is rarely seen in the existing literature. The current literature describes the cross dock principle extensively, and parameters for dock allocation have been defined. Based on the Design cycle methodology of Wieringa (2009) the literature study is combined with an extensive empirical research in the four regional warehouses of Albert Heijn.

Outcome of this research is an iteratively designed tool to help the user to quickly analyse the utilization of the docks and staging lanes in comparison with the current planning. When importing data files the user can compare the capacity needed due to this tactical planning with the current allocation. This can be done specifically for each flow separately (inbound, outbound and transito) and a total overview is also available in the tool.

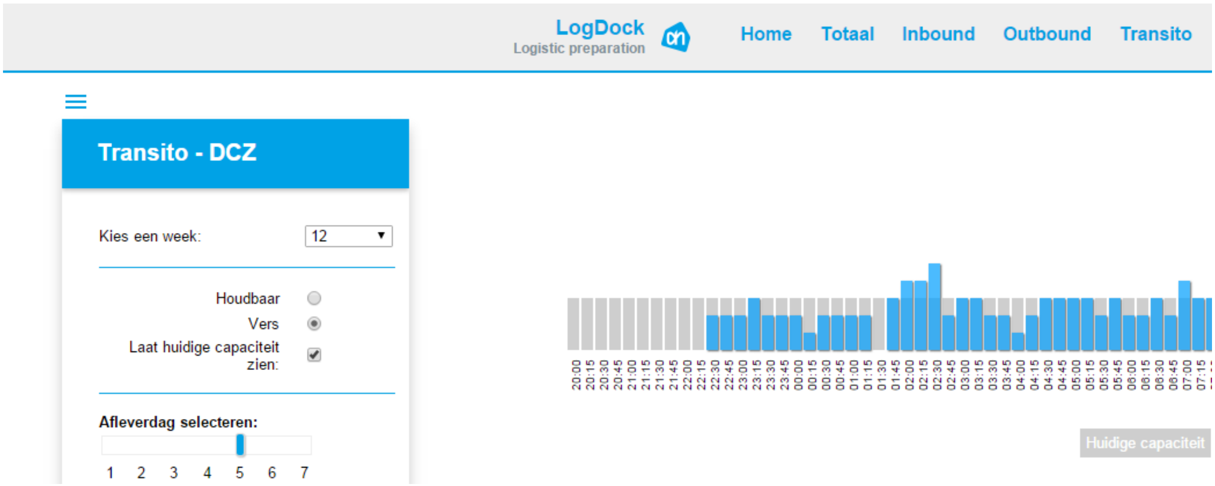

Figure 0.2: The final tool - Third iteration

The tool (Figure 0.2) has raised high awareness within the supply chain of Albert Heijn to the challenges with the current way of allocating the docks and staging lanes. Exemplary in this awareness is the cross dock planning which is extensively discussed and recommendations for an integral approach of planning have been made arsing by the tool.

We give recommendations for an operational implementation of the tool and the dynamic allocation regarding several areas:

- Make use of the current momentum of positive energy towards the project; so do it now
- Get the three departments within the supply chain involved; Ahold Transport, Replenishment and Supply Chain Support.
- A first step is set towards remodelling of the cross dock (transito) process and the corresponding planning but future research is needed.
- Redesigning the physical surroundings of the docks and staging lanes (lines and sizes) will remove limitations inside the warehouses.

With this project the first hurdles towards dynamic allocation of docks and staging lanes has been taken but future work needs to be done. When deploying the tool in an operational environment it needs to be developed into a secure tool that is maintained by professionals. Also several new features, like a management overview, different user roles and graphical layers to support the planning of the allocation have been suggested. Besides the tooling, some physical adaptations are needed to the sites, like new lines on the floor. These adaptations give the opportunity to standardize the sites and uniform their way of working.

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Abbreviations

AH	Albert Heijn
AT	Ahold Transport
BTL	Begin Time Loading (Begin Tijd Laden)
CTN	Central Transport Network (Centraal Transport Netwerk)
DC	Distribution Centre (warehouse)
ETS = VTS	Earliest time staging lane (Vroegste tijd Strek)
FTL	Full Truck Load
LDC	National Distribution Centre (Landelijk Distributie Centrum)
LSP	Logistic Service Provider
LTL	Less-than Truck Load
LTS	Last time staging lane (Laatste Tijd Strek)
LVC	National Fresh Centre (Landelijk Vers Centrum)
LZV	Extra large truck (Lang zwaar voertuig)
ND OSS	National Non-food Distribution Centre (Norbert Dentressangle, Oss)
NOTE	Abbreviation for Transtio flow from DC Oss (Niet Om Te Eten)
RDC	Regional Distribution Centre (Regionaal Distributie Centrum)
RE	Replenishment
ROS-SC	Retail Operations Support – Supply Chain
SFC	Shared Fresh Centre
SKU	Stock keeping unit

1 Introduction

1.1 Motivation

Retailers in the twenty-first century must overcome the challenge of satisfying the customers' demand with high-quality products for a low price. To this end, retailers need to be responsive to customers' unique and rapidly changing needs. (Gunasekaran et al., 2008)

Albert Heijn is the market leader of grocery retailing in the Netherlands and part of the international retailer Ahold. With their slogan "*Het alledaagse betaalbaar, het bijzondere bereikbaar*" (The everyday products affordable, the extraordinary available) the pressure is high to satisfy each day a wide variety of consumers in the Netherlands. This results in a very wide range of almost 30.000 shelf keeping units (SKUs) in each store, more than 900 stores across the Netherlands, 30 stores in Belgium and a web shop that offers almost the complete assortment including perishables and deep frozen food. To fulfil the desires of the demanding customer, a responsive and reliable supply chain is required. (Dawson, 2010)

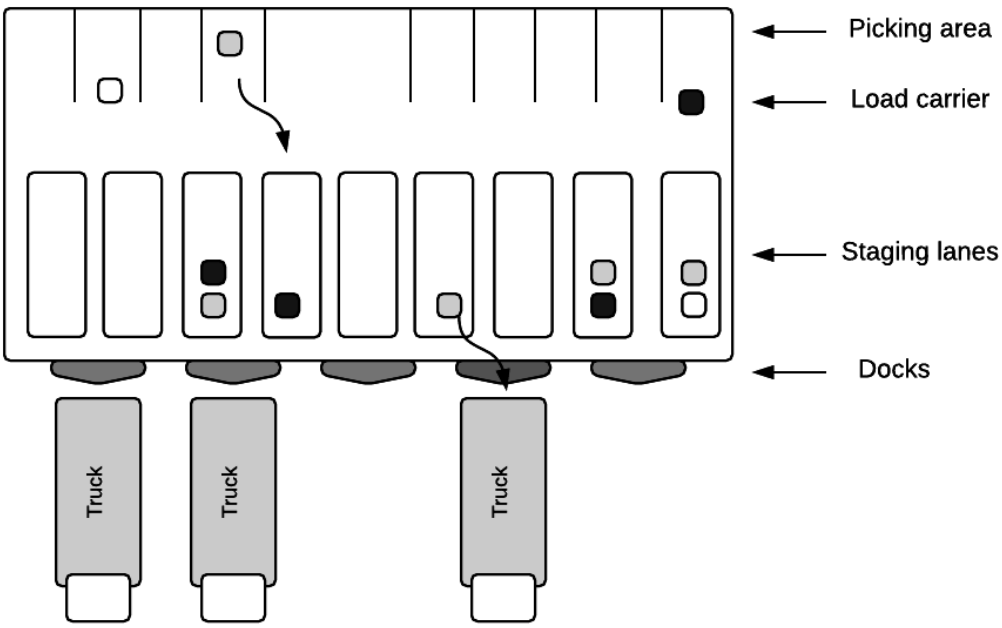


Figure 1.1: A general picture of a warehouse

Since twenty years, every store of Albert Heijn gets their goods replenished each opening day in the week. For the delivery of perishables and groceries alone, this result in 14.000 unloading moments at the stores each week combined in 9200 planned routes[1]. With an average of 3 trips per day at least 450 trucks are required to fulfil this need. From experience, every shop manager wants the perishables delivered early in the morning; to offer the best and fresh products possible. The dry groceries are ideally delivered at the end of the day: after school hours many young people are available to stock the shelves.

[1] Based on the route schema of week 15 - 2015

When deliver each store at its desired time window indeed, the work load will be very high in the morning for the perishables order picking process and in the afternoon for the groceries. In between the work load will reduce to a minimum. To prevent this from happening, the production (order picking) must be spread over the day in order to avoid congestion, reduce risks and to be able to schedule an average capacity all day long. Albert Heijn tries to deliver as many store orders as possible at the previously described ideal delivery time window. To achieve this, all outbound capacity is used to stage this store orders in front of the dock doors: at the so called *staging lanes*.

In Figure 1.1 the staging lanes are drawn in a schematically overview of a warehouse as seen within the supply chain of Albert Heijn. To put it simply; the more staging lanes and dock doors available results in more stores that gets their goods replenished at their desired time slot. Because this process is planned weeks before there are always enough trucks available.

Of course, the case is not as easy as to allocate all staging lanes to outbound freight. Also inbound freight is needed (supplier deliveries) to make the store deliveries possible. These trucks unload their freight at inbound docks and those docks cannot be allocated to the outbound operation as long as they reserved for inbound shipments.

8 November 2014 – 04:42h – Zaandam

Saturday 8 November, the warehouse management system of the warehouse of Albert Heijn in Zaandam froze. No order can be approved or loaded so the whole operation of receiving goods, picking orders and shipment to stores was stuck. Restoring the system, recounting the whole warehouse and recalculating the new store orders took the whole day. At the busiest day of the week no shipment was done in this area.

The impact for the following days is huge, as well in production peaks as in extra truckloads to replenish the missed goods of Saturday. To enable the site to produce and fill as much as truck loads as possible extra staging lanes are needed. With some handmade calculations and a lot of telephone calls; the support department Logistic Preparation add five extra staging lanes to the outbound docks. This enables the site to ship over more than 30 extra truckloads each of the following days.

Beside the inbound and outbound flows, a cross docking flow is also part of the supply chain of Albert Heijn. This so-called transito flow consists of loading carriers that are picked at store level and must be combined with the loading carriers produced in the warehouse itself (see section 2.1).
This flow needs dedicated docks and staging lanes; after unloading the cargo needs to be sorted at store level and move to the outbound staging lanes. Daily operation is in this way planned weeks before for either the inbound, outbound and transito flows will arrive. When an incident occurs these planned capacity does not suffices anymore. The text box above describes a real life incident during this project.

The transito/cross docking flow will increase in the upcoming years. Albert Heijn has started the build of a Shared Fresh Centre; a national warehouse by an external logistic service provider that picks a part of the store orders and cross dock (combine) these at the regional warehouses. This new Shared Fresh Centre will push an even higher pressure on the transito (or cross dock) docks and staging lanes. Besides this development the ambition of Albert Heijn is clear: to quickly extend their assortment in the next few years. This will have a huge impact on the inbound capacity; the inbound docks and lanes are used more than ever before. These developments put enormous pressure on the supply chain organisation of Albert Heijn, and especially on the docks and staging lanes of their regional warehouses.

1.2 Problem statement

The main research question and thus problem statement of this research is:

How can the allocation of the dock and staging lanes within the regional warehouses of Albert Heijn be improved by making the allocation dynamic?

Dock capacity and the capacity of their corresponding staging lanes are important factors in all of the current and future challenges described before. Within in the company there is a high awareness of the importance for a suitable distribution and allocation of docks and staging lanes. “Suitable” is defined as an allocation that causes a minimum waiting time for incoming trucks and has the most possible outbound lanes.

Despite this need for an appropriate allocation each day, the allocation is done only three times a year. For the next seventeen weeks, a dock and staging lane has just a single function. In the desired situation, the allocation will be no longer fixed during the day and for 17 weeks; but changes at the input of: number of trucks; the amount of produced loading carriers or other up-to-date data. This initial observation in the beginning of this project is supported by the academic research of Bodnar and Lysgaard (2013) preformed on the regional warehouses of Albert Heijn and discussed later in this report.

“Dynamic” is in this case defined as the possibility to change the dock allocation specific for each day of the week and make it possible to have an alternating allocating during a day depending on the three possible flows of goods: inbound, outbound and transito (cross dock). This dynamic allocation will be more configurable and adaptive to the current situation. The most efficient use of the resources – docks and workforce – will be achieved when an organization adapts to the current situation (Bodnar and Lysgaard, 2013; Guignard et al., 2012a).

This research describes the needs for this dynamic allocation of docks and staging lanes; and shows that a dynamic allocation is making the use of the staging lanes more efficient indeed. Using the prototyping approach we developed the “LogDock-tool”: a tool that is able to allocate docks and staging lanes dynamically by the input of real (historic/planned) data. The parameters that can change are identified as well and they are used to manipulate the data to simulate a predefined scenario. In comparison with the current situation the improvement is shown.

To answer the main question, five research questions are formulated and listed in Table 1.1. Each question is marked with their corresponding research method. These three disciplines are literature, empirical and simulation research. The literature research method is extensively discussed in section 1.3.2. Empirical research focuses on the gathering of knowledge by observation and experience in order to describe the relation between attitude and behaviour of a person or group (Ajzen and Fishbein, 1977). In this project the discipline of empirical research is mostly conducted by visiting the several warehouses and talks with the people on site, and most important the fact that we have been part of the team Logistic Preparation for half a year. The simulation discipline is used in chapter 5. In these chapters the real data is tested and applied at several scenarios.

Research questions	Subquestions	Research method	Chapters
What is the current situation and which challenges currently occur during planning and execution of the dock and staging lane planning process?	What is the current situation and are the challenges according to the literature?	Literature review	2
	What is the current situation and challenges of Albert Heijn?	Empirical	3
How will the new future supply chain affect the dock and staging lane capacity?		Empirical & Simulation	4
Which parameters and data are needed in order to make a dynamic dock and staging lane allocation?	What parameters are present in the academic literature?	Literature review	2
	What adjustments must be made to use the parameters in the AH-case?	Empirical	5
What are the requirements for the development of the LogDock-tool?		Empirical	5
What is the expected result of the proposed adjustment to the current situation?		Simulation	5

Table 1.1: Subquestions with research methods

1.3 Research overview

The project is done in a systematic manner and is achieved by the use of the design science research method (Wieringa, 2009). This is in keeping with Hevner et al. (2004) who has stated that solving a challenge for stakeholders needs a design of an artefact that will meet the goals of the stakeholders. The method results in an iterative cycle to solve the design or practical problems that are described and elaborated by Wieringa (2009).

The milestones of the project are the several iterations of the tool, and this report. Each deliverable builds on the other. In Figure 1.2 the design steps are illustrated, and the deliverables are put in bold. All boxes of one stage function as input for the stage-deliverable.

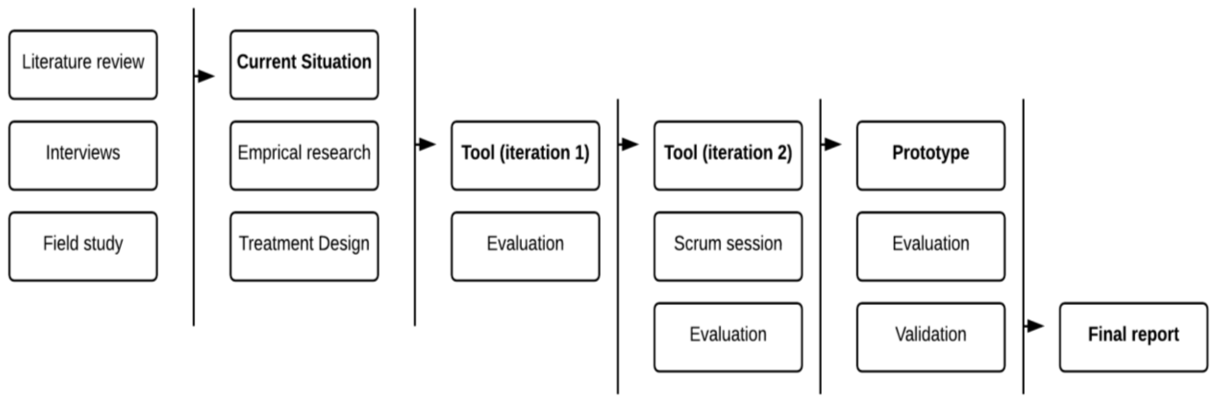


Figure 1.2: Design steps

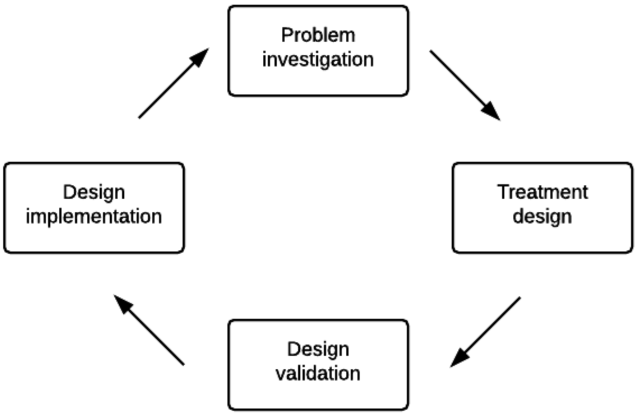


Figure 1.3: Engineering Cycle by Wieringa (2009)

1.3.1 Project methodology

The iterative cycle proposed by Wieringa (2009) is known as the *Engineering cycle* and consists of four successive steps (see Figure 1.3):

Problem investigation is the first step in a new engineering project. In this step the stakeholders are identified and categorized. The stakeholders have several goals that must be reached by the treatment developed in a later stage. Also the effects and the contribution of these effects to the goals are examined. Combined with empirical research, this results in an overview of the current situation in which the project takes place.

The *treatment design* is the next step and is the core of the project. "Treatment" is defined as the attempt to solve a problem, in other words: an attempt to achieve a goal. Before designing this solution (or artefact), requirements must be defined to know where you are looking for and also to specify the desires of the stakeholders. With this information you can compare and select existing treatments, or like we have done in this project: design a new one.

Validating the found or new designed treatment is done in the *Design validation* step. The goal of this validation is to predict how the artefact will perform in practice. Because of the treatment has not been implemented in the real world situation, the validation is based on prediction. This is a drawback according to Wieringa but the only way to test the solution before implementing it in real world.
By asking the effect, trade-off and sensitivity questions in section 1.2 the different circumstance of the solution in the real-world will be predicted. Although these questions can also be asked about a virtual case; the use of a prototype is in our project inevitable. Testing with the prototype helps to simulate the real world as close as possible and results in more reliable predictions/validation.

The last step, *Design implementation,* is added to the cycle to not solely validate before the implementation of the treatment but also evaluate it afterwards. Without this last step, the implementation and evaluation, the cycle is called a design cycle.
The design implementation is often not executed in academic research because it is time consuming, and the impact of implementing a treatment into an organization is significant. Due to the scope of this project, the step of design implementation is not executed in this project either.

1.3.2 Literature methodology

We adopted the following method for the literature review; a systematic method that helps to find, select and present the state of art of the academic literature, concerning the topic. The *Five-Stage Method* by Wolfswinkel et al. (2011) who based their work on the research of Webster and Watson (2002). The theory starts with the first of five steps by the definition of the search queries and research area. In combination with the sources/ search engines and criteria, the first step is experienced as relatively easy to perform. Most of this step is already identified in the previous sections, i.e. the motivation and problem statement. The second step is straightforward either: perform the search in a prevailing scientific search engine. In this research the Google Scholar and the Scopus engine is used. In Figure 1.4 the method is represented in a scheme.

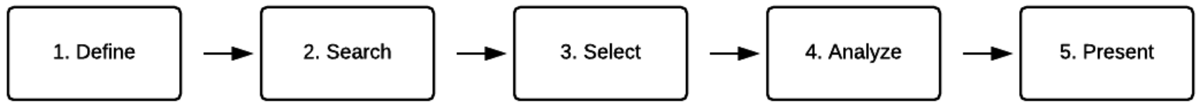


Figure 1.4: Five-Stage Method (Adapted, original from Wolfswinkel et al., 2011)

The third step is the most important and extensively described by Wolfswinkel et al (2011). In an iterative way, the several elements of this step are the key component of our literature review. In Figure 1.5 this crucial step in the process is shown. The forward/backward citations need some explanation: forward citations are the found citations that are used by the analysed paper in their own research. Backward citations are the papers that are used by the author of the paper to support the author's own research. The back and forward citations have proven as very relevant in this project; many papers are derived in such a way. The selected backward citations are in the next cycles also analysed by abstract and full text, due to the iterative way of the step. In a next cycle of the same step, the backward citations can also be leading to other backward citations themselves; as shown in Figure 1.5.

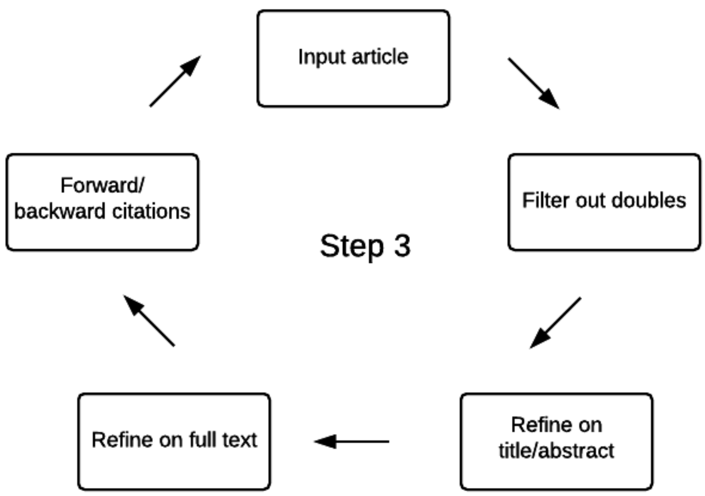


Figure 1.5: Iterative elements of Step 3 of the literature review by Wolfswinkel et al. (2011)

The fourth step of the method is not carried out as proposed by the author, but elements are present in this research though. The coding of the papers, by highlighting keywords so forth is done by annotations and remarks but not documented as Wolfswinkel et al. suggest. This is a very labour intensive process, and we expected it would result in pretty much the same results. A concept matrix, suggested by Wolfswinkel as well, is shown in Table 1.2, to give a clear overview of the basic concepts and their sources in the literature review of chapter 2. The concepts are derived from an initial literature search done in the preparation phase of this project and added up with some extra concepts found during the literature review.

	Dock assignment (with cross docks)	Staging queues	Cross docking (and planning)	Dynamic allocation	Retail supply chains	Multi-criteria Scheduling	Information Processing
Agustina et al. (2010)			X				
Apte and Viswanathan (2000)	X	X	X				
Bartholdi and Gue (2000)	X	X	X	X			
Belle, van et al. (2012)	X	X	X	X			
Berghman et al. (2011)	X					X	
Bodnar and Lysgaard (2013)	X	X	X	X	X		
Boysen and Fliedner (2010)	X		X			X	
Boysen et al. (2010)	X		X				
Boysen et al. (2013)	X		X				
Daft and Lengel (1986)							X
Dawson (2010)					X		
Fleischmann and Meyr (2003)					X		
Flynn and Flynn (2005)			X		X		X
Gagliardi et al.(2007)	X				X		
Galbraith (1974)							X
Gopakumar et al. (2008)	X				X		
Gue and Kang (2001)		X	X				
Guignard et al. (2012a)			X	X			
Guignard et al. (2012b)			X	X			
Hoogeveen (2005)						X	X
Larbi et al. (2011)	X		X				
Liao et al. (2010)			X				
Miao et al. (2009)	X		X		X		
Tsui and Chang (1992)	X		X				
Whiteoak (2004)	X		X		X		
Zhu et al. (2009)	X	X	X	X			

Table 1.2: Basic concept matrix for literature reviewing

2 Literature Review

This section provides a thorough overview of several topics that has shown relevance in this project. Academic literature generally starts from an ideal point of view, unlike the warehouses of Albert Heijn who has its own peculiarities. A comparison of both is therefore inevitable, and is done in chapter 3.

