Multi-Perspective Design

of a

Fast-Track Facility

for

Cargo Transhipment

at

Amsterdam Airport Schiphol

APPENDIX

Noortje Alexandra Kallen
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Transport, Infrastructure and Logistics (TIL)
Delft University of Technology

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ACTOR RELATED APPENDICES

Appendix A: General Actor Analysis

In order to perform the actor analysis, first the processes included in this research will be shortly presented. The point of focus in this research is the cargo handling at the airport. The import as well as the export flows are taken into account. The physical area of the airport which is of importance is from the VOP's until the landside (un)loading docks at the handlers facilities.

The import process ,within the scope of this research, actually refers to the unloading of the cargo at the VOP and placing the pallets and containers on dolly's or transporters which bring the cargo to the right 1st line facility where the cargo is either broken down and loaded in the truck or as a whole (BUP) transhipped through the facility and loaded in the truck.

The export process ,within the scope of this research, refers to the unloading of the trucks at the 1st line handlers facility. In this facility pallets are build up with bulk cargo and the BUPs delivered by the trucks are transported to airside. At the airside the cargo is set up on dolly's when the airplane is not near to the handlers facility and otherwise(if the plane is nearby) it is stored at the airside docks.

There are an enormous amount of actors which have something to do with these handling processes. Either they perform the processes, they are dependent on the processes, or the processes depend on the actors. This actor analysis is based primarily on interviews performed with various parties at Schiphol of which reports can be found in appendix N.

A1 Actor Clusters & Singled out actors

In order to perform an uncluttered analysis of the actors within the scope of this research it is useful to cluster several companies into categories as there are at least 400 companies that need to be taken into account. Other companies however play a different role which is of importance in the air cargo chain at Schiphol and are therefore singled out.

A 1.1 Actor Clusters

Although there are differences between the companies in the clusters, like for example the size and field of expertise of the organization, it is assumed that these clusters have about the same values, dependencies, goals and vision.

Ground Handlers

The first actor cluster which is most directly connected to the processes described above are the Schiphol ground handlers which operate the first line handling facilities at Amsterdam Airport Schiphol. This cluster is directly connected because they actually perform the main part of the process within the scope of this research. The ground handlers main responsibility is the transhipment of the cargo from the airplane to the truck and the other way around. However, not all ground handlers have airside access and they therefore depend on the handlers who do have access for the 'airside handling'. Airside handling is the process that takes place between the VOP and 1st line facilities.

Currently there are seven ground handlers at AAS: six third party ground handlers that have contracts with airlines and one ground handler owned and operated by home carrier KLM (Donk, 2015). The 6 third party ground handlers are: Menzies, Aviapartner, Swissport, Skylink, WFS and Freshport. Besides KLM, the first three mentioned companies have got airside access. This means that Skylink, WFS and Freshport depend on these four companies to transport the cargo between the airplane and their first line facility. Figure 1 below shows where the handlers are currently situated at Schiphol (Centre, South and South-East).

Figure 1: Handler Locations AAS

Airlines

The second cluster are the airlines which are responsible for the actual air transport of the cargo. There are currently 92 airlines which transport cargo from and to Schiphol. 20 airlines are solely dedicated to cargo which are therefore called the cargo airlines. There are 17 combination airlines which own full freighters as well as transporting cargo in the belly of their pax planes. The remaining 55 airlines transport belly cargo in their pax flights (Schiphol Group: TAF, 2015).

The airline has contracts with the handlers and the trucking companies. The airlines are the ground handlers and trucking companies customer. The contract between the airline and the handler is a service level agreement and are currently quite short term contracts. The handlers are supposed to handle the cargo according to these agreements.

Forwarders

There are approximately over 100 forwarders active at Amsterdam Airport Schiphol. These forwarders primarily have facilities at second line. However there are exceptions. DHL Global Forwarding operates a facility at the first line of Schiphol and furthermore there are two forwarders: Kuehne Nagel & DB Schenker who use a dedicated fast-track lane at the first line within a handlers facility. Kuhne Nagel operates an import flower fast-track within the Menzies facility and DB Schenker uses a dedicated fast-track (primarily import) within the Skylink facility. The difference is that DB Schenker does not operate the track itself but is officially responsible for the cargo when it enters the facility at airside.

Trucking companies

The approximately 190 trucking companies at Schiphol are clustered as well. Their main tasks are to provide transport between 1st and 2nd line at Schiphol, to transport between Shipper or consignee and AAS and to drive between different European airports as part of the cargo transfer process. The cargo which is transported with the trucks between different European airport is then officially stated as air cargo (even though it is in a truck) and is accompanied by an Airway Bill.

The contract of the airline with the handler influences the logistic process for the trucking companies, the airlines actually decide where the trucks need to go. The 8 largest trucking companies take care of 50% of the visit frequency at Schiphol (Pieters, 2014, p. 35) They are important market leaders and if they are open to innovation, smaller companies will probably follow.

A 1.2 Singled out actors

Schiphol Cargo
Schiphol Group and in specific Schiphol Cargo is the problem owner of this research. Schiphol aims at being and staying Europe’s preferred cargo airport, which includes facilitating growing cargo volumes in the future.

Schiphol Real Estate (SRE)
Schiphol real estate is the branch within Schiphol Group responsible for the letting of the land and buildings at the Schiphol premises. They are singled out because this branch is directly involved in the relation issues and plan stated in the Masterplan.

KLM Cargo
KLM is the home carrier at AAS and used to have the cargo alone-right at the airport. KLM is a singled out actor because it has the position of an airline as well as a handler in the air cargo logistics chain. As an airline KLM is responsible for 40 of the cargo volumes at Schiphol. This makes KLM the largest airline and handler at Schiphol. Besides their volumes, Schiphol and KLM have a long-term history working together and involve each other in their long-term strategies.

Customs
Customs is an important step in the air cargo logistics chain which takes place within the physical process scope of this project. Customs is situated at Schiphol and is currently working on the realization of the Joint Inspection Centre (JIC) at Schiphol South-East where all custom checks can be performed professionally.

Air Cargo Netherlands (ACN)
ACN is the branch organization which represents and lobbies for several parties within the air cargo logistics chain such as Schiphol, Ground Handlers, Forwarders and Customs. Their main goal is to develop the Dutch air cargo supply chain. Projects that have received attention from Can in the past are the Smartgate concept, the introduction of the ACN card (which allows truckers to be recognized at the handlers gates and therefore decreases truck waiting times), e-Link and various durability an sustainability projects.

Cargonaut
Is *the* community platform for efficient information exchange within Schiphol (Cargonaut, 2015). Cargonaut collects and processes data for the chain and stimulates innovations of the chain or between various players within the chain. It therefore serves as a relatively neutral third party with large information density.

A2 General Interests, Objectives and Problem Perception

In order get an impression of the position of the several actors and actor clusters in the chain at AAS it is interesting to have an overview of several variables. The interests and goals of the actors are stated in table below as well as the expected situation of the actor at AAS specific. This is followed by the causes of these gaps and the possible solutions. This table by Donk (2015) provides a general impression of the actors positioning in the cargo chain at AAS specifically.

Table 1: Interests - objectives - problem perceptions diagram (Donk, 2015) adjusted by author

Actor	Interests	Desired situation/goals	Expected situation/gap	Causes	Possible solutions
Schiphol Cargo	Profit & continuity	AAS becoming Europe's preferred cargo airport and thereby the realization of air cargo growth via AAS in the short and long term future	Growth of air cargo via AAS on the long run will not happen because of insufficient ground handler capacity and unattractiveness of airport due to congestion for trucks	Expansion of passenger terminal due to which KLM Cargo ground handler needs to move. After KLM Cargo is moved there remains only limited space for handlers to physically expand. The open market regime for ground handling at AAS results in trucks having to visit multiple handlers and this causes congestion at AAS and waiting times at handlers	1. Lobbying at SRE to create more space for ground handlers at AAS. 2. Withdrawing licenses of some third party ground handlers (so that trucks have to visit fewer places and capacity is created for the remaining ground handlers to expand). 3. Developing and operating own CPD. 4. Lobbying for market solutions by forwarders, handlers and airlines, such as CPD creation
Schiphol Real Estate (SRE)	Profit & continuity	Continuous demand for land and buildings by market players (such as land and buildings at and around the Cargo World area)	On the long run, a reduced demand for SRE's land and buildings by market players in the air cargo logistics chain at AAS (such as forwarders and trucking companies for their warehouses). This also resulting in companies outside this chain being less interested in settling at or around AAS	Maximum cargo handling capacity at AAS has been reached due to which growth in cargo volumes is ended. Furthermore an increased congestion for trucks at the airport makes the airport unattractive due to which forwarders and other companies decide to not or in fewer extent make use of AAS. This may also result in other companies moving away from	Investing in infrastructure, land, buildings, etc. Redesigning current infrastructure, buildings and land to better serve desires of the market, thereby improving the performance of the air cargo logistics chain at AAS and so increasing demand for SRE's assets; potentially selling pieces of land if land turns out to not be profitable anymore

				the AAS area, because the attractiveness of the hub decreases if the cargo performances decrease	
Freight forwarders	Profit & continuity	Many customers and an extensive, reliable and cost-efficient network to serve these customers (shippers and consignees) - this network either built up by own assets/operations and/or by outsourcing the activities to airlines, trucking companies, etc.	**AAS specific:** Opportunities to build up an extensive, reliable and cost-efficient network in Europe get reduced in the long term future because of worsened performance AAS, making it more difficult to offer shippers and consignees attractive transportation opportunities via the air **General:** Demand for forwarders' services decreases	**AAS specific:** Handling capacity at AAS is limited in the long term future and congestion and waiting times at and around AAS is causing delays and adding to costs of total transport **General:** Integrators taking over more of the market	Moving operations and freight to other European airports – lobbying for direct access to airside at AAS or closing preferred partnerships with ground handlers/airlines at AAS to improve the performance of their own network. Also offering value added logistics and getting involved in other parts of the supply chain to get more control
KLM Cargo (home carrier and ground handler)	Profit & Continuity	Growth of cargo volumes of KLM Cargo and Martinair Cargo, letting long-term relationships increase and increasing profitability of their operations. For example by improving network of connections and the degree of loading in the bellies in passenger planes	**AAS specific:** Cargo volumes of KLM Cargo and Martinair Cargo reach maximum or even decrease in long term future. Therefore incomes from full freighter services and profitability of passenger flights decrease **General:** Demand for cargo space decreases	**AAS specific:** Because maximum cargo handling capacity at AAS has been reached and congestion and waiting times at AAS make the airport unattractive, forwarders do make less use of KLM Cargo **General:** Integrators taking over more of the market	Lobbying at Schiphol Group for more handling capacity. Improving own operations so that cargo handling can take place more efficient (less space is needed). Starting collaboration with other handlers and/or forwarders such as better information sharing, to reduce effects of congestion and reduce growth limitations
Other (cargo) airlines	Profit & continuity	Growth of cargo volumes, letting long-term relationships increase and increasing profitability of their	**AAS specific:** Demand for air cargo from and to AAS in the long term future decreases	**AAS specific:** Forwarders prefer other large European airports for air cargo over AAS, because handling capacity	Moving network to other European cargo airports, potentially both full freighter services and passenger planes. Improving

		operations. For example by improving network of connections and the degree of loading in the bellies in passenger planes	**General:** Demand for cargo space decreases	at AAS is limited and quality is low (due to congestion) **General**: Integrators taking over more of the market	collaboration with forwarders and handlers to compete against integrators
Third party ground handlers (at AAS)	Profit & Continuity	Increased cargo volumes, by attracting more customers and maintaining current customers and continuity because long-term relationships have been closed. Also keep performing many profitable activities in the chain	Decreased/limited cargo volumes at AAS on the long term and fewer turnover and profitability	**AAS specific:** No possibility to expand for ground handlers, which brings limitations to growth of cargo at AAS. Congestion of trucks at AAS decreases attractiveness of AAS, due to which forwarders and airlines (= freight) move away from AAS **General:** Forwarders taking over many activities of handlers because it is more cost-effective/ adds to their profit and integrators take over more of the market and do their own ground handling	Improving own operations, start collaboration with other handlers and/or forwarders, such as a better information sharing – global firm can move activities to other airports
Trucking companies	Profit & continuity	High demand for services of trucking companies from and to the Netherlands and possibility to have efficient operations (e.g. high truckload factor)	Freight volumes for trucking companies will decrease in the long term future and more pressure on operations	**AAS specific:** Freight arriving at/ departing from AAS decreases/ stagnates because the airport has reached maximum capacity and because of congestion and waiting times at and around the AAS area; congestion also negatively influences trucking company's operations **General:** Forwarders	Expanding operations to other major hubs within or outside air cargo industry. Collaborating with ground handlers for better alignment of activities

				investing in own trucks; integrators taking over more of the market	
Customs	High safety and security of air freight at AAS	Ability to conduct efficient, accurate and fast security and safety checks at AAS	More complex operations, because customs checks need to be done more fragmented over AAS area	**AAS specific:** The existence of multiple handlers, due to the open market regime **General:** Forwarders taking over activities of ground handlers, due to which customs clearance also needs to be done in forwarders' warehouses	Adjust customs procedures and oblige all market players to follow new rules
Cargonaut	Profit & continuity	Growth of cargo via AAS hub and more organizations connected to Cargonauts information network – ability to stimulate improvements of and better information sharing between adjoined organizations so that their performances increase and reputation of Cargonaut as well	Decreased/limited cargo volumes at AAS on the long term and limited organizations willing to join Cargonauts network	**AAS specific:** Freight arriving at/ departing from AAS decreases/ stagnates because the airport has reached maximum handling capacity and because of congestion at and around the AAS area **General:** Organizations in air freight industry not willing to share data/collaborate	Lobbying at Schiphol Group for improvements and lobbying at other organizations to mutually search for solutions. Lobbying for more customers. Improving operations of adjoined customers by using own knowledge. Lobbying for adjoined organizations to better collaborate and share information with each other via Cargonauts information network
Air Cargo Netherlands (ACN)	Profit & continuity of connected parties and region	Growth of air cargo via AAS in the short and long term future and high collaboration between different players in air cargo logistics chain	Decreased/limited cargo volumes at AAS on the long term	Cargo volumes at AAS decreases/ stagnates because the airport has reached maximum handling capacity and because of congestion at and around the AAS area	Lobbying for innovations and collaboration between different organizations in the chain, amongst which the Schiphol Group, so that capacity and congestion problems get resolved

Appendix B: Qualitative Actor Research: Fast-Track Facility

After investigating the general vision and goals of the actors involved in the air cargo logistics chain at Schiphol it is important to lay the focus on the research towards the design of the general fast-track facility. In order to investigate the actors attitude towards the idea and learn from the current cargo chain processes at Schiphol an approach for a qualitative actor research is designed.

B1 Actor research approach

The first step in the approach for the qualitative actor research is to point out the critical actors. The critical actors are the actors or actor clusters which Schiphol Cargo depends on for successful realization of a general cargo fast-track facility.

In order to come up with a qualitative and comparable actor research output, it is chosen to perform In-depth interviews with various focus points regarding the General Fast-Track Facility. The focus points for the in-depth interviews are:

- **General attitude FTF**

What is the general attitude of this actor cluster towards a General Fast-Track Facility. Do they think such a facility would be successful and why?

- **Bottlenecks FTF**

What are the bottlenecks for the realizations of a General Fast-Track Facility. Bottlenecks are processes, relationship, financial agreements or other reasons which could 'endanger' successful realization of a FTF on technological and institutional level according to the actor cluster.