Because cross docking is found as the common denominator of academic literature about dynamic allocation and the most deviant flow within the warehouses of Albert Heijn; cross docking is studied first in this review. From this point on the parameters, definitions and methods of dynamic allocation have been studied.

2.1 Cross docking

Cross dock terminals are defined by Boysen and Fliedner (2010) as consolidation points in a supply chain where several smaller shipments can be merged to a full truck load heading to another destination. These combinations are made to realize more efficient transportation and reduce the number of vehicle movements from a supplier to the retailer and their shops. (Liao et al., 2010)

In contrast to traditional warehouses, cross dock terminals are meant to create a direct flow from the inbound to the outbound dock as fast as possible with a minimum dwell time in between. The goods receiving not enter the storage area and not are marked as inventory. (Apte and Viswanathan, 2000). Traditional retail warehouses are mainly based on the break-bulk warehouse principle, where, in ideal situations, full truck loads (FTL) arrive from a supplier and broken up into smaller quantities. These break-bulk warehouses feature the traditional order-picking process; in contrast to a cross-docking centre. Consolidated with other products this resulted in multi-product loads that combined resulted in near as possible FTL to the retailer shops. (Apte and Viswanathan, 2000).

Not all product categories will fit the cross docking or break-bulk principle. Items with an unstable or fluctuating product demand rate are not suitable for cross docking. The absence of an inventory makes the risk of out-of-stock too high. The retailer usually wants a safety-stock of at least a day and warehouses close to the stores. (Apte and Viswanathan, 2000) Products with a low and predictable turn-overrate are slow movers. These slow movers often stored in a central warehouse. Next, these slow movers are cross-docked to the break-bulk warehouse and combined to a single shipment towards a retail store. The biggest traditional retailer in the world, Wal-Mart, is using this combination or hybrid warehouse solution for over twenty years and also Albert Heijn has adopted this strategy as shown in chapter 3. The terms of a *cross-docking terminal* and a *cross-dock* are used interchangeable in the rest of this report, and so do the terms *dock*, *dock door* and *doors*.

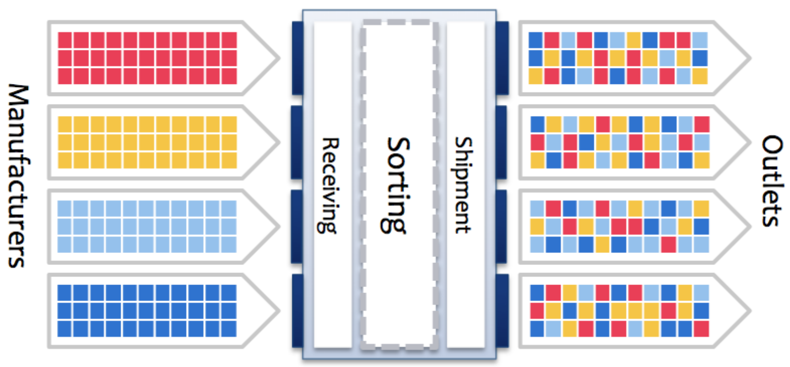


Figure 2.1: Cross Docking

2.2 Cross dock characteristics

Several characteristics are identified and must be considered to get an overview of the different types of cross docks and methods to “cross-dock”.

2.2.1 Staging lanes

An important characteristic that also influence the performance of a cross dock is the staging method. In the pure form of cross docking the staging area is absent; the goods are received and loaded directly into the outbound truck. (Apte and Viswanathan, 2000). In practice this purest form is rarely seen, and freight always need some processing or waiting-time to consolidate with other inbound freight to reach a higher utilization of trucks.

The almost inevitable staging can be done in one or more steps. The paper of Gue and Kang (2001) is most cited in this topic and they described the several options in staged cross docking. In a single-stage cross dock, workers unload the load carriers and place them on the staging lane that is linked to the inbound dock. Other workers deliver the goods from these inbound staging lanes directly to the outbound truck. They combine thus the load carriers of several inbound staging lanes to one outbound truck. (See Figure 2.2)

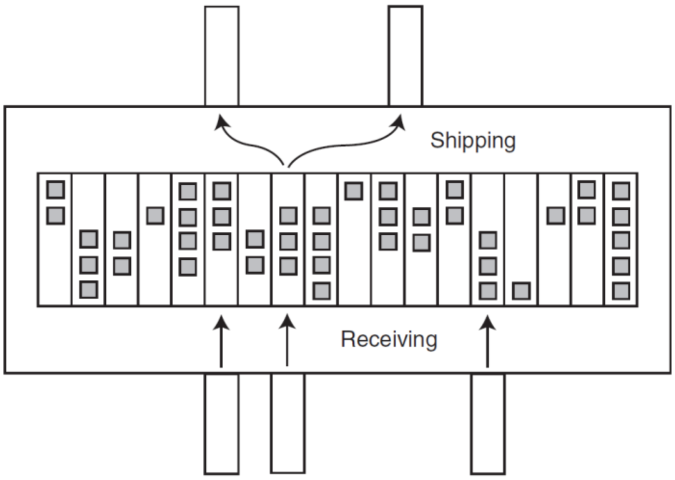


Figure 2.2: Single-stage cross dock, sorted on inbound docks (Gue and Kang, 2001)

The system of Figure 2.2 can also be used to stage in front of the shipping dock rather than in front of the receiving dock. The advantage of staging on inbound is however that the workers that unloads the truck don’t have to worry about the destination of the load carrier. This makes the unloading faster and lowers the need for information about the shipping location. On the other hand Gue and Kang (2001) also explains the advantages of sorting by shipping: the better view of what freight needs to be shipped and the possible combinations of rides are clear benefits.

Because of the aforementioned benefits a combination of this two staging systems is proposed and also used in practice. This two-stage system is seen quite often in the retailing industry. The system is based on two staging areas: a receiving staging area and a shipping staging area. In between these staging area or lanes the load carriers are sorted. This is illustrated in Figure 2.3.
The two-stage cross dock clearly combines both benefits of inbound and outbound staging areas. However, Gue and Kang (2001) prove that these benefits comes with a significant lower throughput in comparison with a single-stage system.

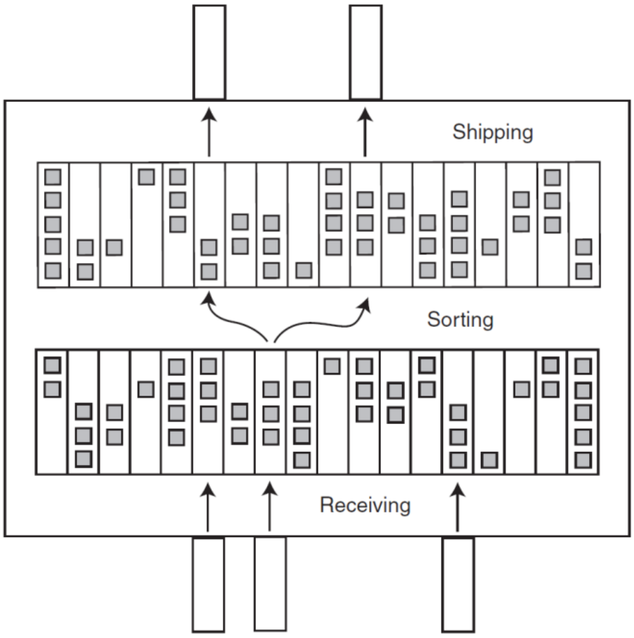


Figure 2.3: Two-stage cross dock; with sorting in between the two staging areas. (Gue and Kang, 2001)

2.2.2 Service mode

The service mode of a cross dock influences the flexibility in the assignment of staging lanes and dock doors, according to Boysen and Fliedner (2010). They recognise the following service modes:

- *Exclusive mode:* Each dock exclusively serving either an inbound or outbound destination for a longer period, for example a month. This will be efficient for the workers because they know and learn each destination by heart. However, when fluctuations occur this solution is less flexible or in the terminology of the authors: “restricts the degrees of freedom for short-term truck-scheduling”.

- *Mixed mode:* No physical differences/restrictions exist that limit a dock only as inbound or outbound. Therefore some cross docks allowing an intermixed allocation of in- and outbound docks over time.

- *Parallel exclusive/mixed mode:* A subset of docks is allocated in exclusive mode and the remaining docks are in mixed mode.

- *Mid-term* horizon: Assignment is done by coupling docks and destinations. An assignment of a truck is thus determined by the trucks’ destination.

The mid-term mode reduces the complexity of the truck scheduling; but reduces also the possibility to adapt to unforeseen circumstances. In each specific case the choice must be made what is the best solution; based on the available information and types of flows in the cross dock.

2.2.3 Arrival & departure

According to Van Belle et al. (2012), arrival patterns have their influence on congestion and capacity inside a cross dock. The arrival times can be *concentrated* on several moments a day, for example in the evening and then all arrivals sorted in the night. The other option is that the arrival scheme is *scattered* throughout the day; and the inbound trucks arrive at different times each day. This makes the planning more complex, but is often a more realistic approach.

In many cases (real world as well as academic experiments) the departure times are not restricted and the trucks depart when all the freight is loaded or unloaded. (Van Belle et al., 2012) Inbound trucks that has restricted departure times must unloaded on time i.e. to prevent getting penalties by the inbound transport company. But in practice the trucks never leave before all freight is unloaded. Outbound trucks in for example the parcel industry must leave exactly on time to meet the delivery appointments with customers. When some freight is delayed the truck will leave the cross dock without the complete freight in order to not delay all other parcel deliveries. (Van Belle et al., 2012) This restricted times has impact on the choice of service modes as described in §2.2.2; mixed modes are more complex when dealing with fixed departure times. The outbound docks must be reserved in advance to guarantee the availability at the specific departure time.

2.3 Cross dock optimization

The main objective in a cross dock terminal is to minimize the handling time between the inbound and outbound destination within the terminal. To fulfil this objective a lot of academic (case) studies are done in order to calculate the optimal planning of in- and outbound dock allocation. The state of art in cross dock optimization is researched by Van Belle et al. (2012). The authors divide the dock allocation problem in two groups. The first group of academic research papers try to answer the question *where* a trailer must be allocated, at which dock. The other group tried to answer the question *when* a truck must be (un)loaded.

2.3.1 Tactical optimization

The *where*-question is classified to determine which dock must be allocated to a truck. The ultimate goal of this optimization is to reduce the traffic and material handling inside a cross dock terminal. A classic study and used in almost all recent papers is the work of Tsui and Chang (1992).

They identify the following basic parameters:

- Number of shipping docks (outbound)
- Number of receiving docks (inbound)
- Number of origins of items
- Number of destinations of items
- Distance between shipping and receiving dock
- Amount of movements needed to move all items from shipping to receiving dock.

Additional parameters by Zhu et al. (2009)

- Volume of goods from origin
- Volume of goods from demand of destinations
- Capacity of receiving dock
- Capacity of shipping dock

Goal: minimize travel distance between docks

The additional parameters of volumes and capacity, makes it possible to assign multiple destinations or origins to a door. The capacity of each door is therefore determined by the available capacity on the corresponding staging area behind the door. (Zhu et al., 2009)

Bartholdi and Gue (2000) investigated the “where-question” in comparison with a First-Come-First-Serve (FCFS) policy. With a FCFS policy each truck is randomly assigned at the dock that is available in order of arrival. To simulate this policy more easily, the authors used the concept of an average trailer. When for example 12% of the total incoming freight is always from supplier X, the average trailer has 12% of its load of supplier X.

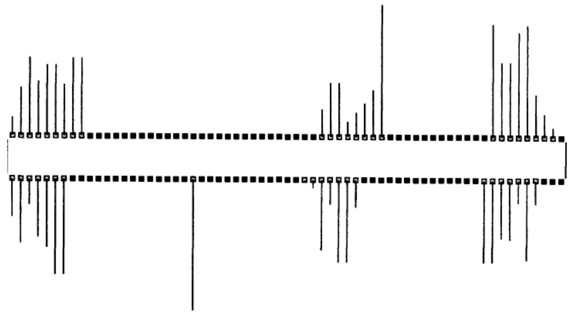


Figure 2.4: A warehouse layout without optimization (Lines are relative use of outbound docks, the filed squares represent the inbound docks) (Bartholdi and Gue, 2000)

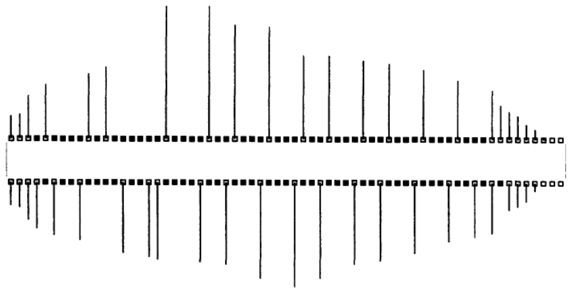


Figure 2.5: A warehouse layout with optimization (Bartholdi and Gue, 2000)

The cross dock layout in Figure 2.5 is the result of the (optimized) calculation as described by Tsui and Chang (1992) with the input layout of Figure 2.4. Bartholdi and Gue (2000) preformed these simulations to conclude the following guidelines for efficient layouts:

- Alternate between high-flow outbound doors with inbound doors in the centre of a cross dock
- Put busy outbound doors slight off-centred to reduce travel time and congestion
- Put inbound doors opposite busy outbound doors
- Put least busy doors in the corners to avoid congestion
- Separate different regions when trailers have different types of freight (e.g. cross dock and break-bulk)

2.3.2 Operational optimization

The *when*-question is, among others, addressed by Boysen et al. (2013), Larbi et al. (2011) and Miao et al. (2009) and focuses on an optimal assignment of truck at a specific time that minimizes the operation cost of the total shipment. Boysen and Miao both combine this with the reduction of unfulfilled shipments when assuming that the outbound trucks leave at a fixed time schedule. They all use the same parameters:

- Number of inbound trucks
- Number of outbound trucks
- Number of docks (depends on service mode that is chosen, see §2.2.2)
- Operational time per unit
- Operational unit cost
- Number of units
- Unload time per inbound truck (when truck is first unloaded and later processed)
- Movement costs (number of fork truck movements or actual costs)
- Capacity of cross dock / staging area

Goal: Sum of total dock operational costs and the penalty cost for all the unfulfilled shipments

Boysen and Fliedner (2010) introduce a classification of truck scheduling problems and all relevant parameters and variables are discussed in the sections before. (2.1 - 2.3). They conclude their overview with the claim that the truck scheduling problem for fixed outbound schedules is yet unexplored. They came up with a proposed solution, which seeks to minimize the weighted number of delayed shipments. These shipments are those who are missed in the shipment and remains in the terminal when a truck departs at a fixed time. They use the same variables as noted above.

In Boysen et al. (2013),the authors not only extend the findings described above, but also applied the method on a case by DHL Airport Hub in Leipzig. They identify the following three extra requirements due to the real world case:

- A terminal can be extended by additional dock doors
- Departure times of the outbound trucks can be postponed in order to meet the deadlines
- Transhipment times can be reduced: the time needed to process from inbound to outbound. This can be done by additional workforce or automation.

These three requirements lead to the conclusion that adding more doors to the simulation results in the most effective solution. The other parameters will help to a certain extend but leads to more congestion when applied too much. This case is one of the few real world examples in this research field. Van Belle et al. (2012) also noted the lack of real world simulations after the extensive literature review they preformed, especially when considering cross docking with fixed outbound departure times.

2.3.3 Dynamic use of allocation

The described services modes in section 2.2.2 enable planners to make the dock allocation dynamic. But almost all researched papers in this project and also by the extensive review of Van Belle et al. (2012) don't take benefits of these different service modes into account. The only distinction they made is the mid-term and short-term allocation of docks, but not in a dynamic way. Until now, only Guignard et al. (2012a)researched this gap in a general way, and Bodnar and Lysgaard (2013) in a case applied to the Albert Heijn warehouses.

Guignard et al. (2012a) proposed two situations; the dynamic allocation of inbound trucks and outbound. If there is a need for an inbound assignment (an inbound truck show up), the dock assignment calculation (for example by Zhu et al. (2009)) is reformulated. All already assigned inbound trailers are removed. All docks that are occupied cannot be used so they are also neglected. For the available inbound dock doors the capacity is calculated; and the assignment calculation is run again and the most ideal inbound door is assigned.

An outbound dock can however be occupied when considering a new outbound flow to a dock. It is important to consider the time needed to finish the job that occupies the dock. All the inbound doors of the flows that need to go across the cross-cock are already assigned to an outbound dock. Therefore only a search to the best dock in terms of distances is needed to complete the assignment.

Bodnar and Lysgaard (2013) consider the problem of scheduling trucks in a cross-dock terminal with a mixed service mode dock door operation. They prove that with proper use of dock doors and scheduling the trucks substantially smaller amount of docks can be allocated. The solution of the authors combines a flexible allocation of docks with a certain amount of doors operating in an exclusive service mode. They stated that flexibility may impose complexity to the organisation in a managerial point of view. This is also described by Bartholdi and Gue (2000) who describe the use of the exclusive service mode due to practical reasons: the type of freight loaded and unloaded differs as do the procedures and equipment.

The authors test their hypothesis that an increase of mixed service mode dock doors will reduce the total cost level on the data of the four regional warehouses of Albert Heijn. The results show that reducing the total number of docks increases the total costs, and as the ratio of flexible door increases the total costs decreases. Bodnar and Lysgaard (2013) concluded that the trucks can be scheduled at the current cost level of AH, but with fewer dock doors, of which 60% is flexible. So the performance of the warehouses increases when a mixed service mode is adapted, but the improvement levelling off as the number of mixed doors increases over 60%.

2.3.4 Slack capacity

The concept of slack capacity is used only by Guignard et al. (2012b) in a study to dock allocations for cross docks. Slack is capacity reserved for deviations in forecasts; in order to have the ability to scale up when needed. In real world cases this slack capacity is often used (and needed!) but in academic project it is a seldom.

The reasoning behind adding slack capacity to the calculation is that forecasts are not 100% reliable and therefore the allocated docks and capacity are possible not sufficient. Guignard et al. (2012b) did their calculations within a range of 10%-30% of the total capacity reserved as slack. They don't conclude in their research what percentage is the most efficient and depends on the reliability of the forecast. The authors simulate therefore with a range of different amounts of slack, and advise to do this in every specific project.

2.4 Multi-criteria scheduling

Berghman et al. (2011) have researched the situation in which the incoming and outgoing shipments of large quantities of directly picked goods are unrelated. This is an unexplored exception in the field and this resulted in several solutions.

Often the challenge in creating a schedule is to achieve the optimal value for multiple criteria at the same time. One criteria is in general more dominant than others and conflicting criteria are sometimes repealed from the original list with requirements. According to Berghman et al. (2011) a common approach to dealing with all criteria simultaneously is to aggregate the different criteria into one function; a process that is called simultaneous optimization. (Hoogeveen, 2005) In this way the dominant criteria can be weighted in the function as the most powerful and devaluate the other. Pinedo (2012) suggests to first analyse the set of all schedules with optimal results calculated with only the dominant criterion and after that perform a search within this set for the best in respect to the other criterion/criteria.

2.5 Information processing

To calculate optimization functions as described in the previous section we need insight in the available information associate with dock allocation. Which information is available and in what frequency, affects to a great extend the ability to make the allocation more dynamic.

2.5.1 Organizational designs

The greater the amount of information that needs to be processed, the greater the uncertainty of the task will be. Galbraith (1974) explains that if the task, that is related with the information processing, is well understood much of the activity can planned in advance. If the task is not well understood, last minute changes must be made during the execution of the tasks. These last minute changes require a lot of information.

> ***"The greater the task uncertainty, the greater the amount of information that must be processed among decision makers during task execution in order to achieve a given level of performance" (Galbraith, 1974)***

2.5.2 Design strategies

To identify the amount of information that needs to be processed in for example the dock and staging lanes capacity three organization design strategies are identified by Galbraith:

1. Coordination rules and programs
2. Hierarchical Referral
3. Goal Setting

Coordination by rules and programs is meant to coordinate behaviour in routine predictable tasks. These tasks can be pre-planned to a great extend and do not require a lot of interaction with the environment. Each actor in the task simply executes his/her role without much information processing.

Hierarchy is employed when uncertainty within a task becomes greater. When actors face a situation in which there are no rules/programs conducted, they must rely on someone or something that has the higher perspective. Of course there is also a limit to this overview and then the uncertainty will increase again.

If uncertainty is increasing and the strategies of rules and hierarchy aren't sufficient anymore the next strategy comes along. *Coordination by targets or goals* takes place by setting output targets or goals instead of specifying the complete task. This creates a higher need of information to reach the ultimate target/goal.

2.5.3 Need of information

Following the example of Galbraith the question asked by Daft and Lengel (1986) is: "Why do organizations process information?" The proposed answer by Daft and Lengel is twofold: to manage uncertainty and also manage equivocality (ambiguousness). Ambiguity is a typical human aspect of information processing; most humans have the capacity to interpret and respond to messages more subtle than a binary good or false.

When taking this answer into account; there is not only a need of information but also a need of correct information. When the information, proposed to reduce uncertainty, in for example allocating docks is meant to interpret by information technology; the level of ambiguity needs be a lot less then when used by a human.

To determine which information is needed in order to make the dock and staging lane capacity more dynamic is therefore depending on the tasks to be preformed but more important of the actors that are involved.

2.6 Summary - Functional requirements

The functional requirements are all the important elements of the allocation method, summarised in one table, based on the relevant literature in this chapter. These requirements are the basis for the project and compared later in with the Albert Heijn-case. The different service modes; whether a dock and staging lane is dedicated to one function or a combination of functions is an important parameter in the decision-making process later on this project. See for the complete overview Table 2.1.

In this literature review is strongly focussed on the cross dock principles. Whether the warehouses of Albert Heijn are hybrid solutions between the break-bulk and cross-dock method (see chapter 2.1); within Albert Heijn also the focus was during this process on the cross-dock optimization. Due to the large extend of information exchange this process relies heavily on correct data and communication between stakeholders. Decisions must be made on tactical level about *where* and *how much* the cross docking staging lanes must be situated.

Slack capacity is an undervalued topic in the academic literature reviewed in this project. Only Guignard et al. (2012b) briefly discuss this topic and take this parameter into account. This low awareness is recognized in practice and also within the organization of Albert Heijn. To determine what percentage of slack must be chosen is a frequently topic of discussion among the different departments.

#	Functional requirements	Urgency	
	Overview		
RQ1	The system delivers an optimal dock and staging lanes allocation based on available data.		
	Input Values		
RQ2	The data needed for the allocation is available and up to date	Mandatory	
RQ3	The data needed to allocate at *place* shall contain at least the following parameters: - Number of shipping docks (outbound) - Number of receiving docks (inbound) - Number of origins of items - Number of destinations of items - Distance between shipping and receiving dock - Amount of movements needed to move all items from shipping to receiving dock.	Mandatory	
RQ4	The additional data when a multiple function allocation is desired: - Volume of goods from origin - Volume of goods from demand of destinations - Capacity of receiving dock - Capacity of shipping dock	Mandatory when multiple function allocation	
RQ5	The data needed to allocate at *time* shall contain: - Number of inbound trucks - Number of outbound trucks - Number of docks - Operational time per unit - Operational unit cost - Number of units - Unload time per inbound truck Movement costs - Capacity of cross dock/staging area	Mandatory	
RQ6	The data can be adapted by certain variables to simulate several scenarios.	Desirable	
RQ7	The user can add different percentages of slack capacity to the model	Desirable	
	Output Values		
RQ7	The locations of the allocated docks must be distributed according to the following rules: - Alternate between high-flow outbound doors with inbound doors in the centre of a cross dock - Put this busy outbound doors slight off-centred to reduce travel time and congestion - Put inbound doors opposite busy outbound doors - Put least busy doors in the corners to avoid congestion - Separate different regions when trailers have different types of freight (e.g. cross dock and break-bulk)	Desirable	
RQ8	The program shall allocate only the dock and staging lanes that are available according to the following classifications: - Exclusive mode - Mixed mode - Parallel mode - Mid-term mode	Mandatory	

Table 2.1: Functional requirements (Summary of literature review)

3 Current situation

3.1 Supply chain Albert Heijn

The national supply chain of Albert Heijn consists of six distribution centres (DCs) owned and managed by AH. Two national DCs and four DCs dedicated for returns are outsourced to logistic service providers (LSP). In the second half of 2015 a third national DC is operational and run by a LSP. This DC, called Shared Fresh Centre (SFC), will replace the National Fresh DC (LVC) in Nieuwegein. The number of SKU's held by this new national centre will be extended in the future by moving some products from the regional centres to the SFC. In 2016 the SFC is fully operational and will replace the current national fresh centre.