- **Incentives FTF**

What are the incentives for the realization of a General Fast-Track Facility. Incentives are processes, relationships, financial agreements or other reasons which could catalyze the successful realization of a fast-track on technological and institutional level according to the actor cluster.

- **Requirements FTF**

What are the requirements for a General Fast-Track Facility. Requirements are the standards and demands which a FTF should meet. These requirements can be system, process or institutional requirements of which an application on the FTF could enlarge it's chances of success.

B2 Actor Criticality

Table 2: Actor criticality (Adjusted source: (Donk, 2015)

Actor	Resources	Degree of substitutability	Successful realization FTF dependent on actor?	Critical actor?
Schiphol Cargo	Can adjust (either directly or via other Schiphol Group departments) some regulations at AAS. Can lobby among actors in the AAS air cargo logistics chain for improvements. Could start to act as more than a facilitator	Low *There is only one airport authority and Schiphol Cargo is responsible for cargo on behalf of he airport authority*	High *FTF potentially a successful solution for the ground handling capacity shortage and truck congestion and waiting times. The initiative for such a facility comes from no-one else then Schiphol Cargo, because they have got the long-term vision. Schiphol Cargo needs to provide a opportunity or at least lobby the idea.*	Yes
Schiphol Real Estate (SRE)	Ownership of land and buildings next to airside (CargoWorld) and competency to develop and rent out this land and these buildings on the CargoWorld area and thereby opportunities to facilitate or frustrate the CPD introduction	Low *Only organization that owns land/buildings directly located next to airside*	HIgh *Decisions about development of Schiphol South-East (which SRE makes) can have direct influence on processes in cargo logistics chain and the decision for the implementation of a potential FTF.*	Yes
Freight forwarders	Can switch of airline and/or airport and can adjust tariffs	Low *Forwarders are responsible for arranging practically all full door-to-door transportation on behalf of shipper and/or consignee and are thereby the parties that really have the say in shaping the international air freight streams, especially the large international forwarders do*	High *Forwarders decide which airlines and airports are being used and if they decide to not make use of AAS anymore because of a potential FTF introduction with an inefficient business model for example, the consequences for AAS will be large – so the desires of the forwarders are of high importance.*	Yes
KLM Cargo (home carrier and ground handler)	Can adjust network of flights so can decide to for example move operations more to Paris Charles de Gaulle, but it can also raise tariffs. Most of the freight carried by KLM Cargo is carried in the bellies of passenger planes, so KLM might also decide to move passenger planes to Paris Charles de Gaulle if these connections become less profitable at AAS because it becomes more difficult or more costly to fill the bellies of these planes with freight	Low *Largest carrier at AAS both for passengers and for cargo – almost impossible to find a replacing hub carrier as all large other airlines already have their own hubs at which they have invested heavily in assets and to create such a network from and to AAS as KLM (Cargo) currently has takes years*	High *Network of flights of AAS and thereby success of the airport is heavily dependent on flights that are being offered by KLM (both for passengers and cargo) and tariffs of these flights. KLM however prefers to arrange their own supply chain instead of outsourcing. If KLM chooses not to use the FTF this will decrease the usage and possibly make or break the usefulness.*	Yes
Other (cargo) airlines	Can decide to leave AAS both with full freighters and/or passenger flights or adjust tariffs for example if CPD introduction has negative effects, for example because business model is inefficient. Can also lobby for improvements	Low *Cargo airlines are the only organizations (except for the integrators) that provide freight transportation via the air and because of the high investments in airplanes, licenses etc. that are*	High *The success of AAS as cargo hub is highly dependent on the connections that airlines offer from/to AAS. Airlines can decide who handles their cargo and could state in the SLA that the cargo may pass a FTF which makes them key players.*	Yes

		required to provide freight transportation via the air, barriers to enter this industry are high. Especially the non-KLM carriers that operate full freighters at AAS are becoming more important for the total cargo volumes.	*Other airlines than KLM Cargo have become more important over the past years. Their share in the total AAS cargo volume has grown and especially in the full freighter segment other cargo airlines have become increasingly important for AAS as cargo hub.*	
Ground handlers (at AAS)	Can decide to quit with their operations at AAS. Can potentially step to European Commission if open market regime at AAS gets threatened or if business model of CPD leads to unfair competition. May design own handling processes. May also cooperate with each other or with forwarders/ airlines to realize operational improvements	Low *Although amount of third party ground handlers is relatively large at AAS, they are really integrated in the chain and have ground handling capabilities. They really are the link between the airlines and the forwarders and are not easily replaced by other companies*	Medium *Potential FTF could endanger the business of the handlers if parts of the cargo will not pass their facility. Therefore handlers should be taken into account in the process & it depends on who operates a FTF if it is the handler choice to tranship via a FTF. (operated by forwarder>not, operated by handler> yes?) However, the airside handling can only be performed by the handlers and a successful FTF needs cooperation for transporting cargo between facility and VOP.*	Yes
Trucking companies	Can adjust trucking network and can adjust tariffs	Medium *They are the most important providers of road transportation in and to/from the Netherlands, only some forwarders and airlines have own trucks. However, market is fragmented and barriers to enter the market are low.*	Medium *Quality of the trucking network in the Netherlands partly determines the quality of the cargo hub AAS, as a good connection with the hinterland is very important. On the other hand the trucking companies do not directly determine the amount of air cargo that is flown via AAS but will follow it and adjust to it.*	No
Customs	Can adjust customs procedures/ rules of checks at AAS and the way the inspections are performed	Low *It is the only organization that has these competences*	Low *Customs has proven to adjust to the situation at AAS, they will therefore not really influence the setup of the future situation. They are open to performing customs checks at 2nd line as well*	No
Cargonaut	Lobbying and influencing the chain's process and separate organizations with Cargonauts acquired data and information	Low *Cargonauts information network is the most extensive and because the different organizations in the AAS air cargo logistics chain are very reluctant to share data and information, it is not easy to take over the role of Cargonaut*	Low *Cargonaut does not have any direct influence on processes and/or actors. They could have a positive influence when integrating in the project.*	No
Air Cargo Netherlands (ACN)	Lobbying	Medium *On the one hand it is the largest and most important air cargo sector organization in the Netherlands, representing all the different kind of involved organizations. The lobbying function can however also be performed by other parties, such as Schiphol Cargo*	Low *The say of ACN will not be a decisive factor for the introduction of a FTF. They could have a positive influence when integrating in the project.*	No

B3 Output Qualitative Actor Research

KLM is partly included in handlers and partly in airlines. As the following results of the qualitative research present the attitude of the various parties towards the FTF, the problem owner: Schiphol Cargo, has not been taken into account.