With the terms warehouse, distribution centre or site we all mean the same thing; therefore the term are used interchangeable within this report.

Type	#	Operator	Locations
National DC (LDC)	1	AH	Geldermalsen (1)
National Fresh DC (LVC)	1	AH	Nieuwegein (2)
Shared Fresh Centre (SFC) (2016)	1	Norbert Dentres-sangle (LSP)	Nieuwegein (2)
Regional DC (RDC)	4	AH	Zwolle (3) Tilburg (4) Pijnacker (5) Zaandam (6)
National non-food DC (ND OSS)	1	Norbert Dentres-sangle (LSP)	Oss (7)
Shared warehouse Cheese DC (SWK)	1	Bakker logistics (LSP)	Zeewolde (8)
Returns	4	Kuehne + Nagel (LSP)	Zwolle (3) Tilburg (4) Pijnacker(5) Zaandam(6)

Table 3.1: Overview distribution centres (DCs) Albert Heijn

Figure 3.1: Locations of the DCs

3.1.1 Return flow

The return flow consists of return goods, like load carriers, empty crates, deposit goods returned by consumers and garbage returned by the stores. The policy of Albert Heijn prescribes that almost every truck that delivers goods to the stores take returns back to the DC, exclusions are extra planned routes. The returns are since 2009 no longer directly transported from the store to the regional DCs but to an external warehouse, managed by Kuehne + Nagel. With so-called shuttle drives the load carriers and empty crates are shipped from the return sites to the RDCs and the national DCs. Of course also the external DCs receive these goods in order to supply at uniform load carriers throughout the chain. Regional centres return empty pallets and garbage like plastics packaging back to the return sites. The pallets and empty crates (for perishables) must also be shipped back to the supplier. This is normally done by the shipper themselves after delivering new stock to the sites. They take the pallets and crates from the return site to their own plant.

3.1.2 Cross docking

As explained in section 2.1, Apte and Viswanathan (2000) identified two different types of warehouses; cross docks and break-bulk warehouses. Where cross docks focus only on the handling of ready to ship load carriers is the break-bulk warehouse meant to receive Full Truck loads of a single item from a supplier and combines only single packages on load carriers to the specific store.

In the supply chain of Albert Heijn a combination of both is adopted in a hybrid solution. The national centres act like a pure break-bulk warehouse: on store level the slow movers are picked from pallets to the load carriers. In a FTL these load carriers are shipped to the regional warehouses. There the carriers are sorted and cross docked to the trucks heading to the stores. This flow is within Albert Heijn known as *transtio* and used interchangeable with cross docking in this research. Besides this cross docking, the regional DCs acts as a break bulk warehouse where items are order picked. Because this is done for the same products in all four regional DCs only the fast movers are slotted in there.

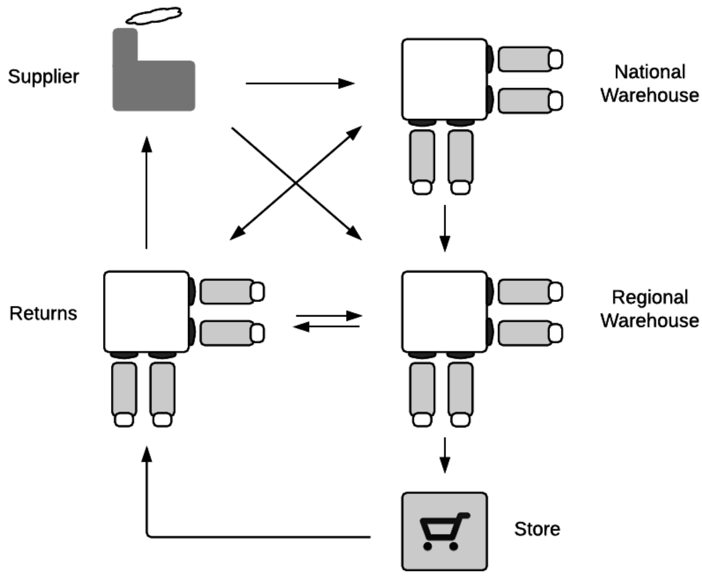


Figure 3.2: Schematic view of supply chain AH

As displayed in Figure 3.2 the supplier delivers thus either to the national DC or the four Regional DCs; depending whether the goods are slow or fast movers. Never a truck leaves a national DC heading to a store; these flows are always cross docked in the regional centres.

3.1.3 Transport

The cross dock movements between the DCs and the shipping to the stores are planned by Ahold Transport. They hire the trucks and truck drivers from external companies; Albert Heijn doesn't own any truck or trailer. Ahold Transport coordinates all these trucks because there are a lot of possibilities to combine truckloads and jobs. The Central Transport Network (CTN) is part of Ahold Transport and tries to make the utilization of hired trucks as efficient as possible. They not only schedule the routes to the stores, but also plan the transportation of goods from the shipper to the DCs and act as a transport company itself. In their vision there is always a truck, part of the CTN, nearby a job, since the stores of AH are spread all over the Netherlands and Flanders.

3.2 Docks & Staging lanes

The staging lanes behind the dock doors are the parking lot for load carriers that are packed with produced colli (packages) and the unloaded pallets from suppliers. Also the transito-flow is, after unloading from the truck, sorted and parked at the staging lanes.

The challenge of dock allocation at Albert Heijn is quite similar to the truck dock assignment problems in cross docking literature described in chapter 2. Due to the hybrid nature of the warehouses of Albert Heijn part of the goods flows are actually cross docking based activities. However, more than 65% of the flow of goods is picked directly in the regional warehouses instead of cross docked from nation-wide warehouses. The incoming and outgoing shipments of large quantities of directly picked goods are unrelated. This is in clear contrast to the numerous examples of cross docking optimization literature. (Berghman et al., 2011).

3.2.1 Function

Due to the different kind of flows that are staged at the staging lanes, each lane has its own function allocation. They are separated into two categories: *inbound* and *outbound* traffic. The inbound capacity is incoming traffic from suppliers, supplies from the return sites and the cross dock flows/transito. The outbound capacity consists mainly of goods that are about to ship to the stores. Also the slack capacity is reserved separately: the extra trips to stores when the planned capacity is not sufficient.
Because there are no outbound deliveries from the national (internal as well as external managed) sites towards the stores, the outbound flow in the national sites is purely transito. In Figure 3.3: Overview of dock and staging lane functions all different flows are schematically represented and per flow the corresponding section is noted. These sections describe the current way of allocating docks.

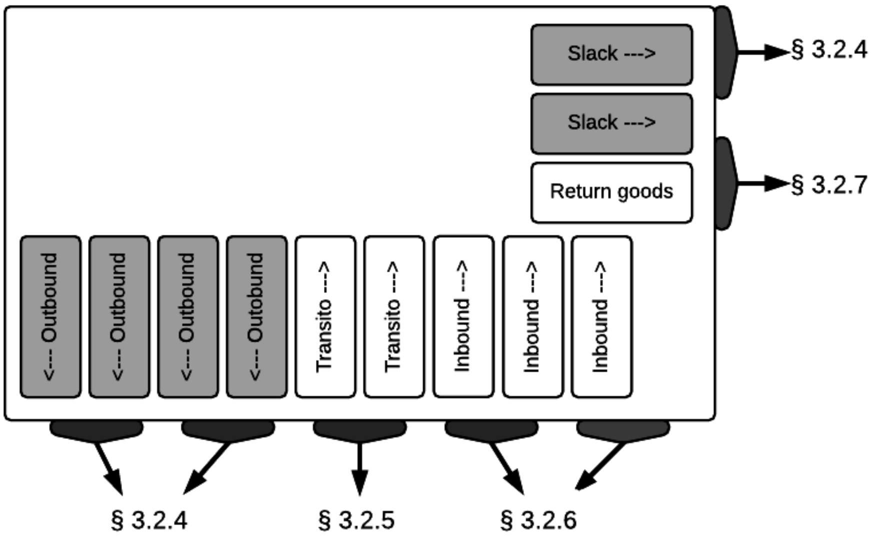


Figure 3.3: Overview of dock and staging lane functions

3.2.2 Service mode

Each dock and the corresponding staging lanes are allocated every 15 weeks. With the use of the route scheduling from DC to stores (the "timetable"), the department *Retail Operations Support Supply Chain* (ROS-SC) makes a function allocation. Their target is to come up with an efficient and well-balanced distribution of docks and staging lanes. A clear target, but with the limitations of section 3.2.3 in mind the planning results in only minor adjustments to the previous planning.
The classification of service modes by Boysen and Fliedner (2010) as discussed in section 2.2.2 can be also applied to the current allocation.

The process of Albert Heijn is clearly an *exclusive* service mode; where the allocation is fixed for several months. In some RDC's there are a few docks and staging lanes that are allocated as *mixed* service mode: some days of the week they are allocated as inbound and the remaining days as outbound function. The DC is in that case defined as *parallel exclusive/mixed* service mode, but the number of mixed allocation is very limited and can be classified as "experimental" according to the responsible manager.

3.2.3 Limitations

Allocation by ROS-SC is done by estimation instead of actual measures. This underlines the need for a tool that supports their allocation by objective numbers. Beside the calculation there are also limitations for each site specific:

- *Location:* Some staging lanes cannot be changed because their location is inherent with the function. For example some inbound staging lanes are allocated as "milk staging lane" because they are located directly in front of the area where the milk is staged. These load carriers cannot be lifted because of their size. Other staging lanes are located directly on a corner and have only outbound functions because of safety reasons.
- *Size:* Each staging lane has its own size; in meters of length and width. This determines their capacity; not all staging lanes can stage a FTL.
- *Physical*: The most staging lanes have only appropriate line markings for inbound either outbound staging lanes. The difference lies in the size of the load carriers; an inbound freight has always pallet sizes, outbound always roll containers.
- *Convenience*: Sometimes staging lanes are allocated with convenience for the workers in the DC in mind. An example is the position of the transito lanes; they are located around the central office to keep a good overview of the transito load carriers that need to be processed.

3.2.4 Outbound allocation

Each DC has more staging lanes than dock doors and this result in lanes that are not positioned directly in front of a door. It is not a problem; the outbound lanes are filled in cycles. In the first cycle the odd numbered lanes are filled and in the next cycle the even numbered. Also the loading process to the truck is done in this sequence and so the dock door is used more efficiently (Figure 3.4).

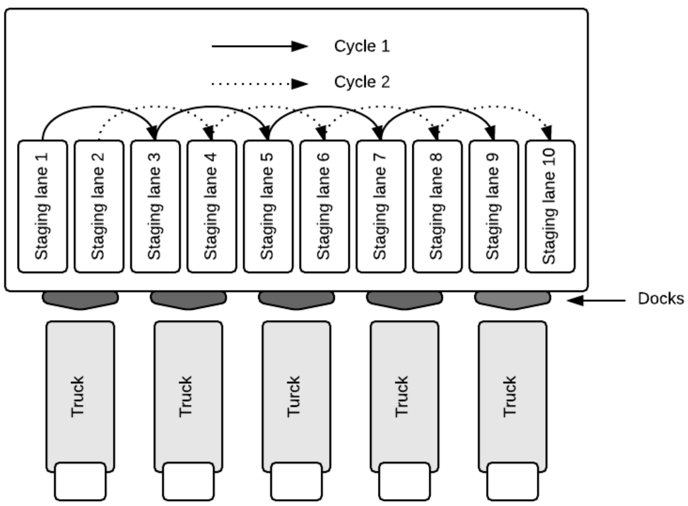


Figure 3.4: Staging lane position and cycles

3.2.4.1 Dynamic scheduling

In the RDC's of Tilburg and Zwolle the scheduling of outbound routes is done every three weeks instead of the usual three times a year. The stores receive a timetable with time windows of an hour still three times a year; and every three weeks this window is narrowed down to the specific delivery time. This gives Ahold Transport the possibility to adapt the schedule to the current situation. However, the amount of staging lanes allocated to outbound flows isn't changed and the scheduling won't benefit from an allocation that fits the schedule. The actual allocation of a specific staging lane number to a route number is done by an Excel macro that respects the cycles and amount of staging lanes available.

3.2.5 Transito allocation

The number of staging lanes meant for transito movements is fixed for the whole period of 15 weeks. In each site the amount differs and is for example in DC Zaandam 5 lanes for dry groceries and 3 lanes for perishables. The staging lanes are allocated around the central office in the middle of each site, called the "cockpit". In this way the controllers can monitor the amount of transito load carriers directly and at first hand.

The actual allocation of an incoming transito ride to a specific staging lane is done by the traffic manager; the external employee that functions as gatekeeper. He knows which lanes are allocated as transito lanes and he verifies by the use of camera's which of them is empty.

When all staging lanes are full he will let the truck wait until a dock will be available. However, he must monitor when the transito load must be shipped to the stores. Otherwise the load cannot be cross docked to the outbound truck because that truck has already left to meet the arrival time at the store.

3.2.6 Inbound allocation

Like the other allocations the inbound allocation is also planned according to an exclusive service mode principle. However, in some sites the experiments with a mixed service mode make the unloading of incoming trucks on other staging lanes than the designated inbound lanes more flexible than the other flows.

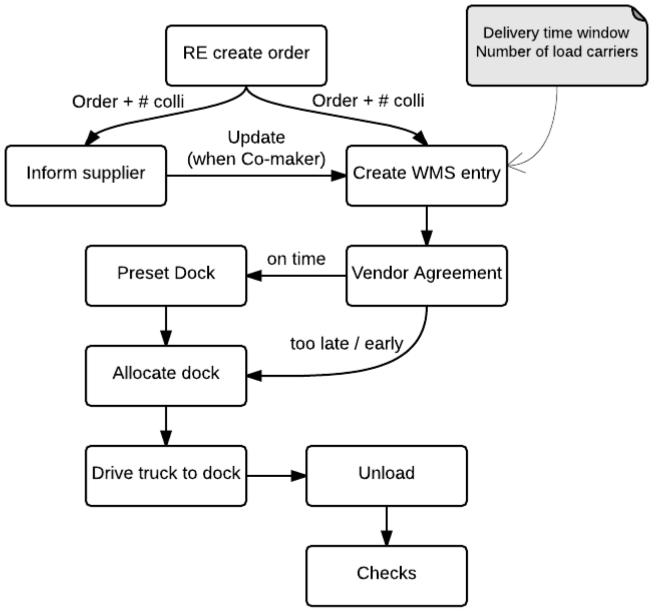


Figure 3.5: Dock allocation inbound (system)

The system flow of inbound dock allocation is elaborated in Figure 3.5 and is the formal way of working. Based on vendor agreements, made by the department Replenishment (RE) a preset dock is defined to advise the traffic manager which dock to choose. This dock is not chosen randomly from the available inbound docks but is tightly coupled to the origin of the load. Milk is always unloaded directly in front of the milk area in the DC. And the freights that carrying beer are unloaded with the use of integrated chain conveyors instead of fork lift trucks; only a few docks has such a conveyor.
When a truck is not on time, arriving not in his delivery window of one hour, his preset dock can be occupied by another truck. Then the traffic manager can allocate the truck to a different inbound dock or put him in to a waiting lane. The last option can cost the supplier a lot of money, and when the supplier must wait too long they will pass on the cost to Albert Heijn.

3.2.7 Return goods allocation

The planning of the shuttle rides between the distribution centres and the return centres is done by the ROS-SC department Logistic preparation. Their goal is to deliver the needed return goods just in time, and take all pallets and other garbage away. However, only in Tilburg and Zwolle these shuttle rides are actual executed; in Zaandam this is only done around the building, and in Pijnacker the empties movements are done within the building, without involvement of trucks.

Therefore only in Tilburg and Zwolle docks and staging lanes are needed and allocated. These designated docks are in an exclusive service mode, and this fixed allocation doesn't cause any problems. In this project we do not focus on these docks and staging lanes because of the modest impact on the total (Example: 3 out of 72 staging lanes in DCO – HB).

3.3 Stakeholder analysis

The current process of staging lane allocation affects many departments within the organization of Albert Heijn. In Figure 3.6 a high-level overview of the different departments is shown specified with the roles within that department that is affect by, or responsible for the allocation choices.

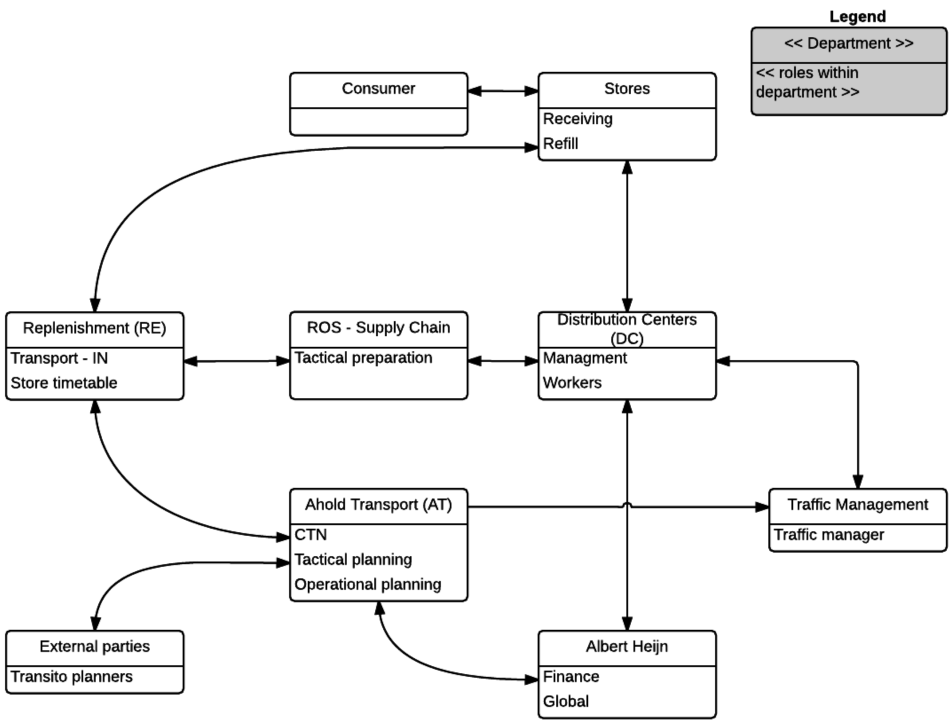


Figure 3.6: Actor overview staging lane allocation

The process is coordinated by ROS-Supply Chain and their decisions affect the other actors. The most direct actors are Replenishment, the DCs and Ahold Transport. But of course; they have their own "customers" and those are affected as well. In Table 3.2: Actor versus interest table this dependency of the actor versus the actors' interest is denoted.

Actor	Role	Interest	Contribution
ROS – Tactical preparation	Coordinator	Support the departments as good as possible in order to help the DCs	Positive
Traffic Management	Coordinator	Clear overview which docks are available and best suitable to allocate truck.	Positive
AT – CTN		As many inbound staging lanes available as possible	Positive for own interest
AT – Tactical planning		As many outbound staging lanes available as possible	Positive for own interest
AT – Operational planning		As many outbound staging lanes and slack lanes available as possible	Positive for own interest
RE – Transport IN		As many inbound staging lanes available as possible	Positive for own interest
RE – Store timetable		As many outbound staging lanes available as possible	Positive for own interest
DC – Management		The best possible allocation as possible to reduce congestion and increase efficiency	Positive
DC – Workers	End user	The best possible allocation as possible to reduce congestion and increase efficiency	Positive
Stores – Receiving	Customer	Receive the goods at the desired time	Positive for own interest
Stores – Refill	Customer	Refill the shelves at time with low consumer rate	Positive for own interest
Consumer		Shop at anytime without disturbing by refilling shelves	Neutral
Albert Heijn – Finance	Owner	Highest utilization of DC to reduce costs and improve consumer satisfaction	Positive
Albert Heijn – Global	Owner	Highest utilization of DC to reduce costs and improve consumer satisfaction	Positive
External parties – Transito		As many transtio staging lanes available as possible	Positive for own interest

Table 3.2: Actor versus interest table

The different actors all have their own interest that result in a positive or negative contribution to the process. A lot of actors has marked *positive for own interest*. These interests are opposite to the other actors; and this will potentially result in conflicts during the decision process. (Ogden and Watson, 1999)

When adding more staging lanes and docks for inbound traffic the part of Replenishment that is responsible for transport IN is satisfied; they have more possibilities to efficiently plan their trucks. However Replenishment that plans the store timetable is not satisfied: the extra inbound staging lanes are possible taken from the outbound lanes which reduce the amount of possible time slots to ship a delivery to a store.

In practice these discussions takes place indeed when defining the new dock and staging lanes allocation for the next months. As stated before, a lot of these discussions are done based on "feeling" and "experience". All people spoken during this research about this topic recognize the need for more clear and understandable information about the usage of the staging lanes to make objective decisions. This will help to eliminate the decisions based on feeling and discussion and will help to keep the interest for the company as a whole.

3.4 Current challenges

The aforementioned conflicting interests are in the current situation solved by experimenting with a few staging lanes more or less for a specific allocation. Mostly these changes are initiated by a site that experience problems in their daily operation. A shortage of outbound staging lanes results in produced load carriers that cannot enter the outbound staging area because the shipment of an earlier cycle has not left the staging lane. In Dutch this is called "dubbelloop", and results in congestion in front of the staging lane. To solve this issue more staging lanes can be added or to solve the situation just once preload the shipment in an empty trailer and let it wait until the route to the stores starts.

At the moment a shortage of inbound docks and staging lanes arise; this results in waiting times for the supplier or it's LSP. The costs of this waiting is at charge of the supplier but when is happens frequently the costs of the products will rise inevitable. To solve this issue again, more docks and staging lanes or more capacity to unload and process the load can be added.

The most pressing issue and challenge in the current operation is the capacity of the transito flow; the cross dock operation between the national and the regional DC's. There are frequently too few staging lanes to unload the shuttle rides between the sites; again this will result in waiting time. But because the goods in the truck are meant to combine with the other store orders produced in the regional DC; there is some time pressure. When the transito truck is unloaded overdue, it is not possible anymore to add more load carriers to the shipment. This time is marked as the Latest Time on Staging Lane or LTS. The truck to the store will then leave without the load carriers of the national centre. Besides the time pressure of this process, either the sorting of the load carriers is taking a lot of space. Before the load carriers are brought to the outbound staging lanes they are sorted on the transito staging lane. When the outbound lane is not opened yet (current time is before VTS- earliest time to staging lane) the load carriers of that store a still on the transito lane. Only when all load carriers have left the staging lane, the lane is released for a new transito shipment.

Flow	Issue/Challenge	Solution
Outbound	Shortage of staging lanes results in congestion (Dutch: dubbelloop)	More staging lanes allocated to outbound or preloading shipments
Inbound	Shortage of staging lanes results in waiting time for supplier trucks	More staging lanes allocated to inbound or more capacity in workers to unload and process the load faster
Transito	Shortage of staging lanes results in waiting trucks and missed load carriers for shipments	More staging lanes allocated to transito or other areas to temporary store load carriers.

Table 3.3: Current challenges in staging lane allocation

4 Future situation

As mentioned, Albert Heijn has the ambition of a significant increase in assortment and in number of stores. This will inevitably lead to an increase of volume that must be processed by the sites. With this ambition in mind the Shared Fresh Centre will replace the LVC in Nieuwegein in order to add capacity in the sites and be able to send more SKU to the stores. Of course the transito flow from this new national centre to the regional sites will grow. However; the amount of stores will remain at least the same and the number of shipments from suppliers will also not reduce. So when all staging lanes are in the current situation are already scare; the future situation will increase the challenges even more.

The capacity calculations and principles for the different flows – inbound, outbound and transito – must be generalized before the tooling can be developed. During the project it appears that these starting points are not reflecting the current situation or interpreted differently within the different links of the supply chain. To overcome these limitations, several meetings have been conducted and visited to agree with the three parties: Replenishment, Ahold Transport and the sites. Together we have discussed the principles to calculate the capacity of the flows. Responsible mangers attending the meetings as well as specialists of the IT systems involved.

4.1 Goals

The future goals, indentified along the process, must be met when implementing the tool and new process. Goals of the LogDock-tool:

1. More capacity in loading and unloading the inbound and outbound trucks
2. More flexible planned events
3. More possibilities in emergency situations

More capacity

As stated before, the capacity is problematic in the current situation, but will be even more challenging in the future situation. Due to the new SFC the transito flow will grow and the inbound flow will decrease. However, new assortment will be added and the expectation of several experts is that the inbound flow will not decrease at all. Also, not all inbound docks are physically suitable for transito either. A lot of inbound docks are positioned on the backside of the fresh centres; specially build to unload directly in the specific area. The outbound, and thus transito staging lanes and docks are position on the other side of the site; in the general area.
In short: to ensure further grow in the organization, with expansion to Belgium and online ordering also taken into consideration, we assume <u>all</u> flows will grow instead of decrease. The first goal of the new way of dock allocation will be to use the persistent docks in an efficient manner to increase the capacity of the supply chain without investing in new warehouses.

More flexible planned events

With a dynamic scheduling and the ambition of Ahold Transport to make that planning even more dynamic to the day-to-day situation, a fixed dock and staging lane allocation is a huge draw back in an effectively dynamic planning. Extra transito or inbound deliveries can also be obviated through this process.

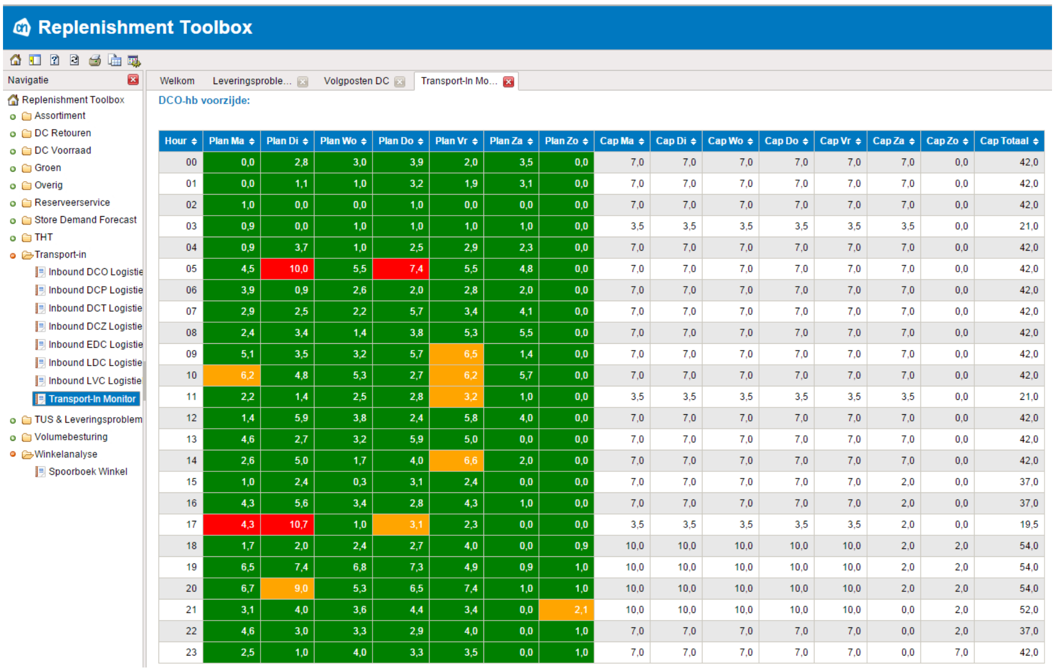
More possibilities in emergency situations

As seen in the introduction of section 1.1 in situations that differ from the normal operation also the normal exclusive service mode of docks and staging lanes is not suitable. The number of outgoing deliveries will rise dramatically when productions starts again after an emergency situation; it will be helpfull when then the allocation of docks can changes directly.

4.2 Principles and calculation Inbound

The current inbound capacity calculation doesn't fit in the desired future situation of dynamic and effective use of docks and staging lanes. In two successive meetings with all the experts mentioned before, involved we determined a new calculation of inbound capacity and also the distribution of the available capacity on a daily basis and even during the day. This changing capacity per part of the day drives the dynamization of the staging lane allocation.

Replenishment (RE) is responsible for the forecast of all products that are sold in the stores. This means that they are responsible for the availability of the products in the stores; but also in the sites. Because of this responsibility they maintain the contacts with all suppliers of Albert Heijn; and develop so-called *vendor agreements* with these suppliers. In this vendor agreements the delivery time windows are described; in general, a time window of one hour in which the supplier is expected to delivery to the site, see chapter 3.2.6.



Hour	Plan Ma	Plan Di	Plan Wo	Plan Do	Plan Vr	Plan Za	Plan Zo	Cap Ma	Cap Di	Cap Wo	Cap Do	Cap Vr	Cap Za	Cap Zo	Cap Totaal
00	0,0	2,8	3,0	3,9	2,0	3,5	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
01	0,0	1,1	1,0	3,2	1,9	3,1	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
02	1,0	0,0	0,0	1,0	0,0	0,0	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
03	0,9	0,0	1,0	1,0	1,0	1,0	0,0	3,5	3,5	3,5	3,5	3,5	3,5	0,0	21,0
04	0,9	3,7	1,0	2,5	2,9	2,3	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
05	4,5	10,0	5,5	7,4	5,5	4,8	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
06	3,9	0,9	2,6	2,0	2,8	2,0	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
07	2,9	2,5	2,2	5,7	3,4	4,1	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
08	2,4	3,4	1,4	3,8	5,3	5,5	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
09	5,1	3,5	3,2	5,7	6,5	1,4	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
10	6,2	4,8	5,3	2,7	6,2	5,7	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
11	2,2	1,4	2,5	2,8	3,2	1,0	0,0	3,5	3,5	3,5	3,5	3,5	3,5	0,0	21,0
12	1,4	5,9	3,8	2,4	5,8	4,0	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
13	4,6	2,7	3,2	5,9	5,0	0,0	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
14	2,6	5,0	1,7	4,0	6,6	2,0	0,0	7,0	7,0	7,0	7,0	7,0	7,0	0,0	42,0
15	1,0	2,4	0,3	3,1	2,4	0,0	0,0	7,0	7,0	7,0	7,0	7,0	2,0	0,0	37,0
16	4,3	5,6	3,4	2,8	4,3	1,0	0,0	7,0	7,0	7,0	7,0	7,0	2,0	0,0	37,0
17	4,3	10,7	1,0	3,1	2,3	0,0	0,0	3,5	3,5	3,5	3,5	3,5	2,0	0,0	19,5
18	1,7	2,0	2,4	2,7	4,0	0,0	0,9	10,0	10,0	10,0	10,0	10,0	2,0	2,0	54,0
19	6,5	7,4	6,8	7,3	4,9	0,9	1,0	10,0	10,0	10,0	10,0	10,0	2,0	2,0	54,0
20	6,7	9,0	5,3	6,5	7,4	1,0	1,0	10,0	10,0	10,0	10,0	10,0	2,0	2,0	54,0
21	3,1	4,0	3,6	4,4	3,4	0,0	2,1	10,0	10,0	10,0	10,0	10,0	0,0	2,0	52,0
22	4,6	3,0	3,3	2,9	4,0	0,0	1,0	7,0	7,0	7,0	7,0	7,0	0,0	2,0	37,0
23	2,5	1,0	4,0	3,3	3,5	0,0	1,0	7,0	7,0	7,0	7,0	7,0	0,0	7,0	42,0

Figure 4.1: Screenshot RE Toolbox - Transport IN

Replenishment maintains a toolbox which encloses information about assortment, sites and stores. For Transport IN the toolbox provides an overview of specific incoming suppliers; and also a total view of capacity per hour. Figure 4.1 is a screenshot of the so-called "colouring page". The right side of the page is the capacity per hour, per day. The left side is the planned capacity in that specific hour. When this is below the 80% of the available capacity it appears green; between the 80% to 99% it will be orange; and 100% and above red.

At first glance a perfect way to analyse the capacity of the transport in flow and its staging lanes, but the current "colouring page" have several issues:

- The total available capacity isn't up to date anymore and do not reflect the current available staging lane capacity due to a lack of maintenance.
- The planned capacity is not up to date; only a tactical planning is available. This creates a situation with only outdated and general information.
- The calculation of "1,0 capacity" is ambiguous
- There are no clear principles on which the planning is done

Because of the timeliness, level of detail and reliability of the data, the information is not used in daily operation, and the planners of RE don't bother when a time window is coloured red. To put it differently, the current overview is useless and not used.

The goal of the pre-mentioned meeting with the logistic managers and experts was to come up with principles for transport in capacity planning, and parameters to calculate the capacity available and planned.

4.2.1 Principles

The new principles of the inbound planning are grounded on a basis of simplicity and to produce a uniform set of measures of all four regional sites. Before the parameters where determined we all agreed on these principles:

- One hour to unload and remove a full truck load (FTL) from the staging lanes to the buffers
    - Thus: a staging lane is blocked for one hour per receivable
    - Thus: one hour after arrival of a truck the next FTL can be unloaded on that same staging lane
- Minimum capacity of a staging lane must be 26 pallets
- The number of staging lanes can vary per hour
- Capacity is measured in staging lanes. One dock can be serving two staging lanes in one hour
- Breaks (lunch/diner)are not taken into account

4.2.2 Prioritizing

Next, prioritizing of the capacity must be determined. Each day consists of three shifts of eight hours; a day shift (7:00-16:00), evening shift (16:00 – 23:00) and a night shift (23:00-7:00). The night shift is difficult in terms of inbound capacity and staffing. Because of age-related agreements there are fewer workers available in the night than a day and evening shifts. And also because there are no trucks leaving to the stores approximately between 21:00h and 3:00h there is a lot of outbound capacity needed to stage the pre produced routes. The prioritizing must be ideally low in the night. The day shift is busy (lots of trucks leaving and new routes produced) but also a lot of workers are available. Normal prioritizing is decided for this shift. The evening shift is special; the workers are available but there is no production and all staging lanes are empty. Therefore top priority is put on this time frame.

Prioritizing is generalized in the following slogan:
Inbound delivery must take place at the moment with the **highest physical capacity**, **the highest staffing capacity** at the **cheapest possible moment**.

Example 1: a supplier that delivers one time per week will deliver by preference in the **evening**
Example 2: A supplier that must deliver four times a day also delivers one moment in the **night** shift

In Table 4.1 the concluding preference factor is noted based on the prioritizing principle. This factor is not the percentage of inbound freight that should be delivered per receiving block. Each block has a different duration time so the percentages will differ from the preference factor.

Receiving block	Hours	Preference factor
Night	23:00 - 7:00	10
Day	7:00 – 18:00	35
Evening	18:00 – 23:00	55

Table 4.1: Receiving blocks and corresponding preference factor

4.2.3 Parameters

In chapter 2.3 the optimization of *when* and *where* a truck must be docked at a general cross dock is answered by the use of academic literature by Boysen et al., 2010; Miao et al., 2009; Tsui and Chang, 1992 and others. The identified parameters in section 2.3.1 and 2.3.2 where used as guideline in the session with Albert Heijn; and fit in many ways on the concluding parameters.

Parameters Boysen et al. (2013)	Parameters Transport IN Albert Heijn	Comparison
Number of inbound trucks	Calculated by average load factor	+/-
Number of outbound trucks	-	-
Number of docks	Number of docks	+
Operational time per unit	Operational time per truck (1 hour)	+/-
Number of units	Number of units	+
Unload time per inbound truck	Included in operational time	-
Movement costs	Not taken into account	-

Parameters Transport In, used in the developing of the tool:

- Inbound trucks
- Slack capacity
- Preference factor
- Unload time per truck

To illustrate the decisions made about the preference factors the excel sheet of Figure 4.2: Calculation sheet example shows the impact on the staging lanes distribution with the named parameters. This example is used in the communication towards the department Replenishment to explain the new situation and if it is possible to reschedule the suppliers in order to achieve a green "colouring page". This reduction of inbound capacity is also profitable for Replenishment because they are also responsible for the outbound flow. When more capacity is available to outbound more stores can be delivered at their ideal time frame (see chapter 1.1, Motivation).

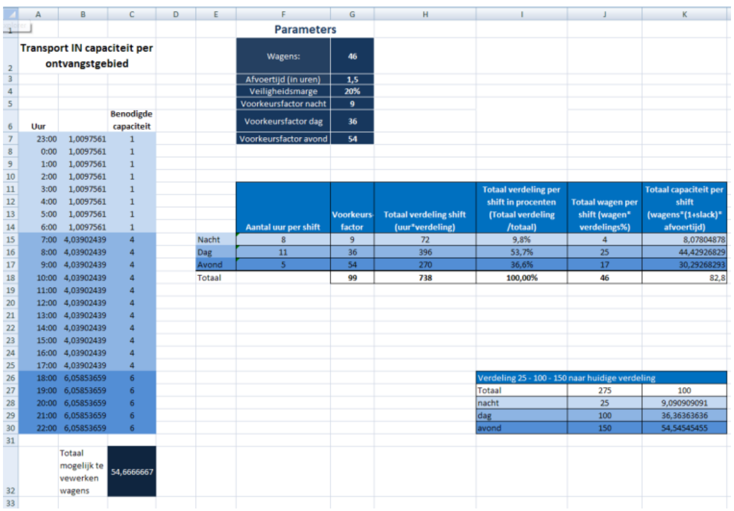


Figure 4.2: Calculation sheet example

4.2.4 Capacity calculation

The former inbound capacity is calculated as:

Former calculation: $$Fc: 0{,}25 * (l * v)$$ Equation 4.1

Fixed time per order	0,25
Number of load carriers:	l
Variable per type of load carrier	v

The variable per load carrier depends of the type of load carrier but is in total 0,75 capacity for a full truck load.

	Pallets (FTL = 26)	Rollys (FTL = 66)	Melkrics (FTL = 108)
Variable v	0,75/26	0,75/66	0,75/108

The drawback of this method is that every **order** gets the fixed variable of 0,25, as denoted in Equation 4.1. The 0,25 represents a quarter of an hour. With the trend of more outsourced deliveries by logistic service provider this generates a growing deviation with the reality. Each truck delivery has a fixed time of docking and registration though. In the new calculation we take this fixed time into account, by using a FTL as starting point. Based on the total number of load carriers in an hour this is divided by the average load factor of that load carrier type. After that; the capacity is rounded up. When for example a capacity of 2,5 is calculated that specific hour, at least three trucks will arrive.

New calculation: $$Nc = \frac{\sum L_{hour}}{f_{avg}} \uparrow$$ Equation 4.2

Number of load carriers in specific hour:	L_{hour}
Average load factor:	f_{avg}

But when the necessary capacity is calculated to fill the right side of the RE Toolbox monitor (see 4.2.1), the formula is extended with the identified parameters of chapter 4.2.3.

Tactical calculation: $$Tc = \frac{\frac{\sum L_{day}}{f_{avg}} \times (1+s) \times t \times p_{hour}}{h_{total}}$$ Equation 4.3

Number of load carriers in specific day:	L_{day}
Slack capacity:	s
Processing time full truck load:	t
Preference factor	p_{hour}
Total hours	h_{total}

4.3 Principles and calculation Outbound

The outbound process follows the pattern of store deliveries as decided by Replenishment and the stores. Roughly between 21:00h and 2:00h no store receives any freight and in the hours before 21:00h no activity on the outbound is needed, as seen on the topic of inbound calculations.

4.3.1 Method discussion

During the night and day there is non-stop production in the cycles mentioned in chapter 3.2.4. During the preparatory research for the development of the tool discussion arose about how to measure the capacity of an outbound staging lane. This discussion was never held before because the approximately 40-45 staging lanes per site always allocated to the outbound proposes. Two methods of calculations shown to be relevant to think about when determine outbound staging lane capacity.

Method 1 only measure the needed time to produce the load of an outbound truck to one or more stores combined. This needed time is thus predetermined and depends on the time the truck must be loaded and therefore all load carriers must be present at the staging lane at that specific time. In Figure 4.3 the variable time, needed for production is called *BTL-90 mins*; which refers to the time 90 minutes before Begin Time of loading (BTL).
As visualised in Figure 4.3 this gives the opportunity to use the available time between two production cycles to unload for example an inbound freight. However, because of the complexity of the outbound process in the nowadays situation, making the situation even more complex is, according to the consulted experts, seen as too much risk and not the desired solution.

The second method is to measure the capacity of the staging lane from the moment the staging lane "opens" and the next outbound route is planned directly after the previous one left the site. This is current way of working for the route planning by Ahold Transport and takes the full capacity of the outbound staging lanes, as marked in Figure 4.3. This has been also the method of calculation: from the Earliest time Staging lane (ETS) to the Begin Time Loading (BTL). The time between BTL and the ETS of the next cycle is marked as occupied as well; this time the staging lane is not available due to the loading process of the load carriers to the truck.

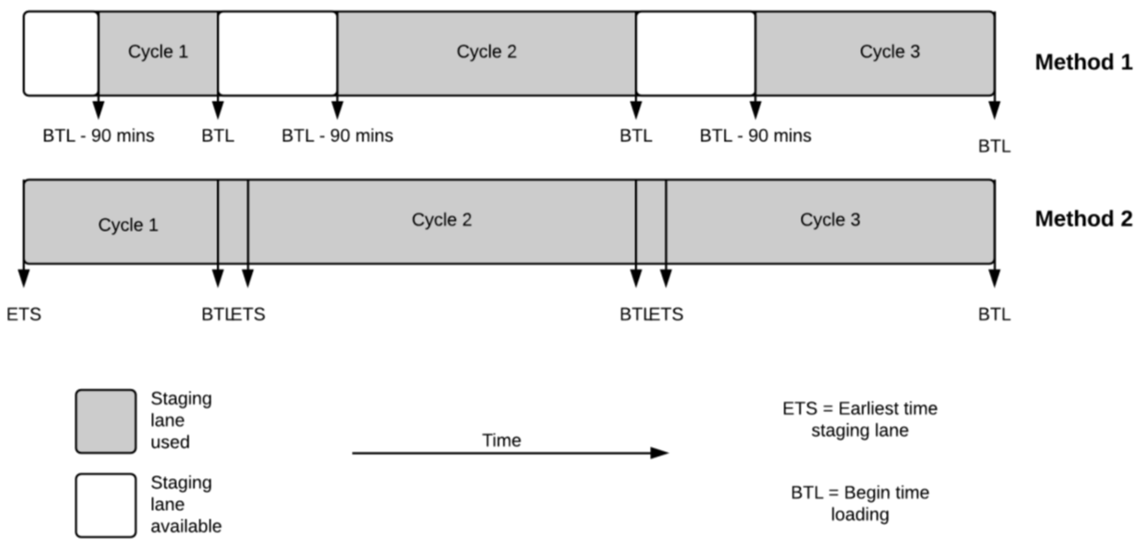


Figure 4.3: Methods to calculate outbound capacity

4.3.2 Capacity calculation

The BTL and ETS times are calculated by Ahold Transport during the making of the time table of store deliveries. In the so-called *Multistop* all routes, store identifiers, forecasted number of load carriers and delivery times are noted for all regional sites. Each store has its own row of data and multiple rows/stores belong to one route number. To clearly identify the different routes the calculation is done only on the rows where that store will be the first in the route and consists in every planned route. In the Multistop the row-identifier in this is the *SequenceRowNumber*.

Next, all rows of the Multistop are analysed for every quarter of an hour for the specific day; when a time match the ETS column in the Multistop the utilized capacity of that quarter rise; and when the BTL match, the capacity decrease as explained in chapter 5.4.

Because loading a truck is done in the cycles described before, the capacity of the dock doors is not relevant in this calculation. The staging lanes are physically positioned in such a manner; the dock door capacity is not a bottleneck in any case.

4.4 Principles and calculations Transito

The transito process is the most complex flow to understand and calculate. The different order moments combined to one outbound order, production times and two-stage cross docking operation (see chapter 2.2) generate a lot of different data to analyse and calculate.

4.4.1 Principles

Within the dry grocery flow of goods (Dutch: “Houdbaar”) a maximum of six different cross docking flows must be combined to a single order to a store. Three flows are only once a week automatically generated at a fixed time: the laundry, communication materials and inventory flow. The non-food, flowers and LDC flow however are added on a daily basis to the store orders; and also ordered like normal products by the store.

The fresh products are combined with two transito flows; the cheese from the SWK and the slow movers from the LVC. These are regularly flows and ordered every day.

The complexity of these combinations is the moment each load carrier arrive at the regional warehouse. Each load carrier from another warehouse will be arriving according to the agreements made with Ahold Transport that performs the planning of all flows, except the inventory flow.

Flow	Agreement
Dry groceries	Earliest store order in the transito route: Not before Begin time loading minus 60 minutes (BTL-60)
Perishables	Earliest store order in the transito route: Not before Begin time loading minus 45 minutes (BTL-45)

Table 4.2: Agreement about the moment of delivery transtio load carriers

The calculation of the production time and departure moment in the national and external warehouse is closely related as drawn in the extensive schematic view in the Appendix A.

A transtio ride between an external or national warehouse and the regional warehouses consist of load carriers meant for many stores. The agreements of Table 4.2 are therefore based on the store order that will leave as first from the outbound staging lane to the store. Other stores in the same transito ride are probably planned at a much later moment and must wait until the outbound staging lane for that specific store is available (time is ETS – chapter 4.3.2). All time they arrive before the Earliest Time Staging lane (ETS) they will remain on the transtio staging lane. Years ago the decision was made that a transtio lane will be marked down as occupied until all load carriers are moved to the outbound staging lanes. With that in mind the capacity calculation can be done.

4.4.2 Calculation

The following variables are important in calculating the capacity used by a transtio truck, arriving at a regional warehouse:

- Arrival time
- Arrival day
- Processing time
- ETS of latest store
- Dry or Perishable goods
- Normal truck load or Extra large truck (LZV – in Dutch: Lang Zwaar Voertuig)

The variables are used to look up the specific values in the data, delivered by the scheduler of Ahold Transport. Agreements with Ahold Transport are made to deliver the latest ETS in the near further in their Transtio schedules. Retrieving the ETS from other sources was a difficult and prone to errors.

5 Simulation-tool

5.1 Introduction

To develop a suitable solution with an extensive list of stakeholders involves many risks, especially in a very complex situation. Building the right tool at once will be unattainable. Due to the limit time and scope of the project the final tool is build in three iterations, with a feedback loop and a connection with the research findings between each iteration. The last two iterations are set up with the Scrum methodology in mind as described in this chapter.

5.2 Transito tool – Iteration (1)

The first iteration of simulation tooling to engineer the desired situation was made, given the motivation in the text box below. Every site wants to know if their assigned capacity of staging lanes would be sufficient to handle all inbound transito flows; like a kind of stress testing before the peak hours of Christmas arrive. The tactical planning of all these transito deliveries is already known at the beginning of the process, as well the outbound staging lanes allocation to which these transito load carriers must be cross docked. This in combination with the last and first time a load carrier can be moved to a staging lane makes the calculation possible when and how long a staging lane is blocked for other shipments.

Transito Tool

In the first half of December 2014 the department Logistic Preparation received several request from the sites to get more insight in their transito capacity. With the busiest period of the year (Christmas) only weeks away, the request to build the tool was made. With some time pressure that week it resulted in the first iteration of the final tooling.