B3.1 Handlers

Table 3: Handler Attitude FTF

General attitude fast-track	Bottlenecks general export fast-track	Incentives FTF
	Number of BUPs is decreasing (Wouterse, 2015)	*Financial advantages for the forwarder* (Boot, 2015)
Would not work for small amounts WFS tranships (Hockemeijer, 2015)	*Low volumes would make it costly* (Hockemeijer, 2015)*, The forwarders need to have the volumes to be able to deliver BUPs. They don't know these volumes in advance. The volumes are sometimes large and sometimes dens, they need combination* (Kervezee, 2015)	*Financial, throughput and control advantages for forwarders which have the volume for delivering BUPs* (Boot, 2015)
	Extra movement from handler to fast-track (Hockemeijer, 2015) *Extra step, transporting the BUPs form the platform to a general point (elongates the dolly transport distance)* (Boot, 2015)	*Fast-track is primarily useful for full freighters, belly freight is max. 8 pallets.* (Boot, 2015)
	Handlers(6 on 1st line) at Schiphol are often part of worldwide concerns, resulting in a low level of interest for local initiatives. These handlers are at Schiphol to have a strategic position when sometimes cargo is not their main field of expertise, but pax transport is. (Pieters, 2014, p. 34)	*Their fast track is purely there for pleasing the airlines/forwarders. They rather have cargo which needs handling (more money)* (Boot, 2015)
	Financial disadvantages handler (Boot, 2015)*& An investment in a fast-track for handlers is not a guarantee for more cargo through their facility. When more cargo flows over the fast-track there is a threat of having to fire employees because handling an checking the fast-track is less work then building up and breaking down.*	*It saves space in the current handler facilities and the space is extremely expensive* (Kervezee, 2015)
	Not useful that airside handlers have to split the pallets in BUPs and ULDs at the platform. The VOP needs to be empty as quick as possible. (Boot, 2015)	*For forwarders financial advantage to deliver BUPs* (Kervezee, 2015)
	The pallets on the dolly's should be in the right order for splitting and transporting the right BUPs to the 'general fast-track' (Boot, 2015)	
	Handlers want to deliver a total package, so they'd rather not outsource. (Kervezee, 2015)	
	The rebuilding of the BUPs is currently performed quite often. The expertise is not yet up to standard at forwarders. (Kervezee, 2015)	
	Handlers want to deliver a total package, so they' rather not outsource. (Kervezee, 2015)	
	Service level agreements are very specific per airline. They all have different time & service requirements (Hockemeijer, 2015)	

B3.2 Airlines

Table 4: Airline Attitude FTF

General attitude fast-track	Bottlenecks general fast-track	Requirements for fast-track
Quite negative: import could be possible, but export not	*Third party owner means extra contract between handlers and 3rd party.* (Graaff, 2015)	*Evert handler needs own supervising* (Graaff, 2015)
	Every handler wants quality supervised, so needs their own men at the fast-track (Graaff, 2015)	*Fast-track, so no storage> so probably not suitable for perishables (and perishables are the biggest shipments (most BUPs)* (Graaff, 2015)
	If 3rd party (forwarders?) would operate fast-track, then it would 'steal' business from the handlers. (Graaff, 2015)	
	Bond between handlers and airlines is tight, airlines would not directly transfer to other handler. (Graaff, 2015)	
	Airlines don't trust the forwarders to build up correctly according to the Service level agreement (Graaff, 2015).	

B3.3 Forwarders

Table 5: Forwarder Attitude FTF

General attitude fast-track	Bottlenecks general fast-track	Incentives general fast-track	Requirements for fast-track
Very positive they already have one for themselves in the Skylink facility for import flows (Bruijs, 2015)	*Currently forwarders do not pay a fee to push through export BUPs at the forwarder, not planning on doing so in the future…* (Brink, 2015)	*More grip, stability and speed in the handling process for the forwarder.* (Bruijs, 2015)	*Owned and operated by neutral party* (Bruijs, 2015)
A combined facility seems promising (Bruijs, 2015)	*Bottleneck for the export process is that this process is already flexible: airlines will prioritize export cargo already and are therefore more flexible.* (Bruijs, 2015)	*Keep paying the handler the same amount, the profit for the forwarder is in saving the transport (more consolidated rides) and the storage costs (almost cost neutral)* (Bruijs, 2015)	*Keep it simple, do not offer other value adding activities* (Bruijs, 2015)
Positive: it doesn't really matter where I drop my cargo (Brink, 2015)	*Who will pay for the first investment?* (Bruijs, 2015)	*The push-principle on the VOP is an incentive for the expeditors pull-principle* (Bruijs, 2015)	
	Can not be operated by another forwarder, ore jointly by forwards, because there are privacy issues. The forwards do not want competitors to know which cargo they transship. (Brink, 2015)	*Less truck movements, if combined shipments of BUPs for several 'handlers' could be dropped (or picked up) at one central point* (Brink, 2015) *Less truck movements means: less waiting time and therefore saving money* (Brink, 2015)	*By adding an activity to the chain, DB Schenker saves about 8 hours of throughput time on average* (Bruijs, 2015)
	Handlers could not agree when stealing their business (Bruijs, 2015)		

B3.4 Customs

Table 6: Customs Attitude FTF

General attitude fast-track	Bottlenecks General fast-track	Requirements for Fast-Track
Quite positive: customs sees no problems in customs activities (Zonneveld, 2015)	*Handlers need to have a financial incentive to implement changes, and this will decrease the throughput for the handlers (is there a breakeven point?)* (Zonneveld, 2015)	*No customs requirements at the facility* (Zonneveld, 2015)
For other actors they see why it would not be accepted quickly (Zonneveld, 2015)		*Customs will work along to perform checks at 2nd line* (Zonneveld, 2015)
		Only obligatory thing is that trucks between 2nd and first line should be sealed according to customs regulations (because they leave secured territory) (Zonneveld, 2015)
		A scanner could be placed in the fast-track facility, but expensive: who will pay? (Zonneveld, 2015)

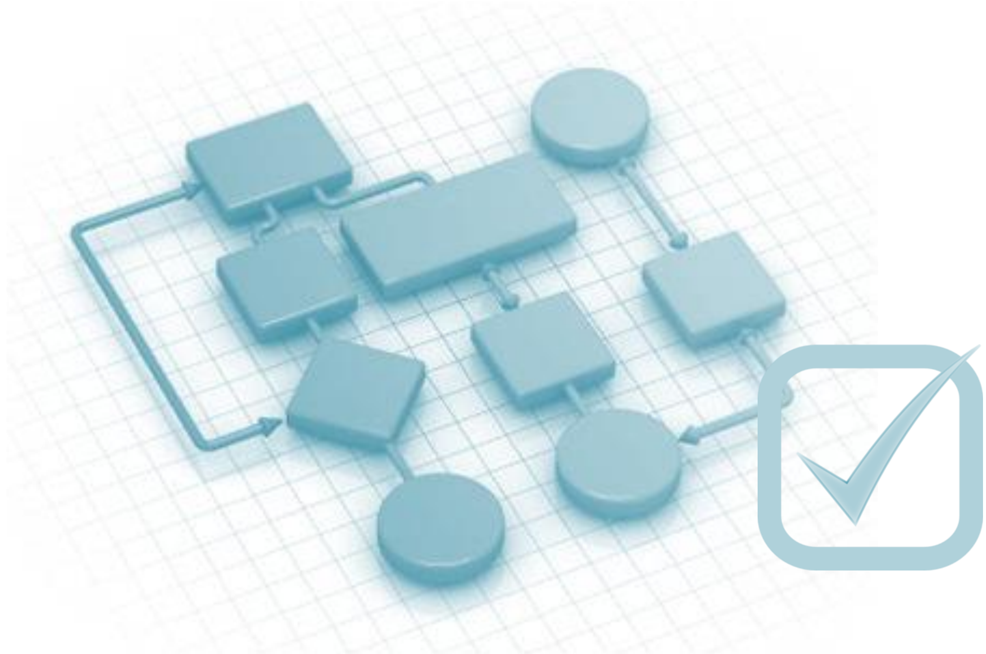
B3.5 Cargonaut & ACN

Table 7: Cargonaut & ACN Attitude FTF

General attitude fast-track	Bottlenecks General fast-track	Requirements for fast-track	Incentives
Could have a potential if the volumes are big enough (Radstaak, 2015)	*Not al truck companies are able to transport BUPs, specific trucks are needed (with rollerbeds inside) to transport BUPs* (Radstaak, 2015)		*Truck movements would be reduced when a FTF would allow smaller BUP numbers (which go through different handlers facilities now) could be 'consolidated' for the trucks at the FTF* (Radstaak, 2015)
Start with a greenfield situation (Radstaak, 2015)	*Who is going to pay for the extra dolly distance and drivers?* (Radstaak, 2015)		

V

METHODS AND REQUIREMENTS



Appendix C Warehouse Design Framework

Several conclusions are stated from previous literature on warehouse design. A summary of the 4 common these which Baker (2009) has identified is: Warehouse Design has a high degree of complexity which is tackled with step-by-step iterative approaches and because of the high number of possibilities , an optimal solution may not be identified.