There was no full design phase or extensive requirement listing in this first iteration due to the mentioned time pressure as describe in the text box. However the resulting tool is used in the actual sites and gain more insight in the expected capacity problems. Because all allocation and planning of staging lanes was already done for the upcoming weeks the tool only has the function to warn the operational managers.

	Requirement	Implemented
RQ1	Tool must give a clear overview of the transito capacity per day, for each site specific	✓
RQ2	The tool must take all transito-flows into account	✓
RQ3	Logistic employees must be able to use the tool without explanation or training	✓
RQ4	Updating the tool with new data must be done easily	
RQ5	Capacity must be measured in staging lanes	✓
RQ6	The latest VTS of a store is the time the staging lane is empty; but must be at least the processing time of a transito flow	✓
RQ7	A LZV-delivery is always two staging lanes	✓
RQ8	The tool must be built in a system that can be used in all locations of Albert Heijn, for example Excel 2007.	✓

Table 5.1: Requirements of Transito Tool

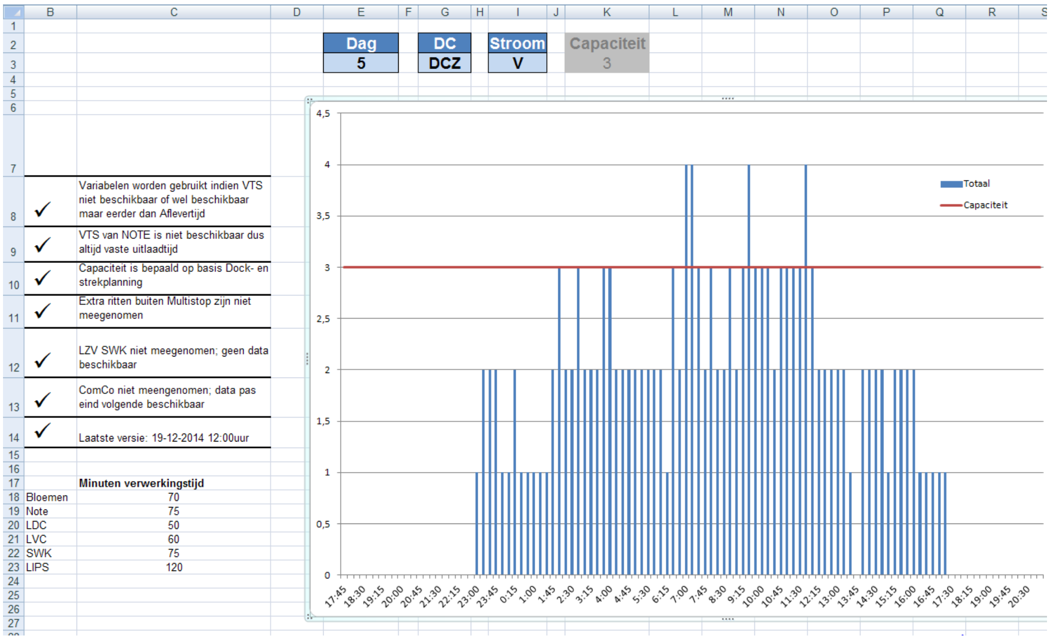


Figure 5.1: Screenshot of the TransitoTool (first iteration)

5.2.1 Evaluation

The transito tool is a first iteration in the design cycle of the final tool, and would help to raise the awareness and acceptation rate of the end users. Therefore also in this premature phase an evaluation was send to gain more insight in what the final tool would look like.

The evaluation is based on the work of Seffah et al. (2006) and is called the *Quality in Use Integrated Measurement* (QUIM). The model decomposes usability into factors, criteria and metrics. The factors relevant for this prototype are taken including the corresponding criteria. Each question is mapped to a criterion of the QUIM framework as visualised in Figure 5.2.
The formulated questions are added to this report in the appendix (Appendix B –TransitoTool evaluation). To support the processing of the results, the evaluation is send online to the respondents with the use of Google Forms.

Results

#	Question	Score (1-5)
		N=6
Q1	The interface of the tool is attractive	**3.5**
Q2	I get a positive feeling (perception) of the tool	**4**
Q3	There are enough settings to adjust to get what I want	**3.7**
Q4	I can use the tool without explanation from other people	**3.2**
Q5	Operating the tool is easy	**4**
Q6	The tool gives an unambiguously and clear overview	**3.3**
Q7	Operating the tool is efficient	**4**
Q8	The tool gives correct results that I recognize in practice	**3.3**
Q9	I will use the tool on a weekly basis when it delivered as such	**4**
Q10	With use of the tool I can make a more efficient planning	**3.7**
Q11	A web based version like the RE toolbox will be an improvement	**4.7**
Q12	I like to see a further development/improvement of the tool	**4.7**
Q13	The tool illustrate the bottleneck in the transito chain in a realistic manner	**3.2**

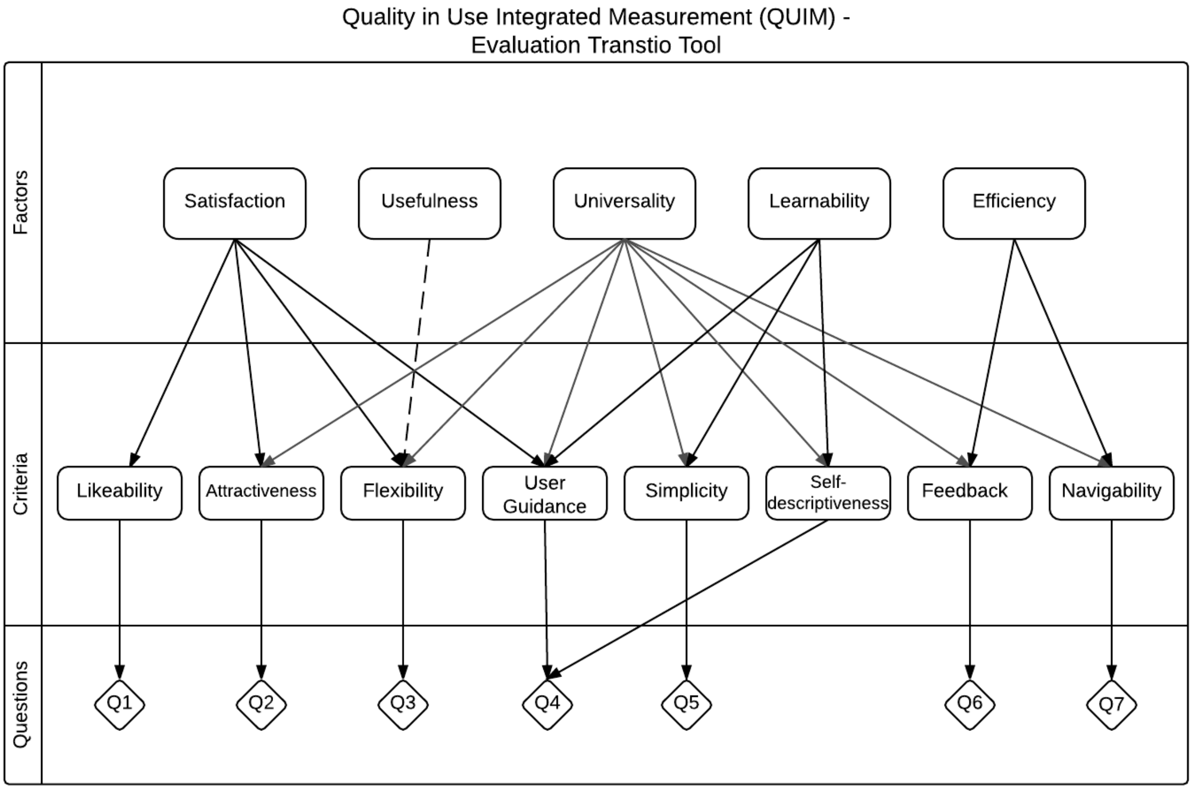


Figure 5.2: Evaluation questions mapped to the QUIM-framework

The overall perception of the tool is positive (4 out of 5) and is recognised in the several compliments received from the ROS-SC team. Despite this positive "overall-feeling" certain issues need to improve before the tool can serve as a dynamic dock toolset. The full results of the evaluation survey are added to the appendix; section C.

The lessons learned from the TransitoTool evaluation:

- Several transito-suppliers where not taken into account in the TransitoTool. Simaro (promotion material and mail) and Stamhuis (inventory goods) where absent. This absent of flows is mentioned by an Operational Site manager who stated that these suppliers are very important due to their "long time-on-staging-lane" nature. These flows usually remain for more than 15 hours on a staging lane.
- Current tool is using future data only one week ahead; this need to be improved to a longer period in order to take measurements when the maximum capacity is reached.
- Without data of the other flows (inbound/outbound) the capacity cannot be dynamically distributed.
- Updating the tool with new data is difficult and the other stakeholders do not receive updates unless they are emailed.

An overarching issue is connection between the several stakeholders and their data. When scheduling the staging lanes the direct impact on the other lanes are important; and also the capacity of several flows is interlinked: when there are more transito load carriers; the outbound flow will also increase.

Almost all routes are planned by Ahold Transport, as mentioned before. Even the different transito routes, between the sites (internal and external) are done by Ahold Transport. But the transito flow from the Shared Warehouse Kaas (SWK) to the RDC's is done by a different planner than the flow from the LVC to the RDC's. They don't take the decisions of each other into account, although they are situated only one desk away in the same room. This can (and in practice will) result in the arrival of two or more trucks at the same time at the RDC's causing capacity issues.

More insight into the different flows by the responsible planners is therefore essential to come up with a dynamic and efficient planning; and must be part of the next iterations of the LogDock-Tool.

5.3 Scrum approach

Manifesto for Agile Software Development

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

Manifesto for Agile Software Development, 2001

5.3.1 Agile principles

The manifesto (Beck et al., 2001) above is a summary of the principles for the Agile software development movement. From the year 2001 several pioneers tries to come up with a new way to develop software; other than the standard waterfall approach. In the waterfall approach each process step of development is done successively and a step backward in the development is a huge drawback in the project. The steps involved are requirements, design, implementation, verification, maintenance.

Instead of this incremental method, Agile development focus on iterating all process steps regularly. In each period of maximum one month all steps normally done in the full waterfall approach are done in order to release a working product. The benefits over the traditional way of working are the early product delivery, the possibility to receive early feedback and make changes less costly. (Highsmith and Cockburn, 2001)

The benefits of a quick working result, to discover the real needs the logistic department of Albert Heijn, the low costs of adapting the product in each stage of development and the time pressure on the project are reasons to adopt the scrum-methodology in this project.

5.3.2 Scrum method

A well-known framework to apply the agile way-of-thinking is the Scrum framework. Based on the iterating steps several "rules" are build around the agile manifesto. (Schwaber, 2004)

The main components of the framework:

- *User stories and tasks*
  Each scrum project starts with the identification of some user stories; desires and demands from the stakeholders. Mostly formulated according to a predefined format like: *As a <type of user>, I want <some goal> so that <some reason>.*
  The user stories must be split up in tasks in order to define them precisely enough to estimate the time needed for completion.
- *Sprints*
  The goal of each iteration or sprints is to deliver a working product, with the predetermined user stories/tasks that are completed. A sprint duration is mostly between a few days and a month.
- *Product backlog*
  The product backlog contains all user stories that are not planned yet, and is sorted on priority. The customer has its most important features first, and can stop the project when he is satisfied.

5.4 Sprint 1 – Iteration (2)

5.4.1 Organization

The scope of this project is not a full scale development process, and has not the resources an ideal scrum team has. However, the initial meeting and the condensed time frame made the first sprint an Agile way of working.

The initial session was held with several disciplines out of the supply chain of Albert Heijn: employees of the logistic preparation department, as well a data expert and his manger of the supply chain improvement department. Some stakeholders of the project, like Replenishment and Ahold Transport where not involved in this first sprint. In the preparatory research (chapter 4) they contributed to the principles and calculations though.

In this first session the backlog of the project was filled; all the desires, must-haves and ideas were noted down on paper notes and discussed thoroughly. To clarify the statements of the project members, the use case format of writing was applied; *As a <type of user>, I want <some goal> so that <some reason>.*

The results of the meeting are digitalized and put in a shared backlog with all contestants of the initial meeting. During the first sprint they were all informed of the process to ensure the development heading in the right direction. An impression of the meeting, including the full backlog can be found in the appendix D0 -F.

The three use cases, taken as starting point for this first sprint, are:

1. As a logistic preparation employee, I want to be able to request an advice for a specific week so that I can make an optimal capacity distribution.

2. As a logistic preparation employee, I want to be able to simulate what the effect of another allocation of a staging lane is so that I can solve problems ad hoc.

3. As a logistic preparation employee, I want to be able to look back and check if a forecast was right so that I can improve the process in the future.

Several other important remarks were made during the session i.e. a decision must be made what data sources are being used and imported in the tool, and that the use of Microsoft Excel (like in the first iteration) is not suitable of such a tool.

5.4.2 Technical explanation

The tool built in the second and third iteration functions as a responsive website with the use of HTML, CSS, PHP and JavaScript. The JavaScript library AngularJS is the framework used to calculate and display the data.

The Model-View-controller principle let developers separate the files of viewing, editing and calculating an application. (Krasner et al., 1988; Leff and Rayfield, 2001) This way of working is also applicable with the AngularJS framework. In Figure 5.3 the MVC-principle of AngularJS is explained. The “scope” within the framework functions as a virtual model; it is not a separate file but a virtual instance within the framework. This makes the framework easy to understand for developers that are already experienced with the MVC-principle.

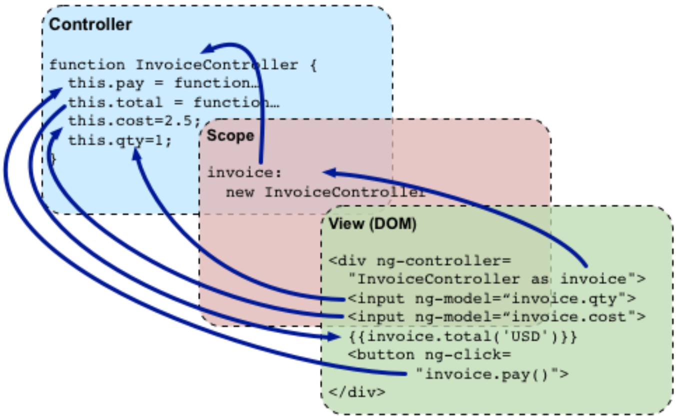


Figure 5.3: Conceptual overview of the AngularJS framework (source: https://docs.angularjs.org/)

The data used and imported in the database of this tool was extensively discussed with a data expert of the Retail Operation Support department of Albert Heijn. The data must be easily available (with future use in mind) and the responsibility of the data must remain to the responsible part of the organisation. In such a manner, the stakeholders act as committed member of the tool development.

Each flow has its own data input and also of different stakeholders within the organization of Albert Heijn gives an overview of the used data and its internal description for the organization. Also the adaptations needed to put in the system are noted.

Flow	Responsible department	Internal name	Adaptations
Inbound	Replenishment	Transport In - data	None
Outbound	Ahold Transport	Multistop	Remove unnecessary columns
Transito	Ahold Transport	Transtio overview + ETS	ETS added to original overview

5.4.3 Results and evaluation

In the period of three weeks (15 working days) the second iteration of the tool was build and accessible through a local web server. The data upload was not working and the upload of the real data was done directly to the database. The capacity calculation and current capacity of the transtio flow is fully functional in this iteration. The outbound page was not build at all due to the discussions about the calculation of capacity. The inbound page was build and adapted to the latest decisions, described in chapter 4.2. However a comparison to the current planned capacity was not there due to time limitations and a wrong estimation of effort costs.

Unless the many missing parts, the application as a whole was functioning well. Based on this result the same members as part of the first meeting where asked to give their opinion again. Unfortunately, it was not possible to arrange a meeting with all the experts at once. Alternatively several meetings where conducted to meet all experts and asked their opinion. First with the use of the paper cards, on those cards they all individually described their observations, desires and comments to each page of the tool. Second, they all fill in the same questionnaire used in the first iteration. The comparison of the results is presented in Table 5.2, where some scores dropped instead of rose after the second iteration. This was because the lacking features on some pages, features that did not meet the expectations of the experts.

#	Question	Score (1-5) Iteration 1	Score (1-5) Iteration 2
		N=6	N=4
Q1	The interface of the tool is attractive	3.5	4.8
Q2	I get a positive feeling (perception) of the tool	4	4.8
Q3	There are enough settings to adjust to get what I want	3.7	2.8
Q4	I can use the tool without explanation from other people	3.2	3.5
Q5	Operating the tool is easy	4	3.8
Q6	The tool gives an unambiguously and clear overview	3.3	3.8
Q7	Operating the tool is efficient	4	3.5
Q8	The tool gives correct results that I recognize in practice	3.3	4
Q9	I will use the tool on a weekly basis when it delivered as such	4	4.8
Q10	With use of the tool I can make a more efficient planning	3.7	2.8
Q11	A web based version like the RE toolbox will be an improvement	4.7	5
Q12	I like to see a further development/improvement of the tool	4.7	5
Q13	The tool illustrate the bottleneck in the transito chain in a realistic manner	3.2	4.5

Table 5.2: Questionnaire - Iteration 1 and 2

Many suggestions to improve the tool and add the desired functionality were made during the sessions. These suggestions are also documented and listed in the backlog. See the appendix H, also. The input is listed in three categories: Layout, definitions and functionality. All suggestions to improve the layout will be carried out in the next iteration, as well as the topic of definitions. These suggestions were all discussed during or after the sessions and described in chapter 4. Due to the scope of the project only three weeks were left for further development in this stage. Therefore, among the list of functionality several choices must be made to create a feasible workload for the next iteration of development.

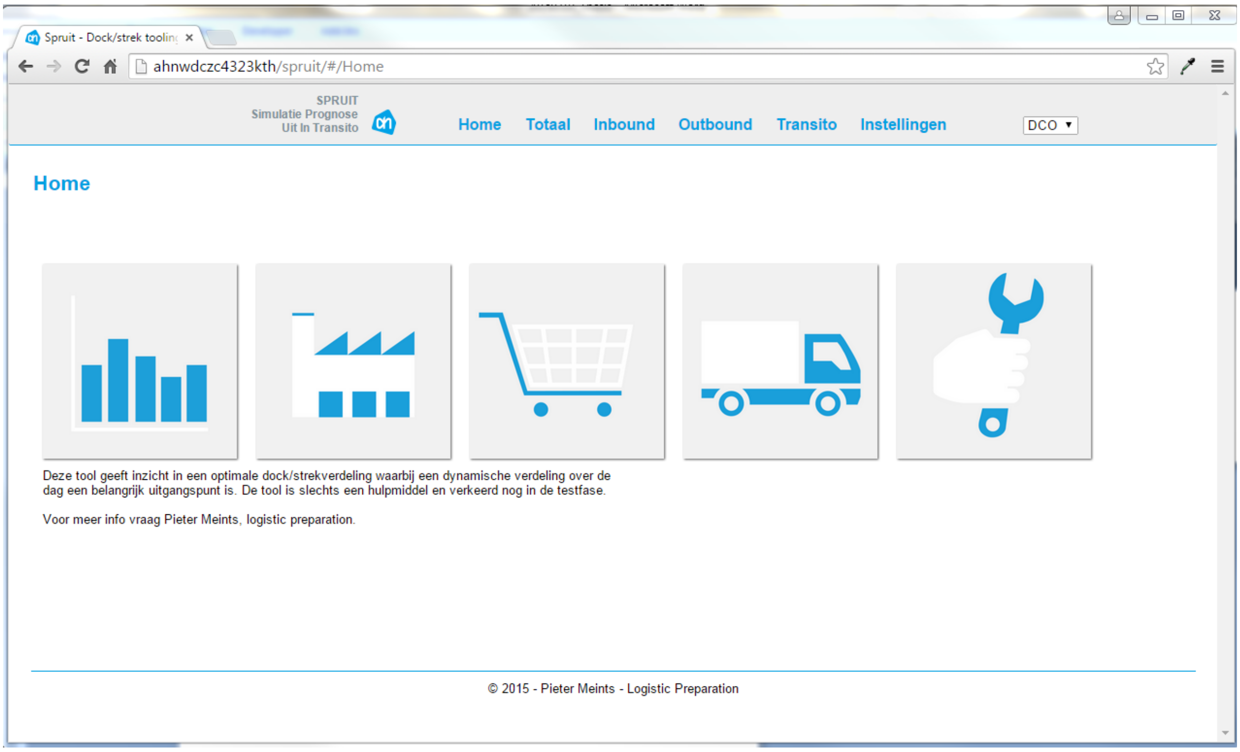


Figure 5.4: Screenshot of tool - (Iteration 2)

5.5 Sprint 2 – Iteration (3)

The selection of items from the backlog marked the start of the second sprint. We come up with a shortlist of 5 goals that must be met at the end of this iteration. Again, this iteration was just 3 week/15 working days.

The following list of goals was conducted and approved by the experts:

1. Editing suggestions of layout and definitions
2. Overlay of all flows with the planned versus realised capacity
3. Dock- and staging lane capacity planning per hour; as preparation for the replacement of the current spreadsheet
4. Possibility to import new data by the use of CSV files
5. Explanation per screen; help content

Because the overall basis of the tool and the learning of the coding were already done in the first Sprint, the results to the goals of the second sprint came in a rapid pace. Besides the goals also some extra additions were made to the tool; like new layout features and animations. These additions where necessary in order to present the data and graphs in a consistent manner.

5.5.1 Data consistency

While the technique of data import by comma separated values documents was easily available by the used coding libraries; data consistency was a big issue though. As mentioned in the sections 4.2 - 4.4 the data is acquired from different department within the organisation of Albert Heijn. Each department has its own data formatting and this resulted in several issues as shown in the following examples:

- In the view function of the inbound data by Replenishment hours are represented as 00, 01 ... 22, 23. However when downloading the data the format changes to 0, 1 ... 22, 23. Our tool uses the double digit notation and the wrong formatting resulted in a conflict between an octal and decimal numeral system. This issue was fixed by adding a zero to the importing coding rule.

- Ahold Transport, on the other hand uses the 0:00, 1:00 ... 22:00, 23:00 system without the double digit hour notation but including the minutes. This flaw was also tackled during the import of the data.

5.5.2 Results and evaluation

After the deadline of Sprint 2, four of the five goals were met. Only goal 3 wasn't fulfilled in the iteration. Due to time limitations, but also because creating a new dock and staging lane planning was more complex than estimated.

The complexity of a new planning is not a technical challenge; but organizational. A lot of stakeholders use this planning (six sites, Ahold Transport, support) and we were not able to arrange a solution suitable to all needs.

A week after the iteration ended, a focus group of experts was met each other for the third time. The responsible manager for the direct users of the tool, the manager responsible for maintenance and improvement of the end using computing tool and one direct user was initiated to share their opinions about the result. But also more important; to discuss the further use and development of the tool after this research project ends. These findings are discussing in the next chapter.

The same evaluation was asked to the expert as in iteration 1 and 2. In Table 5.3 the results are shown and compared to the previous iterations. On many sections the highest scores are rewarded to the last iteration. As a matter of course this achieved by the improvements made thanks to the feedback in the sessions; but also shows the understanding of the environment the tool will perform in.

Some scores appear to be lower than expected. This seems to be a flaw in the questionnaire; some questions didn't apply to all participants. They rated some questions very low because they are not applicable to them. An option in the questionnaire "not applicable" would prevent these experts from giving such low scores but still give their opinion on other questions.