The 11 steps for warehouse design are integrated in the SE framework. Step 1 is performed in the requirement analysis. Step 2,3 and 4 are not extremely applicable as there is no data yet on the future 'fictive' fast-track facility. Information is retrieved from a current system analysis. This current systems analysis is used as an exploration of the possibilities for a fast-track facility. Input data is however data obtained, defined and analysed in order to use this for the simulation study performed in chapter 6. Step 5, 6, 7, 8 and 9 are addressed in chapter 5 (and appendix G) where the applicable functions, variables and design options for the various variables of the Fast-Track Terminal are argued. The ninth step is performed with the help of a morphological study. Step 10 is performed with a discrete simulation study in chapter 7 and step 11 is performed after an integration between the technological and institutional perspective is made in chapter 10

Proposed framework, tools and key references

Step	Tools and key references
1. Define system requirement	Refer to literature on business and supply chain strategy literature (e.g. Christopher (2005)) and scenario planning (e.g. Sodhi (2003)) Warehouse role framework is provided in Baker (2007a) and role checklist in Higginson and Bookbinder (2005)
2. Define and obtain data	Checklists and spreadsheet, or database, models are used Useful checklists appear in Rowley (2000), McGinnis and Mulaik (2000), Bodner et al. (2002), Frazelle (2002b) and Rushton et al. (2006)
3. Analyse data	Database and spreadsheet models are used Activity profiling techniques are given in Frazelle (2002b) Planning base, planning horizon and warehouse flow charts are described in Rushton et al. (2006)
4. Establish unit loads to be used	Analytic and simulation approaches are described in Roll et al. (1989)
5. Determine operating procedures and methods	A wide variety of techniques are used Rouwenhorst et al. (2000) set out a framework of the cluster of decisions that need to be considered Rushton et al. (2006) describe warehouse zoning Flexibility frameworks are set out in Baker (2006, 2007b)
6. Consider possible equipment types and characteristics	Spreadsheet models and decision trees tend to be used Heuristic, analytic and simulation methods are described in Ashayeri and Gelders (1985) A heuristic approach is set out in Naish and Baker (2004) Decision tree examples are given in Rowley (2000) and Rushton et al. (2006)
7. Calculate equipment capacities and quantities	Spreadsheet models, as well as historic performance measures, are used The analytic and simulation methods described by Ashayeri and Gelders (1985) are also relevant for this step
8. Define services and ancillary operations	Checklists are used by some practitioners
9. Prepare possible layouts	CAD software is generally used by practitioners Outline steps and methods are provided by Mulcahy (1994), Hudock (1998) and Frazelle (2002b) A warehouse relationship activity chart is described in Frazelle (2002b)
10. Evaluate and assess	Simulation software is useful at this step (e.g. see Kosfeld, 1998) and is commonly used by practitioners Analytic models are also used by practitioners
11. Identify the preferred design	Quantitative (e.g. financial business case) and qualitative (e.g. SWOT analysis) methods are used No specific process is described in the literature

Figure 2: Warehouse Design Framework (Baker & Canessa, 2009)

Appendix D: Requirement Analysis

'The aim is to discover all the requirements that are relevant to the product which we intend to build as early as we possibly can' (Robertson, 2001). In order to deliver a thought-through design it is important to extract and take into account all relevant requirements. Discovering the requirements for the design is a basic step within the systems engineering process. The need statement provides input for the requirements and the requirements are the input for the design (Ludema, 2014)

There are various types of requirements which are necessary for providing an integrated design. The initial requirements are set by the critical actors of the future FTF system. The high-level actor requirements are translated towards detailed functional and non-functional requirements.

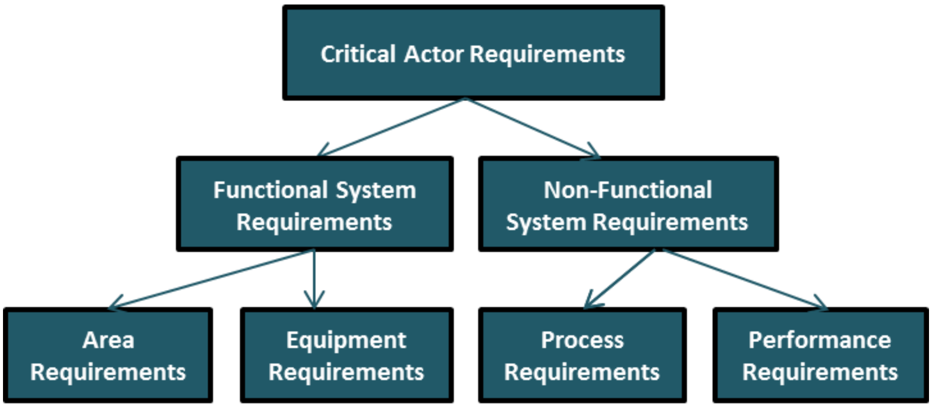


Figure 3: Requirements Catgories Overview

The system requirements are divided in: functional requirements 'things a system need to do' and non-functional requirements: 'qualities a system has to have'. The requirements are used as constraints or guidelines for both the technological and the institutional design. The four sub-component requirement categories are:

- Area requirements: these set the boundaries for the lay-out of the design.
- Equipment requirements: these set the boundaries for the functioning and configuration of the FTF equipment
- Process requirements: these requirements argue what processes need to take place within and around the FTF and when and how these processes are supposed to take place.
- Performance requirements: these requirements state the minimum performance level of the FTF

D1 Critical Actor Requirements

The critical actor requirements are stated below. Critical actors exist of several groups. Users are referred to as the future users or operators of the to-be designed system. These users operate the processes within the FTF. The costumers are referred to as the future customers of the system. These are first line customers which aim at transferring BUPs between air- and landside through the FTF. The stakeholders are indirect actors which are not in direct contact with the FTF, but they influence or are influenced by the performance of the FTF.

The specific actor configuration per group is variable. For example: a freight forwarder can either be a user or a customer and Schiphol Group could either act as a stakeholder or a user. The institutional design phase will further elaborate on the various institutional actor configurations. The critical actor requirements are based on the general actor analysis (appendix A) and the qualitative actor research (appendix B).

Table 8: Critical Actor Requirements

	Critical Actor Requirements	Process Design
1	The FTF must be designed such that the BUP transhipment is flawless	✓
2	The FTF must ensure safe cargo transhipment	✓
3	The FTF must be designed such that the fastest possible BUP transhipment is ensured	✓
6	The FTF must ensure anonymous transhipment	Depends on ID
7	The FTF should be equipped with the right cooling facilities for perishables	✓
8	The FTF must ensure efficient space use (occupy the minimum possible area while ensuring maximum possible transhipment)	✓
9	All clients must be able to use the FTF	Depends on ID
10	All clients must be able to use the FTF at the same time	Depends on ID
11	The FTF should be financially attractive for all critical actors	Depends on ID
12	The realisation of the FTF should not have a negative influence on the road congestion: it should not increase the number of truck movements	✓
13	The FTF must ensure that export BUPs meet weight and dimension requirements for the load plan	n.a.
14	The GTFT must ensure that export BUPs are build up safe and correct without leaks	n.a.

D2 System Requirements

In order to use the user, customer and stakeholder requirements as guidelines and constraints for the design they have to be converted to detailed system requirements. The system requirements are divided in two categories: the functional and non-functional requirements.