"With this tool other departments will understand some of our concerns regarding to capacity far more easily" – employee

"This transito overview is a long-cherished wish for the sites" - *manager*

"This tool gives me the insight I want since several years" – *employee*

"Can we develop also an app to use the tool on a tablet?" - *manager*

#	Question	Score (1-5) Iteration 1	Score (1-5) Iteration 2	Score (1-5) Iteration 3
		N= 6	**N=4**	**N=3**
Q1	The interface of the tool is attractive	**3.5**	**4.8**	**4.3**
Q2	I get a positive feeling (perception) of the tool	**4**	**4.8**	**5**
Q3	There are enough settings to adjust to get what I want	**3.7**	**2.8**	**3.7**
Q4	I can use the tool without explanation from other people	**3.2**	**3.5**	**3.7**
Q5	Operating the tool is easy	**4**	**3.8**	**4.3**
Q6	The tool gives an unambiguously and clear overview	**3.3**	**3.8**	**3.7**
Q7	Operating the tool is efficient	**4**	**3.5**	**3.7**
Q8	The tool gives correct results that I recognize in practice	**3.3**	**4**	**3.7**
Q9	I will use the tool on a weekly basis when it delivered as such	**4**	**4.8**	**3.7**
Q10	With use of the tool I can make a more efficient planning	**3.7**	**2.8**	**4.3**
Q11	A web based version like the RE toolbox will be an improvement	**4.7**	**5**	**5**
Q12	I like to see a further development/improvement of the tool	**4.7**	**5**	**5**
Q13	The tool illustrate the bottleneck in the transito chain in a realistic manner	**3.2**	**4.5**	**4**

Table 5.3: Questionnaire of all three iterations combined

6 Discussion & Conclusion

6.1 Introduction

"How can the allocation of the dock and staging lanes within the regional warehouses of Albert Heijn be improved by making the allocation dynamic?"

To answer this main research question, the project has resulted in two deliverables. First product is this report with an extensive description of the state of literature, current and future situation of the supply chain of Albert Heijn and a description of the iterative development process of the LogDock-tool. Albert Heijn now uses the tool to support their daily work and this is an evident result of this project. However, the numerous meetings, conversations and questionnaires held to understand the purpose of the dynamic allocation and tool are even more valuable for the outcome of this project. Not only to identify the features that possibly can be added to the tool in further development but also to trigger the employees of Albert Heijn to rethink their processes and inspire them to improve their work processes.

6.2 Literature

RQ1: What is the current situation in dynamic dock allocation and what are the challenges according to the literature?

The literature study is focussed mainly on cross dock terminals in where load carriers with already order-picked goods of several flows are sorted and combined to multiple other routes. The work of Boysen and Fliedner (2010), is exemplary of the recent state of art in dock allocation. Based on the work of Tsui and Chang (1992) who identified the parameters for dock usage as first in the field further research has been conducted to parameterization of dock allocation. Van Belle et al. (2012) provide a thorough and comprehensive overview of the cross dock methodology and this is a valuable source for this project.

Research is also done in other papers for the traditional break-bulk warehouses, where goods are delivered directly by the supplier and must be order-picked in the warehouse itself. However, no literature is found on the specific case of a combination of the cross-dock and break-bulk principle. This hybrid solution is adopted in the regional warehouses of Albert Heijn and the break-bulk principle requires different allocation parameters in contrast to a standard cross dock terminal. When optimising the allocation, the parameters interfere with each other in the hybrid solution and can therefore not treat apart from each other.

Because the cross dock load carriers consume a lot of staging area in front of the dock doors, the several staging steps that are involved with cross docking are examined carefully. In general two types of staging during the cross dock process are identified in the literature: one and two stage cross docking. (Gue and Kang, 2001). As described in section 2.2.1 the two stage cross docking is more space consuming but reduces the amount of errors and the one stage cross docking will improve the performance of the overall flow.

Four types of allocating dock and staging lanes are identified by Boysen and Fliedner (2010) as service modes. They conclude that the use of a fixed allocation of docks and staging lanes will reduce the possibilities of dynamic planning the flows in and around a warehouse; but also that a more dynamic way of allocation will lead to less effective workers because of the search to the right staging lane. See section 2.2.2 for more extensive description of this important distinction.

6.3 Current situation – Albert Heijn

RQ2: What is the current situation in dynamic dock allocation and are challenges of Albert Heijn?

As noted in Chapter 3, the current challenges of Albert Heijn became clear by empirical research. With an exclusive service mode for over four months, no dynamic allocation of docks and staging lanes is in place. The current way of allocating docks and staging lanes is just based on "experience". The allocation is ad-hoc and reaction based and when problems occur measurements cannot be taken in less than a couple of days.

RQ3: How will the future supply chain affect the dock and staging lane capacity?

With the decision to outsource the national fresh centre (SFC) and increase the number of stock keeping units (SKU) to this new SFC, an increase of the cross dock movements from this national centre to the regional centres is inevitable. This so-called transito flow causes problems in the regional centres already by a mismatch of the staging lane allocation and needed capacity and this will increase even more in the future. This mismatch results in inbound trucks that cannot be unloaded and must wait: resulting in extra transporting costs. Also the process inside the warehouse is not optimal when there are not enough staging lanes available. Besides the important change in the future supply chain, flexibility is needed to adapt to the fast changing and highly demanding consumer in a online and offline environment.

6.4 Improvements in allocation

RQ4: Which parameters and data are needed in order to make a dynamic dock and staging lane allocation?

Each of the three flows (inbound, outbound and cross dock) within the warehouses of Albert Heijn has different characteristics and input data to calculate its optimal allocating of docks and staging lanes. As shown in chapter 4, these flows are treated separately and the results are calculated and combined in the LogDock-tool.

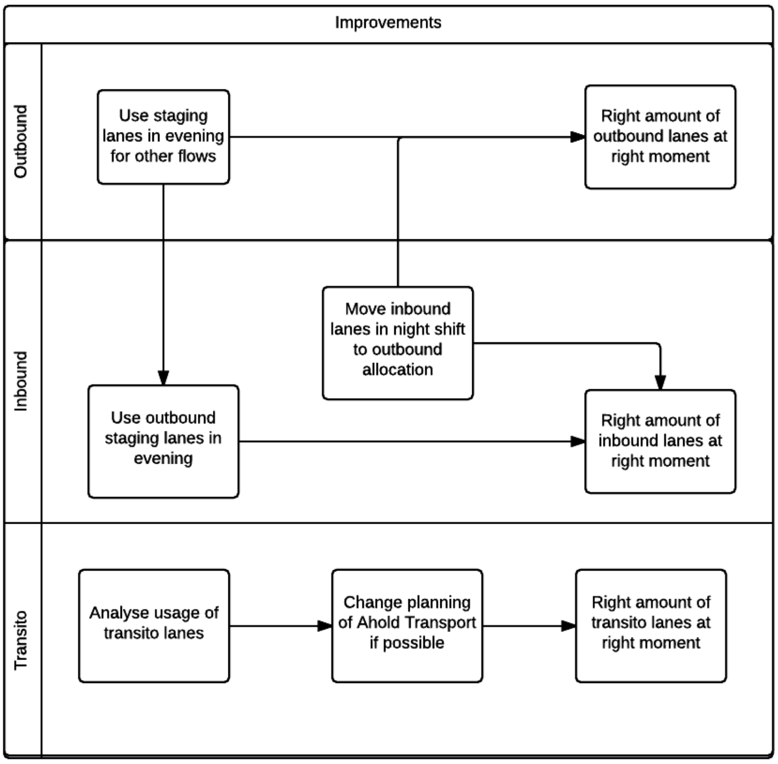


Figure 6.1: Summary of flow improvements

6.4.1 Outbound

In the already challenging environment of the combination of break-bulk warehousing and cross docking, the supply chain of Albert Heijn has one other important constraint; all outbound trucks (to the stores) leave at a fixed time schedule. This implies that the outbound staging lanes must be available at the right time. These rides are planned weeks before and even in a dynamic allocation for two sites the changes are minimal in number of rides. However in the moments there are no rides to the stores (evening and first half of the night) the outbound docks and staging lanes can be used for other flows. The data used for the outbound capacity calculation is the timetable of the routes to the stores, the so-called “spoorboek”.

6.4.2 Inbound

A lot of inbound capacity is not used at various moments a day; whether at other moments trucks are waiting because the capacity isn’t sufficient. Based on the literature and the experience of experts a new set of parameters is built to calculate the inbound capacity of docks and staging lanes dynamically during the day, based on real tactical plans.

Based on the principle “Inbound delivery must take place at the moment with the **highest physical capacity**, **the highest staffing capacity** at the **cheapest possible moment**” a distribution of inbound capacity is visualised. Together with the input data, the number of docks and staging lanes needed to handle all inbound trucks is calculated. The conclusion is an allocation with the highest capacity in the evening, as low as possible in the night and an average number in the dayshift. Of course these differing numbers of docks during the day causes also changes to the other allocations. In the night shift more docks are available for outbound and transito flows; and in the evening only a few or none. The inbound capacity is calculated by with the data from the department Replenishment.

6.4.3 Transito

The transito (cross-dock) capacity is measured in the number of staging lanes that are occupied at a certain moment. Each truck will occupy a staging lane from the moment he arrives until the last load carrier leave the staging lane to the outbound staging lane of its destination ride. Calculations show the problems in transito staging lane, and for the first time proved with the data of the transito planning, delivered by Ahold Transport.

6.5 LogDock – tooling

RQ5: What are the requirements for the development of the LogDock-tool and how are the requirements identified?

The full list of requirements and desires is added to the appendix, and discussed in the sections 5.4 and 5.5. Given the limited scope and time of this research we focussed on the desired functionality by the expert group. During the first “hands-on”-experience of the tool, the following future improvements where suggested by the experts:

- During the last review session the responsible managers came up with the idea of a management info board: an overview to quickly see all current issues. Not all information at once, but only the relevant and pressing issues where immediate action is needed.

- Ability to down drill on the information of a specific flow by i.e. clicking on an hour and see only the relevant transito rides of that hour. This will also be a helpful feature to other departments like the (regional) sites. See also the next section.

- Calculation of the time between the earliest time (ETS) and latest time on staging lane (LTS) for the first cycles of outbound routes and forecast the succeeding ETS of the day. This enables the user to simulate a route scheduling with more or less available outbound docks.

- A total overview of dock allocation, available to the traffic managers to inform them which dock is suitable for what type of truck.

- Implementing a graphical representation of a warehouse (i.e. a map) to plan the dock allocation per hour and day. This can be also the graphical layer to a new dock and staging lane planning.

- Ability to create different user roles and account to make different types of information and settings available to the appropriate users. This isn't implemented in the current version because this requires a secure system that must be tested thoroughly.

6.5.1 Scrum-method

The used Agile Scrum method to facilitate the build of the tool (section 5.3), was successful in quickly identify the needs of the stakeholders and let them describe the requirements in a uniform way. This was a success directly related to working with Scrum: the experts recall that the used method of user stories was the most effective way of conducting requirements they had ever experienced. However, the small size of the development team (one person) and limited amount of sprints (two) made that the Scum method was not used at its full potential in the rest of the development process:

- No daily stand-up meetings where possible.
- Not all members of the expert group where present every meeting because of the short period to invite them.
- Although the most targeted feedback was given after the second sprint, only two sprints where held. The experts where motivated by the clear functionality of the tool; and this was not seen as such in the first sprint.
- The work done by one person is not enough to share updates on a daily/weekly basis to the expert group; although this regularly updates will keep them motivated throughout the project.

When taking these remarks into account, the adapted Scrum methodology has proven useful to gather the requirements in a team of different stakeholders, but will be used to its full potential by a larger team of developers and more sprints.

Because this has been the first experience with the Scrum methodology for the Supply chain-team of Albert Heijn, a lot of lessons have been learned. During this project, the experts showed a lot of interest in the Scrum method but recall that this is very different to the current way of developing and collaborating in the supply chain. Scaling up to a full Scrum-team with for example 5 developers would not fit in the current organizational structure of Albert Heijn. That amount of developers is simply not available within the supply chain, and the programmers of the organization aren't used to work inside a department on their own.

Reviewing this project, it seems more about data analysis than developing pure information technology. Marchand and Peppard (2013) have concluded that developing an IT solution to improve efficiency in for example handling claims, is quite different than building an analysing tool for (big) data. They prove that analysing data it is not about deploying technology (developing tools) but it focuses on the exploration of information. The latter will take more time and will not fit into a fixed development scheme. Understanding data and how people will use it is more complex and need to be experienced instead of designed.

The described change of mind regarding to the allocation process, but also to the specific flows as described in the previous sections, are examples that the tool is just an opportunity to explore the information.

Therefore, the next steps in the process for Albert Heijn should not be just finishing the implementation of the tool, but to be conscious of the impact of the information and also take time to understand the consequences. Regarding the current process, procedures within Albert Heijn are more about deadlines and predefined requirements. These are leading in normal projects and this is an entrenched habit within the organization.

6.5.2 Results

RQ6: What is the expected result of the proposed adjustments to the current situation?

Empirical evidence by visiting the sites shows the day-to-day issues of lacking space to handle and sorting the load carriers that need to be cross-docked to the outbound staging lanes. These findings were supported by the simulations of the tool as shown in Figure 6.2. These simulations show the exceeding of the planned capacity (blue columns) to the current available capacity (grey columns). Congestion due to wrong planning is a frequent returning issue and it due to our tooling an urgent topic to discuss with the planners of Ahold Transport.

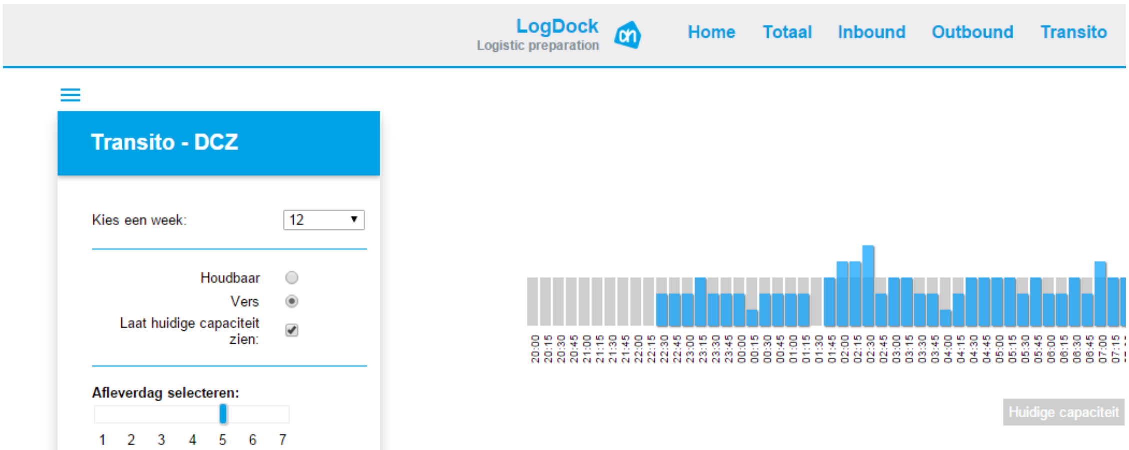


Figure 6.2: exceeding of the current capacity (grey)

The new visualization of the inbound capacity with the new parameters is also possible with the use of the LogDock-tool. This view will help in the new allocation of inbound docks and to convince the rest of the organization of the benefits of this change.

Insights in the comparison between the current allocated capacity and a tactical planning are inevitable for a dynamic allocation and gain understanding in the situation of the forthcoming weeks. These insights were lacking at the responsible department by all means. The tool visualizes the data and calculates the new allocation principles as described in chapter 4. However, it does not provide an intelligent system that learns from previous weeks. This is an opportunity for further development but must be considered carefully. We recommend Albert Heijn to wait until the current solution is used for several months before making a decision about investing in an automated system.

The evaluation after the three iterations shows that the average score of the new tool is 4.2 out of 5. Based on the results of the third evaluation (see Table 5.3: Questionnaire of all three iterations combined), the positive perception about the tool is grown during the process. Some questions score lower than the iterations before though. Some of these scores are related to the type of manger that answer the questions; some of them do not use the tool directly and answer a question like “I will use the tool on a daily basis” with a very low score. This is a flaw in the questionnaire; an option “not applicable” would solve this and is recommended by us to use in further evaluations.

The tool helps the employees of Albert Heijn to make an efficient dock and staging lane planning and this is also seen as such in the evaluation (Question 10 – score 4.3 of 5).
However, the awareness off the problems with the cross dock (transito) planning, the unused capacity in the inbound allocation and distribution of inbound docks during the day are not questioned directly, but are real achievements of the tool as well. Without direct statistical evidence, the empirical research shows that the tool is a catalyst to all these issues. Without the tool this research was still a theoretical solution to a problem the employees of the logistic preparation department don't fully understand. With the simulation of real data in current situations the urgency became clear and the momentum is here to change the process now.

6.5.3 Collaboration

When exploring the future improvements and extensions of the current tool, the collaboration between the logistic departments was a recurring matter of debate. The three collaborating logistic entities (Logistic Preparation, Ahold Transport and Replenishment) share a lot of data with each other but not in uniform ways. For example; the data provided by Replenishment is usually retrieved from their online platform. This is in contrast to Ahold Transport who is used to e-mail the essential information to the other departments. Also the data consistency (section 5.5.1) is a pressing issue when using data within a collaboration setting.

Apart from the difficulties, the new tool will service a lot of opportunities to intensify the collaboration. The insights in for example transito planning will help the department Logistic Preparation (the initial stakeholder) but also Ahold Transport to integrate their planning of transito. The same applies to the new insights in inbound allocation: insight build in this project to facilitate Logistic Preparation but also valuable information for Replenishment.

With the used web techniques sharing this information is only a matter of sharing the link. So, sharing information obligates Logistic Preparation to ensure a safe and correct system. This change of scope will implicate a huge change to the maintainability and span of control of the tool, and must be therefore made in a next step outside the scope of this project.

The absence of the experts from Ahold Transport and Replenishment was a debatable decision in the development process. We made the decision to not invite them in the Scrum-sessions to tighten the scope of the project; but afterwards the current tool has the potency to be used by the other parties already in this stage of the development. Examples of this use are the transito planning that can be improved by Ahold Transport with the use of the LogDock-tool. Also an effect analysis with the tool will help Replenishment in moving the suppliers to another time slot (section 4.2). This was unforeseen, the iterations where focussed on the functionality to the department of Logistic Preparation.

6.6 Recommendations

The tool that simulate dock capacity and advise in dock allocation, and this report are a first step toward a dynamic the dock and staging lane allocation of Albert Heijn. The positive responses of the employees but also the constructive discussions during this research show the awareness in the organization to take the opportunity to improve the dock and staging lane allocation. The questions asked during this research create a lot of positive energy towards this topic and the tool shows some promising results as shown in the previous section. The most pressing recommendation to the organization of Albert Heijn is therefore to use this momentum and make the necessary changes and invest in further development of the tooling now.

In the near future (within months) the development of the tool should result in a version that is also able to allocate the docks and staging lanes in the tool itself and export it to the other departments. With that improvement, the tool quickly evolves from a simulation tool (now) to a dock and staging lane allocation tool. Necessary changes also include the physical adaption to the sites with uniform lines to remove the limitations (section 3.2.3) and differences between the sites in general.

One issue that immediately became clear during the first test of the tool was the planning inefficiency regarding transito routes. Almost every night at least one of the inbound transito rides from the national fresh centre (LVC) and the Shared Warehouse Kaas (SWK) respectively is planned to arrive at the same time. A visit to the Ahold Transport planning office of the transito rides reveals the cause of this issue: the different flows are planned by different planners who don't check the conflicting routes. A quick win is to make an integral planning for transito rides such that the docks and staging lanes are more effectively used. Obvious, but no put into practice yet.

In the current research we focussed on the allocation to the current staging lanes in number and format. However, it is recommended to investigate the possibilities to improve the transito process by other locations and shapes of the transito staging areas. The recommendations by Hans Danhof published by (Buijs, 2014)must be considered seriously in this process. He proved that efficiency can be improved by sorting the load carriers further up the chain. More concrete: sort the load carriers in the national warehouses before transporting to the regional warehouses. This reduces the needed space in the regional centres and increase the handling time. Also he suggests to place the transito staging lanes in between the outbound lanes to reduce the distance travelled to deliver the transito load carrier to the corresponding outbound lane.

Some of the goals agreed upon in the sprint meetings aren't fulfilled as described in the previous chapter. The functionality lacking due to these missed goals is not the problem (the tool is still at an early stage) but the consequences of missing the goals were not clear during the development. In this research project this is just a minor issue; but when up scaling the project to commercial size, consequences for missing goals must be agreed upon beforehand.

A dynamic approach to dock and staging lanes will only succeed when Albert Heijn will trust the up to date and correct data. This data, delivered by various departments is mostly a combination of various sources and after receiving edited by Microsoft Excel macros. This is a risk: when the sources change the data will not be valid anymore. Also the macros are big risk in itself; when updating the Microsoft Office suite some of the macros will break down and a lot of effort must be made to make them work again. The recommendation is to make a shift from Microsoft Excel based "tools" to more future proof and multiple device ready technology. The tool of this project is a showcase how this can be implemented within the organization of Albert Heijn.

6.7 Limitations

In this project no actual measurements are done before and during the simulation project. This is a limitation to the research but because there isn't a real implementation yet, the initial 0-measurement can be done before the next steps proposed in the recommendations section.

The research is done specifically within the context of Albert Heijn. No competitors where asked and this can be considered as a limitation to the project. The literature is an external source but specific to the Dutch market we haven't performed any comparison.
When gathering the results of the evaluation it was difficult to get the responses of all the experts involved. Therefore not all three evaluation results are held with the same number of experts and this makes the results more difficult to interpret. Also the option to select in the evaluation "not applicable" was not there. Therefore some people answered question that wasn't applicable to their situation.

References

Agustina, D., Lee, C.K.M., Piplani, R., 2010. A Review: Mathematical Modles for Cross Docking Planning. Int. J. Eng. Bus. Manag. 2, 47–54.

Ajzen, I., Fishbein, M., 1977. Attitude-behavior relations: A theoretical analysis and review of empirical research. Psychol. Bull. 84, 888.

Apte, U.M., Viswanathan, S., 2000. Effective cross docking for improving distribution efficiencies. Int. J. Logist. 3, 291–302.

Bartholdi, J.J., Gue, K.R., 2000. Reducing labor costs in an LTL crossdocking terminal. Oper. Res. 48, 823–832.

Beck, K., Beedle, M., Bennekum, A., 2001. Manifesto for Agile Software.

Berghman, L., Leus, R., Spieksma, F.C., 2011. Optimal solutions for a dock assignment problem with trailer transportation. Ann. Oper. Res. 1–23.

Bodnar, P., Lysgaard, J., 2013. Scheduling Trucks in a Cross-Dock with Mixed Service Mode Dock Doors.

Boysen, N., Briskorn, D., Tschöke, M., 2013. Truck scheduling in cross-docking terminals with fixed outbound departures. Spectr. 35, 479–504.

Boysen, N., Fliedner, M., 2010. Cross dock scheduling: Classification, literature review and research agenda. Omega 38, 413–422.

Boysen, N., Fliedner, M., Scholl, A., 2010. Scheduling inbound and outbound trucks at cross docking terminals. Spectr. 32, 135–161.

Buijs, P., 2014. Horizontal and vertical collaboration in distribution networks with cross-docks, Ph.D. Thesis. University of Groningen.

Daft, R.L., Lengel, R.H., 1986. Organizational information requirements, media richness and structural design. Manag. Sci. 32, 554–571.

Dawson, J., 2010. Retail trends in Europe. Retail. 21st Century 63–81.

Fleischmann, B., Meyr, H., 2003. Planning hierarchy, modeling and advanced planning systems. Handb. Oper. Res. Manag. Sci. 11, 455–523.

Flynn, B.B., Flynn, E.J., 2005. Synergies between supply chain management and quality management: emerging implications. Int. J. Prod. Res. 43, 3421–3436. doi:10.1080/00207540500118076

Gagliardi, J.P., Renaud, J., Ruiz, A., 2007. A simulation model to improve warehouse operations, in: Proceedings of the 39th Conference on Winter Simulation: 40 Years! The Best Is yet to Come. IEEE Press, pp. 2012–2018.

Galbraith, J.R., 1974. Organization design: An information processing view. Interfaces 4, 28–36.