D2.1 Functional System Requirements

Table 9: Area Requirements (based on appendix G1)

Area requirements	Conc. Alt 1 Manual	Conc. Alt 2 Automated
The area of the FTF cannot exceed 65.000 meter in order to have a minimum productivity of 10 ton/m2/year and a minimum throughput of 650.000 ton/year	✓	✓
The depth of the total FTF terrain cannot exceed either 165 metres or 320 metres depending on the location at South-East	✓	✓
The depth of the FTF cannot exceed 165 or 320 metres minus the depth needed for the airside and landside terrain of the FTF	✓	✓
The depth of the landside terrain is at least 40 metres	✓	✓
The area of the FTF landside terrain must be large enough for the two truck buffer positions per landside dock.	✓	✓
The area of the FTF landside terrain must be large enough for the required amount of trucks to enter, deliver/pick-up, turn around and leave the terrain at the same time	✓	✓
The width of the FTF landside terrain is similar to the FTF width	✓	✓
The height of one level within the FTF is at least 7 metres	✓	✓
The height of the FTF at landside may not exceed 15 to 7 metres, depending on the distance from the runways.	✓	✓
The height of the FTF at the airside cannot exceed 23 metres, depending on the distance from the runways.	✓	✓
The paths between equipment and storage should have a minimum width of 3200 mm, which is the turning radius of the slave pallet movers.	✓	✓

Table 10: Equipment Requirements

Equipment Requirements	Conc. Alt 1 Manual	Conc. Alt 2 Automated
The FTF should be equipped with a conveyer system for BUP transport	✓	✓
The FTF transport equipment should be able to handle at least regular BUP dimensions (270 cm x 360cm) and maximum allowed BUP weights	✓	✓
The FTF should be equipped with (un)loading docks at air and landside	✓	✓
The FTF should offer a storage system with a sufficient amount of storage space for BUPs in order to prevent bottlenecks and queues on the conveyer system	Depends on QA[1]	Depends on QA
The FTF should offer sufficient cooled storage positions for all perishable BUPs in order to prevent bottlenecks and queues on the conveyer system	Depends on QA	Depends on QA
The FTF should be equipped with storage equipment which can place and retrieve BUPs from the storage facilities	✓	✓

[1] Quantitative Analysis (Simulation) and Refined Design

D2.2 Non-functional Requirements

Table 11: Process Requirements

FTF Airside Process Requirements	Process Design
The import BUPs must be split from the ULDs before entering 1st line facilities at airside	✓
The BUPs should be transported with a transporter or dolly to and from the FTF airside terrain according to the nearness of the VOP location (near = transporter, far=dolly)	✓
The import BUPs must be able to be checked by customs before entering the FTF	✓
The BUPs must enter and leave the FTF via an airside dock	✓
General Process Requirements	
Only BUPs may enter the FTF terminal (No ULDs)	✓
The FTF must be able to tranship all commodity categories accept for live animals	✓
The FTF should offer at least transhipment and storage buffer functions	✓
The export BUP weight should be checked in the FTF	n.a.
The export BUPs dimensions should be checked in the FTF	n.a..
The FTF should check the export BUPs for looks and leakage	n.a.
The FTF should allow bypasses after all export checks	n.a.
The FTF should either include a rebuild possibility or a send-back possibility for rejected export BUPs	n.a.
FTF Landside Process Requirements	
The import cargo trucks should depart once their fully loaded or when a signal for departure is provided (when maximum waiting time is reached)	✓
The export BUPs should be transported with a transported or dolly to the VOP according to the VOP location	n.a.
The export BUPs must be split from the ULDs before entering 1st line facilities at landside	n.a.
The required customs check for export BUPs should be performed before the cargo enters the FTF	n.a.
The export BUP trucks should maximize their load factor	✓
The export BUPs should be transhipped from the truck to FTF at an unloading dock	n.a.
The BUPs must enter an leave the FTF via an airside dock	✓

Table 12: Performance Requirements

FTF Performance Requirements	Refined Design 1 Manual	Refined Design 2 Automated
The total transhipment time of FTF import BUPs must be below 3 hours.	✓	✓
The minimum required FTF import capacity is 450.000 tons	✓	✓
The minimum required FTF export capacity is 131.250 tons	n.v.t.	n.v.t.
The minimum required FTF import capacity is 147.500 BUPs per year	✓	✓
The minimum required FTF export capacity is 40.000 BUPs per year	n.v.t.	n.v.t.
The productivity of the FTF must be at least 10 ton/m^2/year	✓	✓
The FTF storage capacity should cope with peak throughput	✓	✓
No blockages should arise in the FTF conveyer system	✓	✓
Resources should be used efficiently. This means that utilization is between 30% and 50%.	✓	✓
Conveyer Utilization should not exceed 75%	✓	✓
The FTF transhipment costs must be lower than current transhipment costs	✓	✓

VI
AAS CARGO HANDLING

Appendix E: Processes Analysis

E1 General Shipment Flows

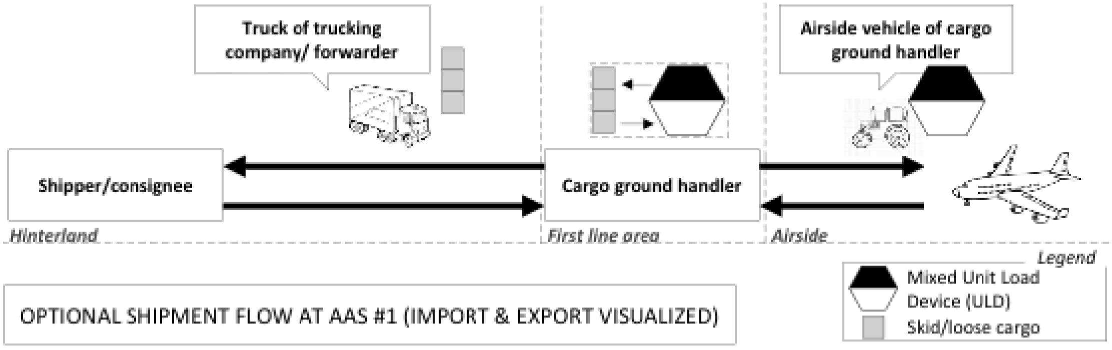


Figure 4: Visualization of optional shipment flow #1 – flow of skids/loose cargo between handler and shipper/consignee (Source: (Donk, 2015))

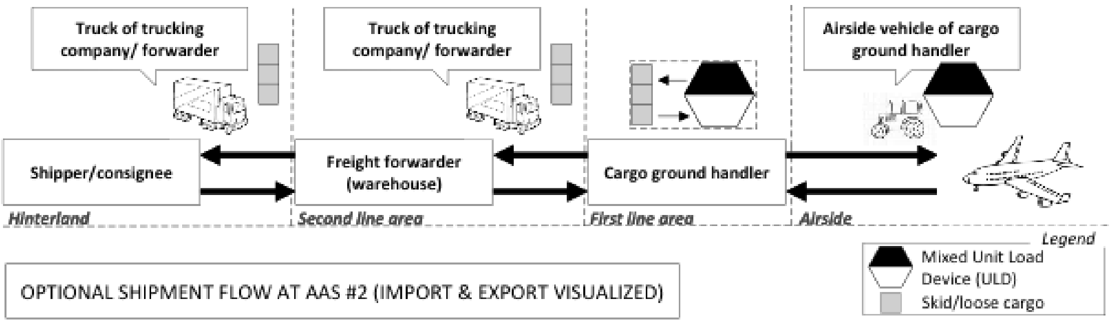


Figure 5: Visualization of optional shipment flow #2 – flow of skids/loose cargo between handler and shipper/consignee via forwarder (Source: (Donk, 2015))