Gopakumar, B., Sundaram, S., Wang, S., Koli, S., Srihari, K., 2008. A simulation based approach for dock allocation in a food distribution center, in: Proceedings of the 40th Conference on Winter Simulation. Winter Simulation Conference, pp. 2750–2755.

Gue, K.R., Kang, K., 2001. Staging queues in material handling and transportation systems, in: Proceedings of the 33nd Conference on Winter Simulation. IEEE Computer Society, pp. 1104–1108.

Guignard, M., Hahnb, P., Zhangb, H., 2012a. Dynamic vs. Static Optimization of Crossdocking Operations1.

Guignard, M., Hahn, P.M., Pessoa, A.A., da Silva, D.C., 2012b. Algorithms for the Crossdock Door Assignment Problem, in: Proceedings of the Fourth International Workshop on Model-Based Metaheuristics.

Gunasekaran, A., Lai, K., Edwin Cheng, T.C., 2008. Responsive supply chain: A competitive strategy in a networked economy. Omega, Special Issue on Logistics: New Perspectives and Challenges 36, 549–564. doi:10.1016/j.omega.2006.12.002

Hevner, A.R., March, S.T., Park, J., Ram, S., 2004. Design science in information systems research. MIS Q. 28, 75–105.

Highsmith, J., Cockburn, A., 2001. Agile software development: the business of innovation. Computer 34, 120–127. doi:10.1109/2.947100

Hoogeveen, H., 2005. Multicriteria scheduling. Eur. J. Oper. Res. 167, 592–623.

Krasner, G.E., Pope, S.T., others, 1988. A description of the model-view-controller user interface paradigm in the smalltalk-80 system. J. Object Oriented Program. 1, 26–49.

Larbi, R., Alpan, G., Baptiste, P., Penz, B., 2011. Scheduling cross docking operations under full, partial and no information on inbound arrivals. Comput. Oper. Res. 38, 889–900.

Leff, A., Rayfield, J.T., 2001. Web-application development using the model/view/controller design pattern, in: Enterprise Distributed Object Computing Conference, 2001. EDOC’01. Proceedings. Fifth IEEE International. IEEE, pp. 118–127.

Liao, C.-J., Lin, Y., Shih, S.C., 2010. Vehicle routing with cross-docking in the supply chain. Expert Syst. Appl. 37, 6868–6873. doi:10.1016/j.eswa.2010.03.035

Marchand, D.A., Peppard, J., 2013. Why IT fumbles analytics. Harv. Bus. Rev. 91, 104–112.

Miao, Z., Lim, A., Ma, H., 2009. Truck dock assignment problem with operational time constraint within crossdocks. Eur. J. Oper. Res. 192, 105–115.

Michael Pinedo, 2012. Scheduling : theory, algorithms, and systems, 4th ed.. ed. Springer, New York ; London.

Ogden, S., Watson, R., 1999. Corporate performance and stakeholder management: Balancing shareholder and customer interests in the UK privatized water industry. Acad. Manage. J. 42, 526–538.

Schwaber, K., 2004. Agile project management with Scrum. Microsoft Press.

Seffah, A., Donyaee, M., Kline, R.B., Padda, H.K., 2006. Usability measurement and metrics: A consolidated model. Softw. Qual. J. 14, 159–178.

Tsui, L.Y., Chang, C.-H., 1992. An optimal solution to a dock door assignment problem. Comput. Ind. Eng. 23, 283–286. doi:10.1016/0360-8352(92)90117-3

Van Belle, J., Valckenaers, P., Cattrysse, D., 2012. Cross-docking: State of the art. Omega 40, 827–846.

Webster, J., Watson, R.T., 2002. Analyzing the past to prepare for the future: Writing a literature review. Manag. Inf. Syst. Q. 26, 3.

Whiteoak, P., 2004. Rethinking efficient replenishment in the grocery sector. Fernie J Sparks L2004 Logist. Retail Manag. 2, 138–163.

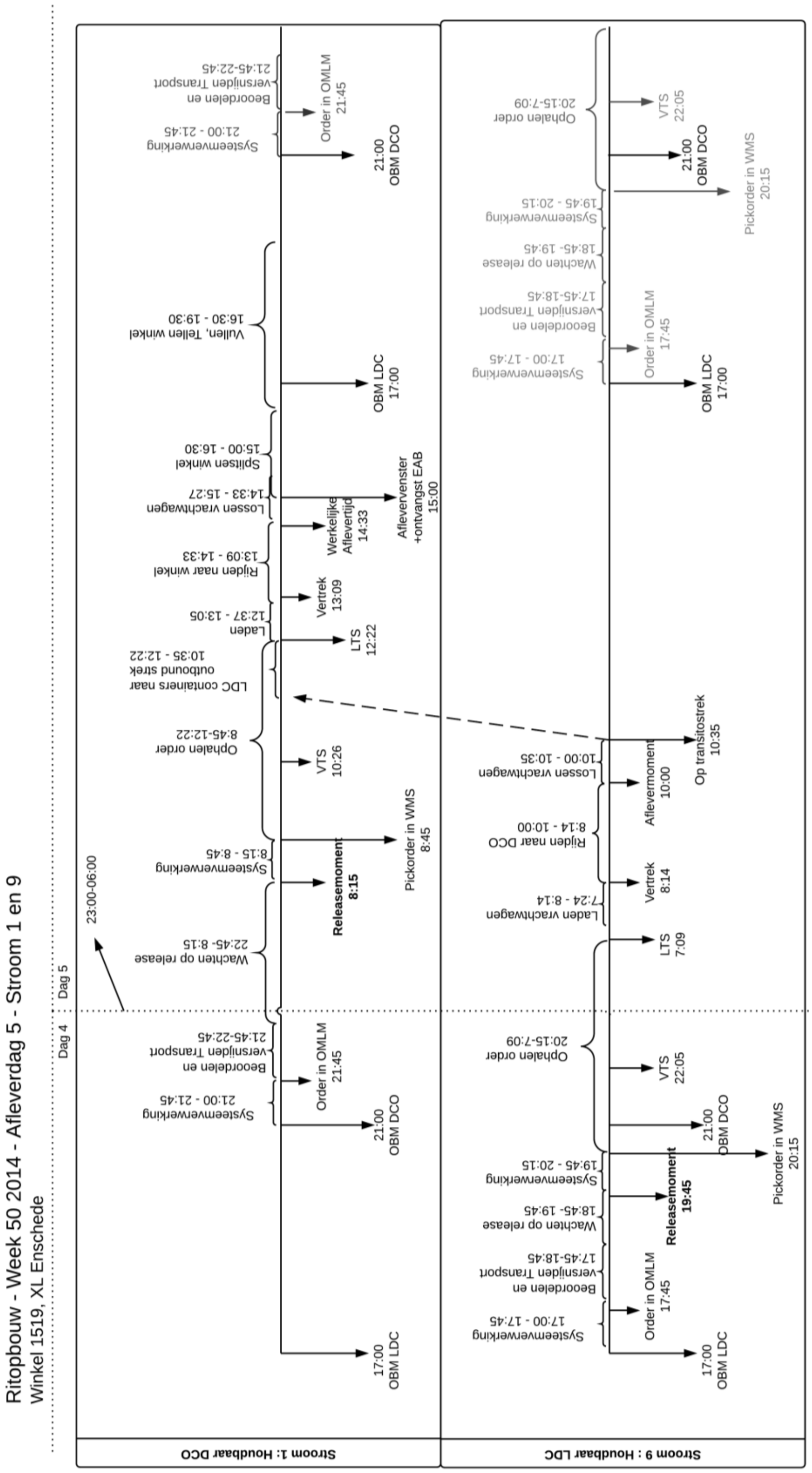
Wieringa, R., 2009. Design science as nested problem solving, in: Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology. ACM, p. 8.

Wolfswinkel, J.F., Furtmueller, E., Wilderom, C.P.M., 2011. Using grounded theory as a method for rigorously reviewing literature. Eur. J. Inf. Syst.

Zhu, Y.-R., Hahn, P.M., Liu, Y., Guignard, M., 2009. New approach for the cross-dock door assignment problem, in: In Proceedings of the XLI Brazilian Symposium on Operations Research.

Appendix

A . Schematic view of store order



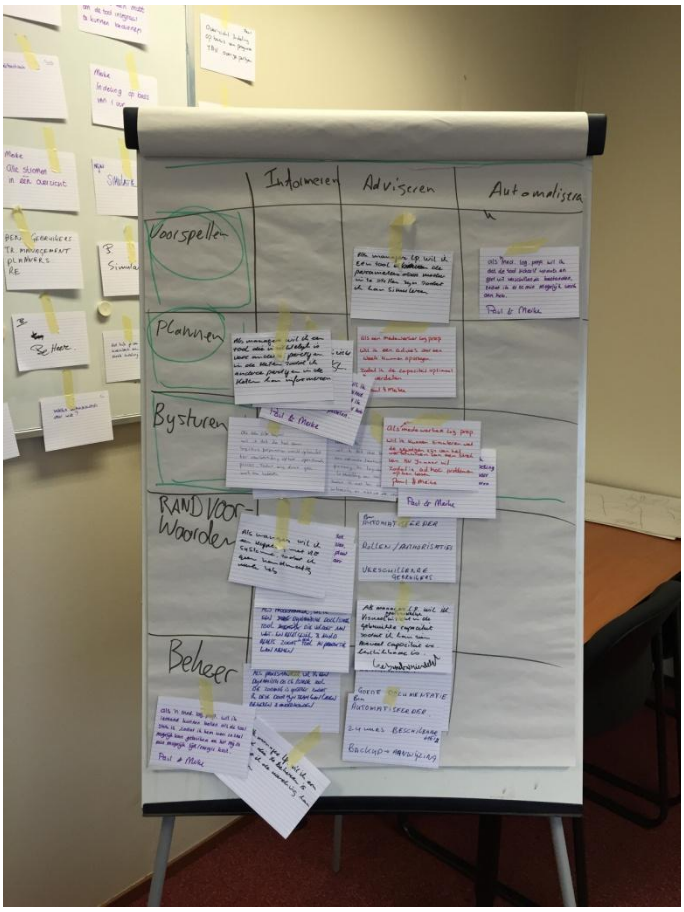
B. TransitoTool evaluation (Dutch)

		Helemaal mee eens	Mee eens	Neutraal	Oneens	Helemaal mee eens
Q01	Het uiterlijk (interface) van de tool is aantrekkelijk					
Q02	Ik krijg een positief gevoel (perceptie) bij de tool					
Q03	Er zijn voldoende instellingsmogelijkheden om te bereiken wat ik wil					
Q04	De tool kan ik gebruiken zonder uitleg van anderen					
Q05	Het bedienen van de tool is eenvoudig					
Q06	De tool geeft een ondubbelzinnig en helder overzicht					
Q07	De bediening van de tool is efficiënt					
Q08	De tool geeft correcte resultaten die ik herken in de praktijk					
Q09	De tool ga ik wekelijks gebruiken wanneer deze wordt aangeleverd					
Q10	Met de tool kan ik een efficiëntere planning maken					
Q11	Een online variant zoals de RE toolbox zou een nuttige verbetering zijn					
Q14	Ik zou graag zien dat de tool verder verbeterd wordt (opmerkingen in veld onderaan)					
Q13	De tool illustreert de knelpunten binnen de transitostrekken op een realistische manier					
Welke verbetermogelijkheden zie je? Verdere aan of opmerkingen?						

C. Full evaluation results TransitoTool

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
TOTAL	**3.5**	**4**	**3.7**	**3.2**	**4**	**3.3**	**4**	**3.3**	**4**	**3.7**	**4.7**	**4.7**	**3.2**
	3	4	3	2	3	4	3	4	4	5	5	5	4
	5	5	4	5	5	5	5	5	4	4	5	5	5
	3	4	4	5	5	4	5	3	5	4	4	4	2
	4	3	4	2	2	4	2	4	4	4	4	4	4
	4	4	4	4	4	2	4	3	4	4	5	5	3
	2	4	3	1	5	1	5	1	3	1	5	5	1

D. Impressions SCRUM –session – Iteration 1



E. Result Brainstorm – Iteration 1

Vragen
Hoe kijk je aan tegen diversiteit van indeling per site?
Welke werkinstructies en voor wie?
Is de data er? Scope? Tijd?
Wat wil je bereiken met dock/ strekplan? M2/strekbezetting
Wat is de definitie van dynamisch
Hoe ga je jouw tool borgen na je vertrek?
Wie zijn de gebruikers en hoe gebruiken ze de tool?
Hoe kijk je aan tegen de niet uniforme werkwijze op de sites mbt docks?
Wat levert dit de supply chain op?

Termen
Simulatie
Simulatie
Beheer
Real Time
Objectief
Capaciteitscheck
Prioritering
Fysieke inrichting (per site anders)
Onderhoudsvriendelijk
Meetbaar resultaat
Visueel

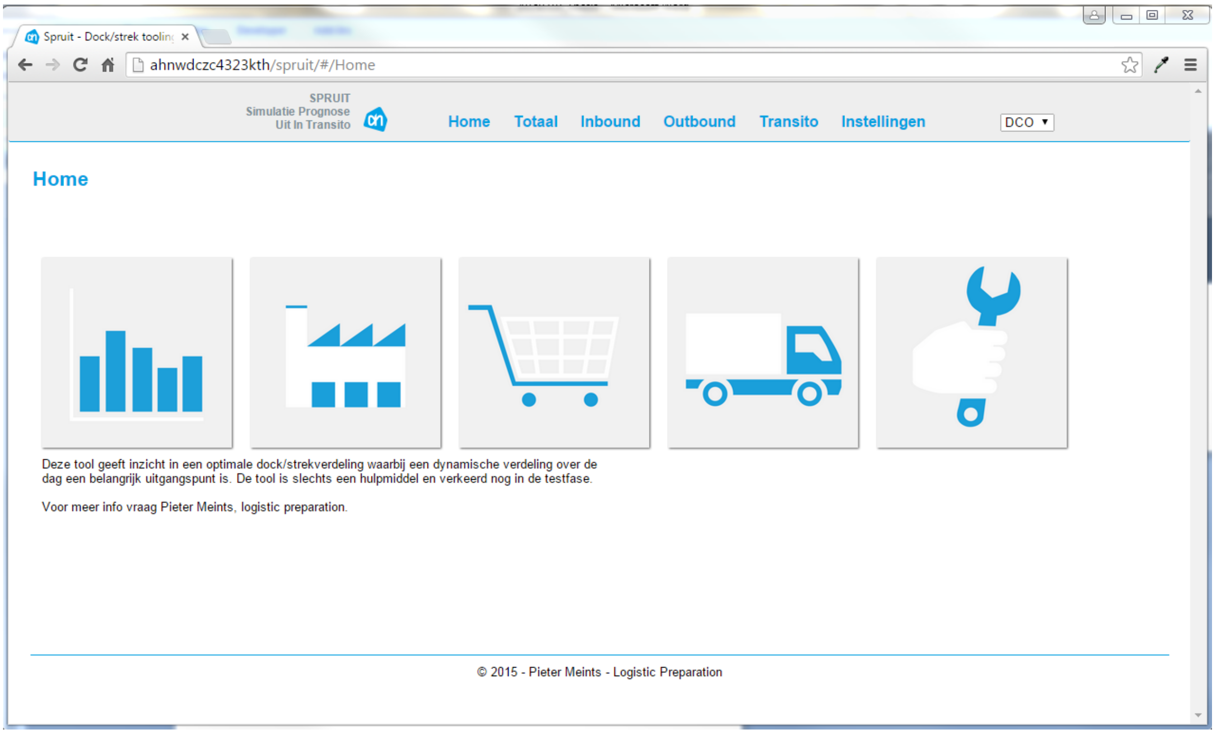
Functionaliteit
Indeling op basis van 1 uur
Eenvoudig in gebruik
Overzicht indleing op basis van prognose tbv overige partijen
Adviesverdeling op basis van plan
Inzicht in druk op stromen dag/uur/week
Gebruikers - rollen
Alle stromen in 1 overzicht
Inzicht in juiste verdeling van beschikb cap. (taartdiagram)
Parameter setting door gebruikers
Verschillende dagen/weken in 1 tool; dus niet iedere week nieuwe
Strek - Tijd - in balken uitgedrukt
toegang voor de stakeholders
Te onderhouden
Geen Excel/VBA!
Resultaat = meer capaciteit
plattegrond én data
Integratie met TP-in mogelijk
Tool koppelen aan reeds bestaande systemen voor simpel onderhoud
In kunnen zoomen per stroom voor gebruiksgebmak
Webbased, grafisch en simulaties

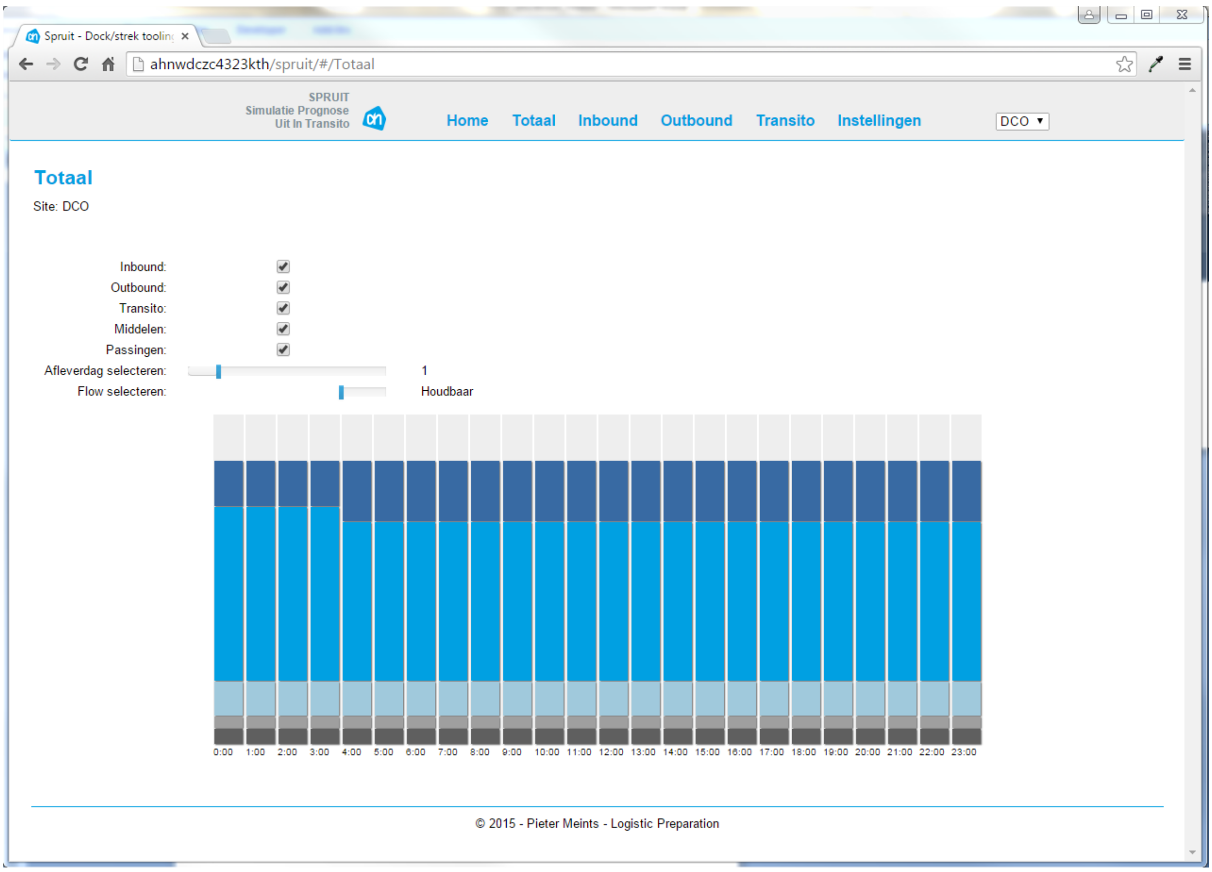
Opmerkingen
Online is een must om te tool integraal te bedienen
Traffic management versus cockpitmedw
Operationeel/tactisch?