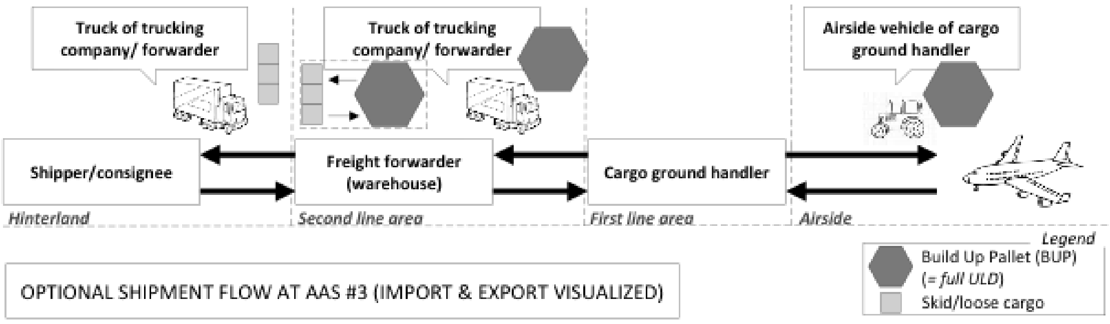


Figure 6: Visualization of optional shipment flow #3 – flow of skids/loose cargo between forwarder and shipper/consignee and BUP between handler and forwarder (Source: (Donk, 2015))

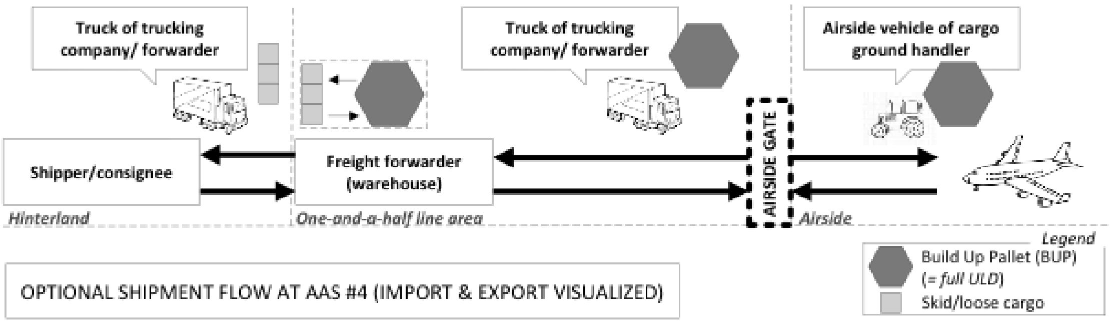


Figure 7: Visualization of optional shipment flow #4 – flow of skids/loose cargo between forwarder and shipper/consignee and BUP between airside gate and forwarder (Source: (Donk, 2015))

E2 Future FTF Airside and Landside Process Flows

The process flow diagrams including the actor responsibility is presented this section.

E2.1 Airside Import Process

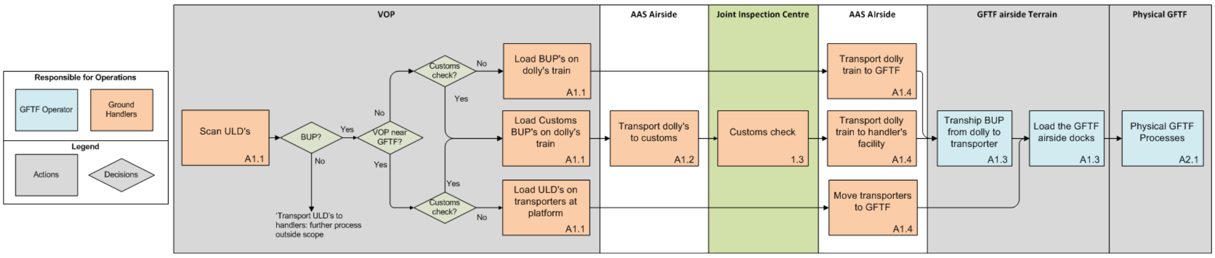


Figure 8: Airside Import Process Flow, variation 1

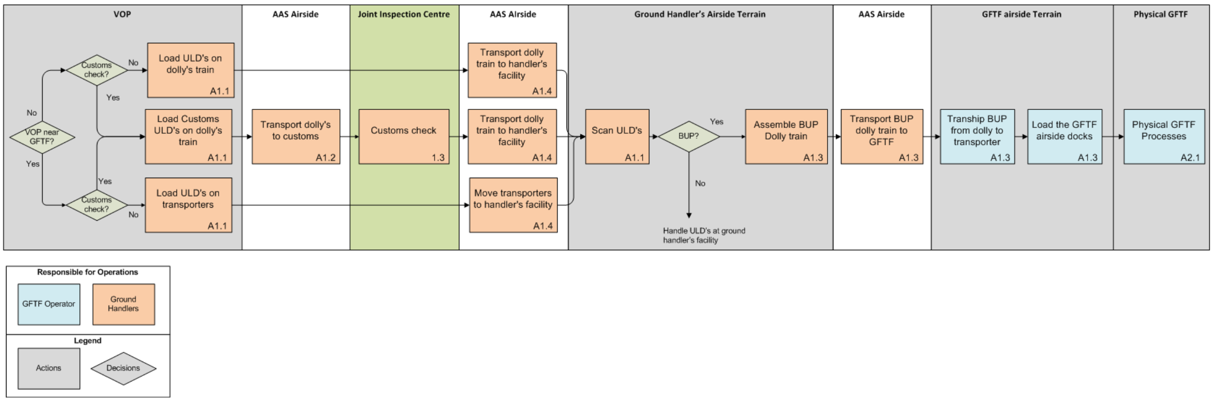


Figure 9: Airside Import Process Flow, variation 2

E2.2 Airside Export Process

The export BUPs are loaded on transporters at the airside docks. If the aircraft stand is near the FTF and the critical hours before flight departure are reached (between 2 and 4), the transporters are moved to the designated aircraft stand. If the aircraft stand is not nearby, the BUPs are transhipped onto dolly trains. If the critical time before departure is reached, the dolly trains are transported to the designated aircraft stand. If the critical time is not yet reached, the dolly trains are stored until it is time for transportation.

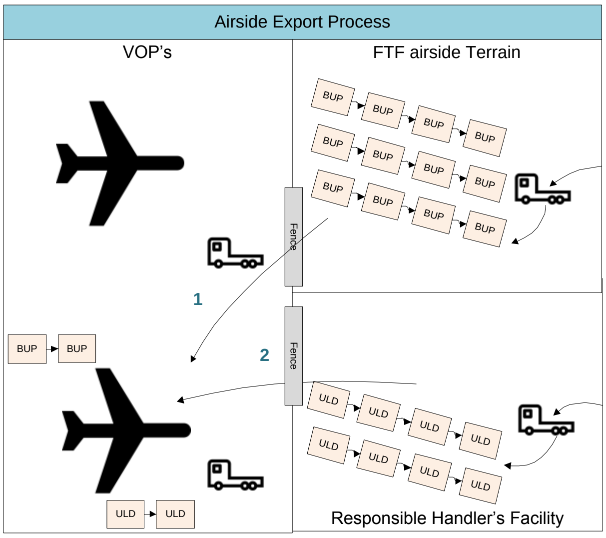


Figure 10: Airside Export Process

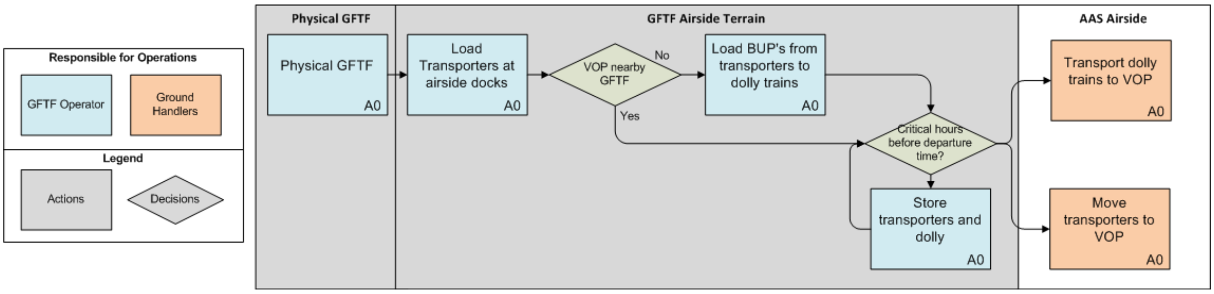


Figure 11: Airside export Process Flow

E2.3 Terminal Export Process

The export cargo enters the fast-track facility at a truck dock on and is placed on the rollerbed system. The BUP rolls to the scale and scanner where it is checked for looks & leakage, weight restrictions and dimensions. If the BUP is approved and it is the critical time before departure is reached, the BUP is rolled to the airside docks and loaded on a transporter. The critical time before departure is between 3 and 4 hours depending on the aircraft type which the BUP is allocated to. At the critical time before departure, the BUPs should be ready at airside on the dolly train or transporters to be transported to the aircraft stand.