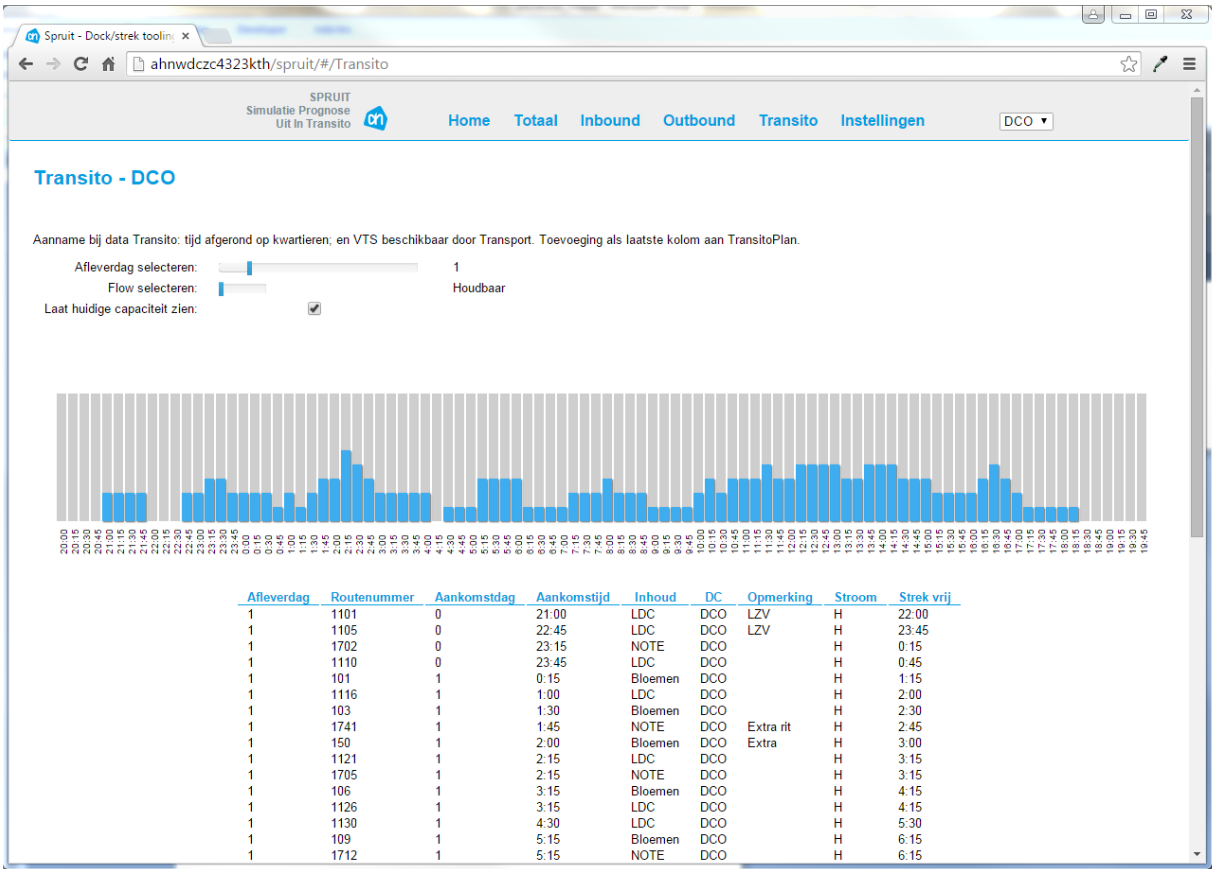
F. Product Backlog – iteration 1

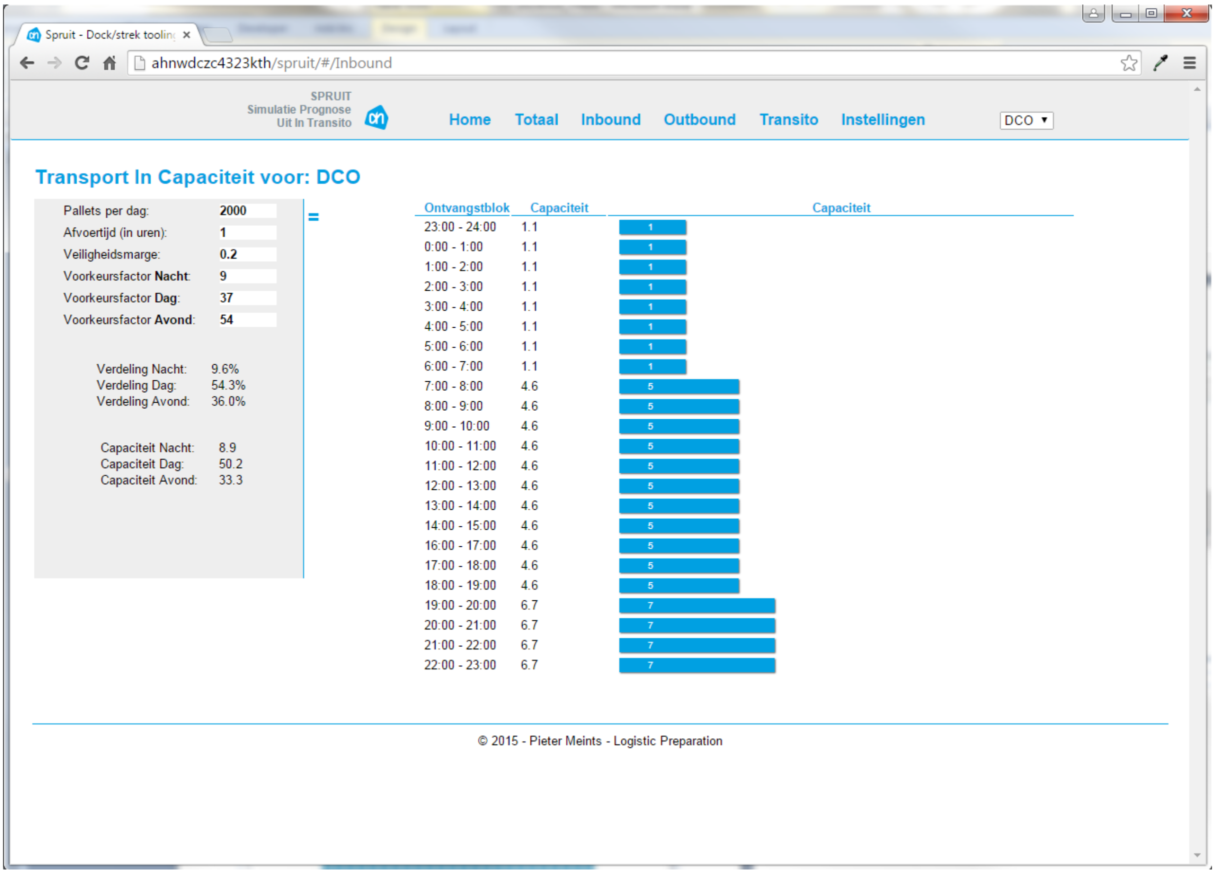
	Informeren	Adviseren	Automatiseren
Voorspellen		Als manager logistic preparation wil ik een tool die parameters door medewerkers in the stellen zijn zodat ik kan simuluren (by)	Als medewerker log prep wil ik dat de tool zichzelf update en grut uit de
Plannen	Als manager wil ik een tool die inzichtelijk is voor andere parijen in de keten zodat ik andere partijen in de keten kan informeren (by)	**Als een medewerker log prep wil ik een advies voor een week kunnen opvragen zodat ik de capaciteit optimaal kan verdelen (p+m)**	
	Als OMB wil ik inzicht zodat de cockpit/ traffic geinformeerd blijft.		
	Als cockpitmedewerker wil ik dat operationele wijzigingen direct worden verwerkt in de tool, zodat ik een zo up to date mogelijk beeld heb en niet meer hoef te puzzelen (p+m)		
Bijsturen	Als OMB wil ik dat de tool leidt tot een optimale tactisch en operationele planning (verdeling van werkaanbod) bij log prep zodat ik mij kan richten op de uitvoering en niet op de voorbereiding (p)	**Als een medewerker log prep wil ik kunnen simuleren wat de gevolgen van het verschuiven een strek van In naar uit zodat ik ad hoc problemen op kan lossen. (p+m)**	
	Als "site totaal" wil ik dat de tool door log prep gebruikt wordt ter voorereiding op het operationele proces zodat wij daar geen werk van hebben (p)	**Als een medeweker log prep wil ik kunnen terugkijken of een voorspelling juist was, zodat ik het proces voor de toekomst daarmee kan verbeteren (p+m)**	
	Als OMB wil dat de tool door log prep gebruikt wordt en dat dit leidt to de gewenste resultaten. Ik wil wel inzicht hebben... (p)		
	Als OMB wil ik dat de tool aansluit op de huidige systemen zoals doccams en werkprocedures en instructies zodat er geen sprake is van aanpassingen op de sites (p)		
	Als een cockpitmedewerker/shiftleader wil ik niet met de tool te maken hebben, i word aangestuurd door het huidige systeem zodat ik me kan richten op de uitvoering van de processen (p)		
Randvoorwaarden	Als manager wil ik een koppeling met RE systemen zodat ik geen handmatig werk heb. (by)		
	Als medewerker log prep wil dat alle disiplines dezelfde data zien, zodat we samen naar dezelfde plaat kijken en geen discussie hebben over data (p+m)		
	Als procesmanager wil ik een dynamische dockstrek tool die baten helder presenteert in capaciteit zodat ik een business case kan bouwen (a)		
	Als automatiseerder wil ik rollen en authorisaties zodat er verschillende gebruikers in het systeem kunnen (b)		
	Als manager log prep wil ik visueel aantrekkelijk inzicht in de gebruikte capaciteit zodat ik kan zien hoeveel capaciteit er beschikbaar is. = gebruiksvriendelijk (by)		
Beheer	Als procesmanager wil ik een dynamische tool die zodanig is opgezet zodat ik deze door mijn team kan laten beheren en onderhouden.		
	Als automatiseerder wil ik een 24uurs beschikbaarheid en backup. (b)		
	Als automatiseerder wil ik goede documentatie zodat functionaliteit inzichtigelijk is (b)		
	Als manager log prep wil ik een tool die te beheren is zodat ik de werking kan borgen (by)		
	Als een medewerker log prep wil ik iemand kunnen bellen als de tool stuk is zodat ik hem weer zo snel mogelijk kan gebruiken en het mij zo min mogelijk tijd/energie kost (p+m)		

G. Screenshots Tool – Iteration 2






Spruit - Dock/strek tooling
ahnwdczc4323kth/spruit/#/Transito
SPRUIT
Simulatie Prognose
Uit In Transito
Home
Totaal
Inbound
Outbound
Transito
Instellingen
DCO
Transito - DCO
Aanname bij data Transito: tijd afgerond op kwartieren; en VTS beschikbaar door Transport. Toevoeging als laatste kolom aan TransitoPlan.
Afleverdag selecteren:
1
Flow selecteren:
Houdbaar
Laat huidige capaciteit zien:
Afleverdag
Routenummer
Aankomstdag
Aankomstijd
Inhoud
DC
Opmerking
Stroom
Strek vrij
1 | 1101 | 0 | 21:00 | LDC | DCO | LZV | H | 22:00
1 | 1105 | 0 | 22:45 | LDC | DCO | LZV | H | 23:45
1 | 1702 | 0 | 23:15 | NOTE | DCO | | H | 0:15
1 | 1110 | 0 | 23:45 | LDC | DCO | | H | 0:45
1 | 101 | 1 | 0:15 | Bloemen | DCO | | H | 1:15
1 | 1116 | 1 | 1:00 | LDC | DCO | | H | 2:00
1 | 103 | 1 | 1:30 | Bloemen | DCO | | H | 2:30
1 | 1741 | 1 | 1:45 | NOTE | DCO | Extra rit | H | 2:45
1 | 150 | 1 | 2:00 | Bloemen | DCO | Extra | H | 3:00
1 | 1121 | 1 | 2:15 | LDC | DCO | | H | 3:15
1 | 1705 | 1 | 2:15 | NOTE | DCO | | H | 3:15
1 | 106 | 1 | 3:15 | Bloemen | DCO | | H | 4:15
1 | 1126 | 1 | 3:15 | LDC | DCO | | H | 4:15
1 | 1130 | 1 | 4:30 | LDC | DCO | | H | 5:30
1 | 109 | 1 | 5:15 | Bloemen | DCO | | H | 6:15
1 | 1712 | 1 | 5:15 | NOTE | DCO | | H | 6:15


Spruit - Dock/strek tooling
ahnwdczc4323kth/spruit/#/Inbound
SPRUIT
Simulatie Prognose
Uit In Transito
Home
Totaal
Inbound
Outbound
Transito
Instellingen
DCO
Transport In Capaciteit voor: DCO
Pallets per dag: 2000
Afvoertijd (in uren): 1
Veiligheidsmarge: 0.2
Voorkeursfactor Nacht: 9
Voorkeursfactor Dag: 37
Voorkeursfactor Avond: 54
Verdeling Nacht: 9.6%
Verdeling Dag: 54.3%
Verdeling Avond: 36.0%
Capaciteit Nacht: 8.9
Capaciteit Dag: 50.2
Capaciteit Avond: 33.3
Ontvangstblok
Capaciteit
Capaciteit
23:00 - 24:00 | 1.1 | 1
0:00 - 1:00 | 1.1 | 1
1:00 - 2:00 | 1.1 | 1
2:00 - 3:00 | 1.1 | 1
3:00 - 4:00 | 1.1 | 1
4:00 - 5:00 | 1.1 | 1
5:00 - 6:00 | 1.1 | 1
6:00 - 7:00 | 1.1 | 1
7:00 - 8:00 | 4.6 | 5
8:00 - 9:00 | 4.6 | 5
9:00 - 10:00 | 4.6 | 5
10:00 - 11:00 | 4.6 | 5
11:00 - 12:00 | 4.6 | 5
12:00 - 13:00 | 4.6 | 5
13:00 - 14:00 | 4.6 | 5
14:00 - 15:00 | 4.6 | 5
16:00 - 17:00 | 4.6 | 5
17:00 - 18:00 | 4.6 | 5
18:00 - 19:00 | 4.6 | 5
19:00 - 20:00 | 6.7 | 7
20:00 - 21:00 | 6.7 | 7
21:00 - 22:00 | 6.7 | 7
22:00 - 23:00 | 6.7 | 7
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H. Product backlog – Iteration 2

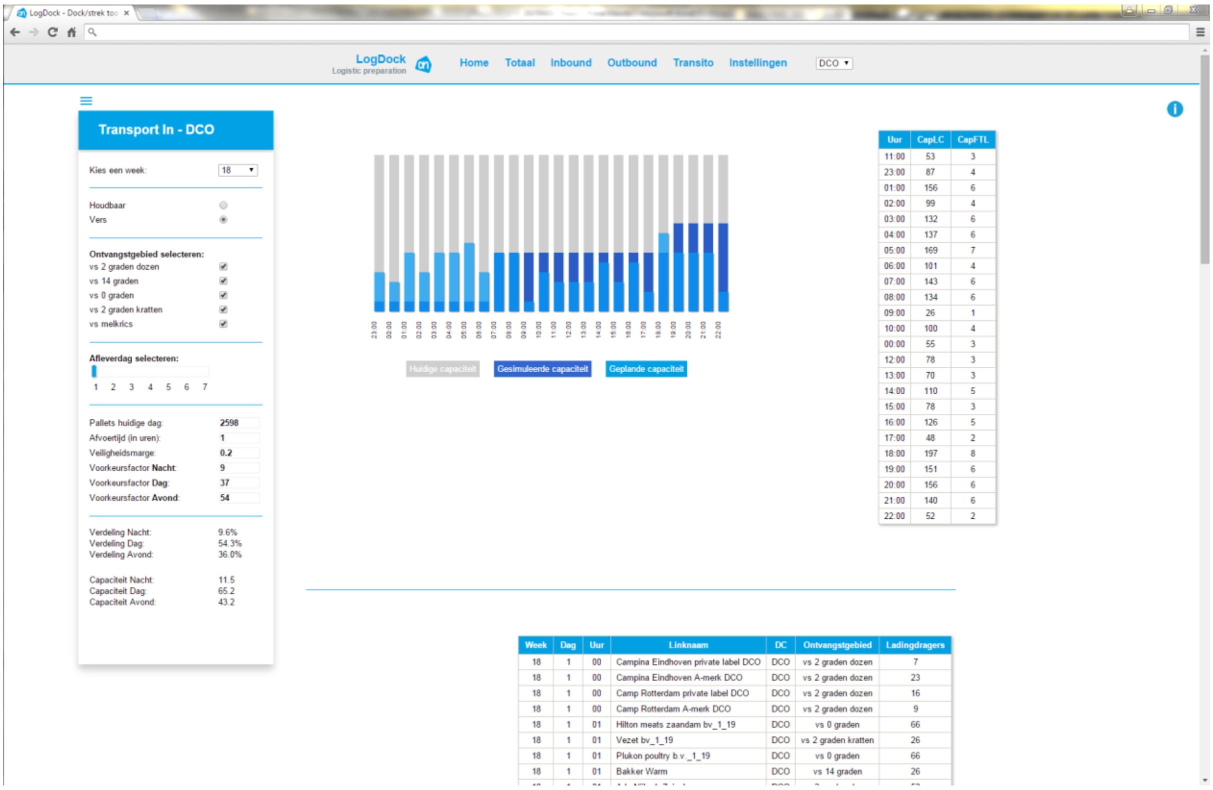
Sessie 2

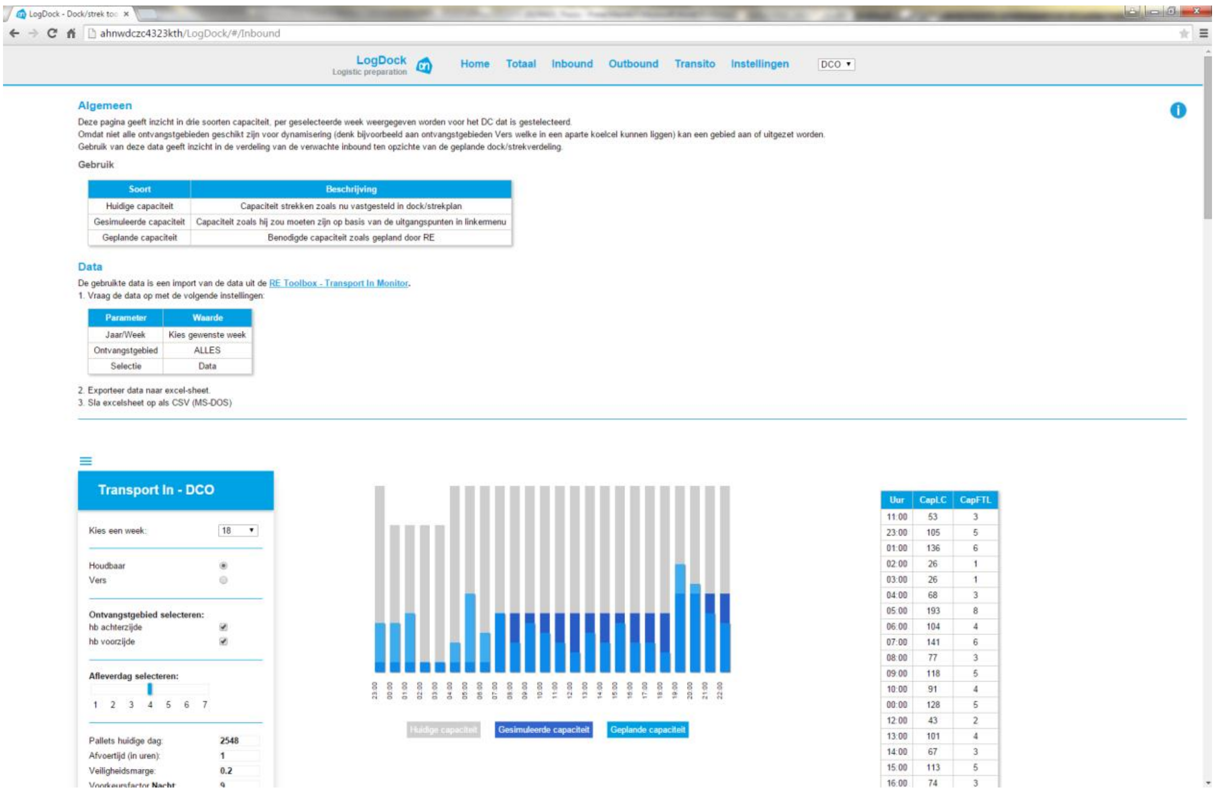
Layout	
Alle	Houdbaar/vers andere kleur
Totaal	Achtergrond tabel wit maken
Transito	Capaciteit niet meer zichtbaar waneer realisatie capaciteit overschreid
Transito	Kolombreedte is niet gelijk wanneer er geen capaciteit is.
Alle	Andere naam/logo
Home	Buttons werken niet over het hele plaatje. Alleen de tekst
Totaal	Duidelijk maken wat maximaal aantal strekken is; totaal

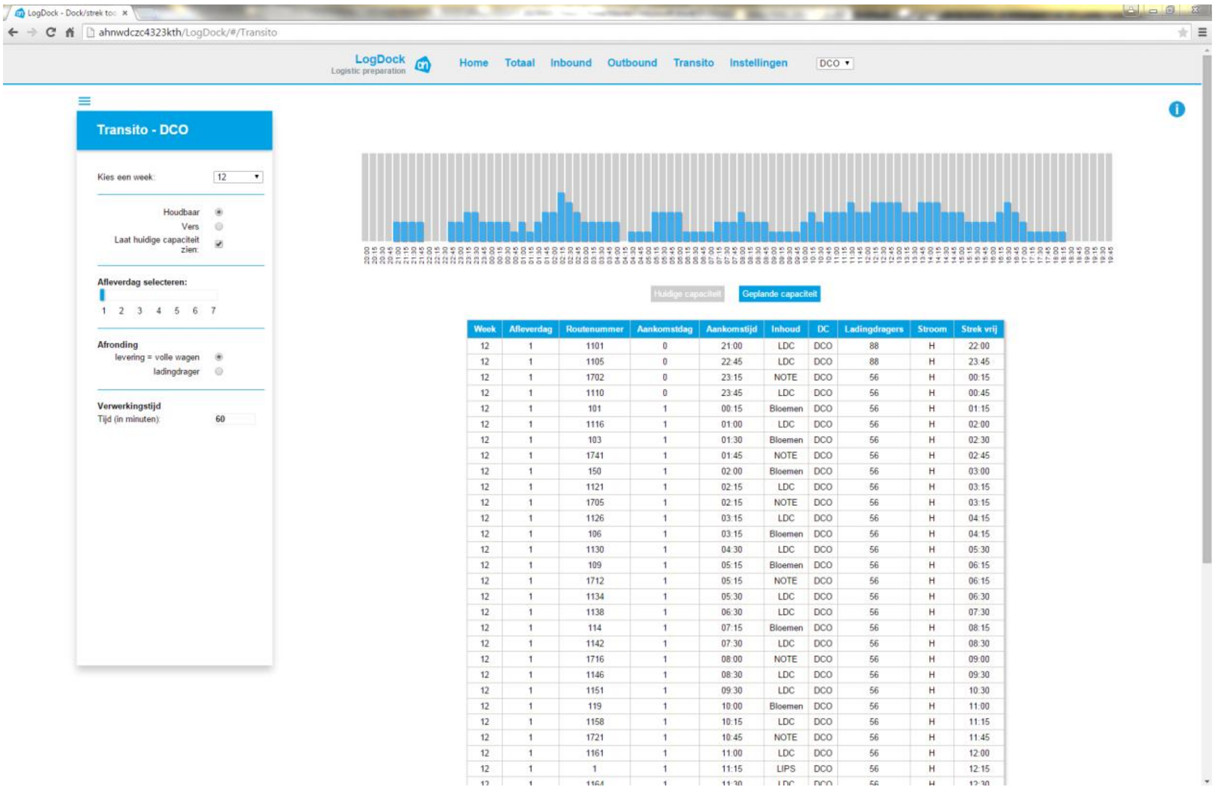
Uitleg/Definities	
Inbound	Afvoertijd per volle vrachtwagen?
Inbound	Veiligheidsmarge weergeven in %
Alle	Legenda
Alle	Houdbaar/vers andere kleur
Alle	Schaalverdleing aan zijkant/ y-as
Transito	Kleur per stroom
Alle	Legenda bij de schuiven
Alle	HB/VS selectie door radiobutton
Alle	Productiedag/aankomst dag? Van 0:00 - 23:59 of van 20:00 - 19:59uur?
Inbound	Pallets of Ladingdragers?

Functionaliteit	
Inbound	Vergelijking maken met realisatie/planning
Totaal	Capaciteitsissues weergeven
Transito	Opbouw van capaciteit weergeven bij klik
Transito	Selectie van ritten in bepaalde tijdseenheid
Transito	Capaciteit standaard aan
Totaal	Vergelijking capaciteit en gepland --> per stroom
Outbound	Dubbelloop zichtbaar maken
Outbound	Passingen
Outbound	Inzicht in wanneer outbound docks gebruikt
Outbound	Op basis van winkelritten
Outbound	Verschil in weergave op VTS of BTL-opbouwtijd. VTS is altijd gelijk na volgende ETL
Outboudn	Strekbezetting: van VTS -----> Vertrektijd (Finishing time load)
Alle	Import/export via een file selector
Alle	Selectie alle DC's
Alle	Meerdere dagen tegelijk?
Alle	Vergelijking maken tussen twee stromen; bijv inbound en outbound. Zie tekening Pau
Alle	Historie mogelijk maken --> Tabellen als selecties

I. Screenshots Tool – Iteration 3







Week	Afleverdag	Routenummer	Aankomstdag	Aankomstijd	Inhoud	DC	Ladingdragers	Stroom	Strek vrij
12	1	1101	0	21:00	LDC	DCO	88	H	22:00
12	1	1105	0	22:45	LDC	DCO	88	H	23:45
12	1	1702	0	23:15	NOTE	DCO	56	H	00:15
12	1	1110	0	23:45	LDC	DCO	56	H	00:45
12	1	101	1	00:15	Bloemen	DCO	56	H	01:15
12	1	1116	1	01:00	LDC	DCO	56	H	02:00
12	1	103	1	01:30	Bloemen	DCO	56	H	02:30
12	1	1741	1	01:45	NOTE	DCO	56	H	02:45
12	1	150	1	02:00	Bloemen	DCO	56	H	03:00
12	1	1121	1	02:15	LDC	DCO	56	H	03:15
12	1	1705	1	02:15	NOTE	DCO	56	H	03:15
12	1	1126	1	03:15	LDC	DCO	56	H	04:15
12	1	106	1	03:15	Bloemen	DCO	56	H	04:15
12	1	1130	1	04:30	LDC	DCO	56	H	05:30
12	1	109	1	05:15	Bloemen	DCO	56	H	06:15
12	1	1712	1	05:15	NOTE	DCO	56	H	06:15
12	1	1134	1	05:30	LDC	DCO	56	H	06:30
12	1	1138	1	06:30	LDC	DCO	56	H	07:30
12	1	114	1	07:15	Bloemen	DCO	56	H	08:15
12	1	1142	1	07:30	LDC	DCO	56	H	08:30
12	1	1716	1	08:00	NOTE	DCO	56	H	09:00
12	1	1146	1	08:30	LDC	DCO	56	H	09:30
12	1	1151	1	09:30	LDC	DCO	56	H	10:30
12	1	119	1	10:00	Bloemen	DCO	56	H	11:00
12	1	1158	1	10:15	LDC	DCO	56	H	11:15
12	1	1721	1	10:45	NOTE	DCO	56	H	11:45
12	1	1161	1	11:00	LDC	DCO	56	H	12:00
12	1	1	1	11:15	LIPS	DCO	56	H	12:15
12	1	1164	1	11:30	LDC	DCO	56	H	12:30