If the critical time before departure has not been reached, the BUP is retrieved from the rollerbed placed with a storage system in the nearest storage position. Once the critical time before departure is reached, the pallet is retrieved from the storage, placed on the rollerbed and loaded onto a transporter or dolly at an airside dock. If the pallet is rejected in the scale and scanner, it is retrieved from the rollerbed and either send back to the forwarder which build the cargo, or rebuild in the fast-track facility.

This decision depends on various factors:

1. Is rebuilding possible in the fast-track facility?
2. Does the forwarder want to rebuild the BUP himself?
3. Does the forwarder want another party to rebuild the BUP?
4. Is the critical time before departure nearly reached?

If the pallets is rebuilt at a different facility, it is redirected into an import truck or dedicated priority truck via the rollerbed system. This pallet has priority over other pallets because it needs to be rebuilt at the forwarders facility. If there is no truck available, the pallet is stored in the storage spot which is nearest to the truck dock and retrieved when a space is available in the truck.

If the pallet is rebuild inside the fast-track facility it is directed via the conveyer system towards a workstation where it is broken down and build up. The pallet is then placed on the conveyer system and either storage or pushed through towards airside based on the critical time before departure.

E2.4 Landside Import Process

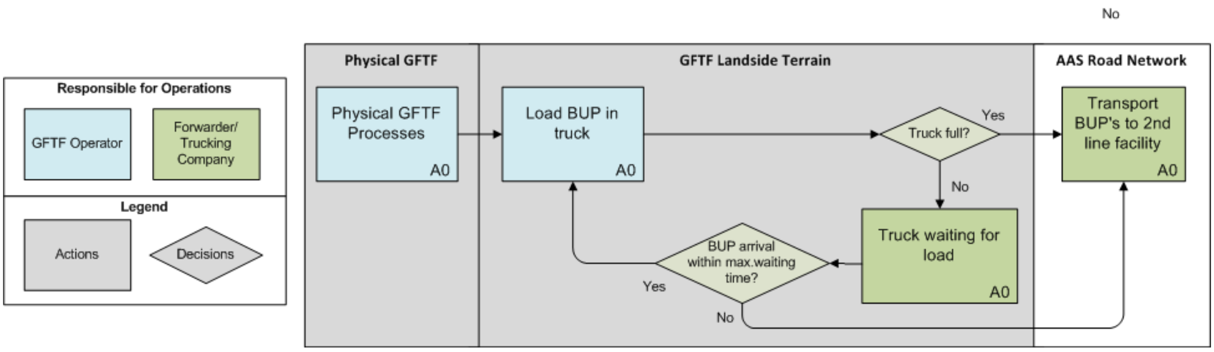


Figure 12: Landside Import Process Flow

E2.5 Landside Export Process

Export BUPs should be dropped off at the fast-track facility at a certain time before flight departure. This time period is referred to as the 'export drop-off time'. Because cargo needs to be ready at airside 3 to 4 hours before plane departure, the export drop-off time generally set to 8 hours (Bruijs, 2015). Forwarders should indicate on the FTF system what the desired drop-off time is. Based on this information, the system checks whether dock space is available and allocates a most near to desired drop-off time window and dock number to the BUP shipment. The truck driver knows that he is supposed to be at the fast-track facility at that time window.

The landside export process starts at the forwarders facility where the BUPs are split from the ULDs. If the BUP truck is completely loaded at one forwarder the truck immediately departs to the fast-track facility. If the truck is not fully loaded the truck can combine truck loads from several forwarders. Once the truck is on its way to the fast-track facility it should signal this on the FTF system. Also, when the driver experiences an unexpected delay, it should signal the expected time of arrival. The system can then re-evaluate the best docking option.

Once the truck has arrived at the fast-track facility it either docks immediately, or parks at the dock buffer position. Once the truck is docked it is unloaded. The empty truck either leaves or picks up import BUPs afterwards. If the truck is picking up import cargo as well, the driver should indicate this in the FTF system in advance.

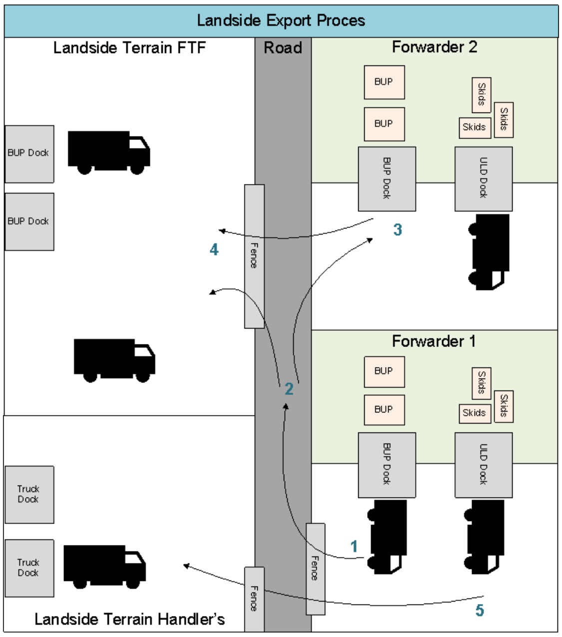


Figure 13: Landside Export Proces

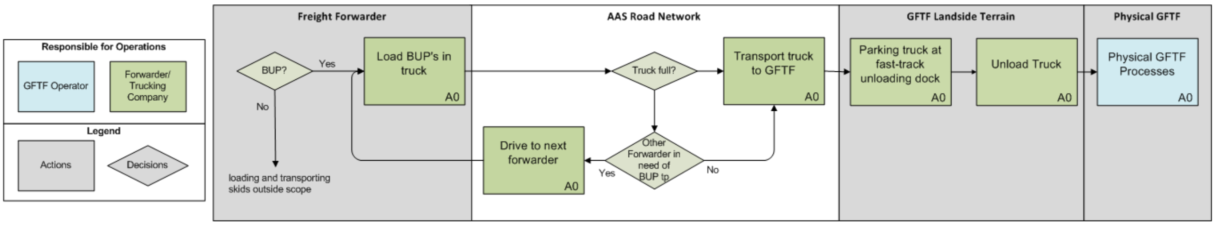


Figure 14: landside Export Process Flow

E3 The Milkrun Concept

In order to optimize the air cargo supply chain, and in particular the 'on airport transport' at AAS, the Milkrun project is initiated. The 'On airport Transport' is a large bottleneck for the air cargo supply chain. Transport is arranged individually by the various forwarders, resulting in low truck loads. The 'on –airport' truck loads at Schiphol are often lower than 25% (Air Cargo Netherlands, 2015).

During a Milkrun the truckloads of several forwarders are combined and dropped of at various handlers facilities (figure 15). Forwarders book truck spots for their required cargo movements on an online Milkrun Portal. The Milkrun system has two main advantages. Trucks loads increase and less truck movements are necessary. This means that less trucks movements are made on the airside terrains of the handlers and the cargo is made available faster and easier (Air Cargo Netherlands, 2015).

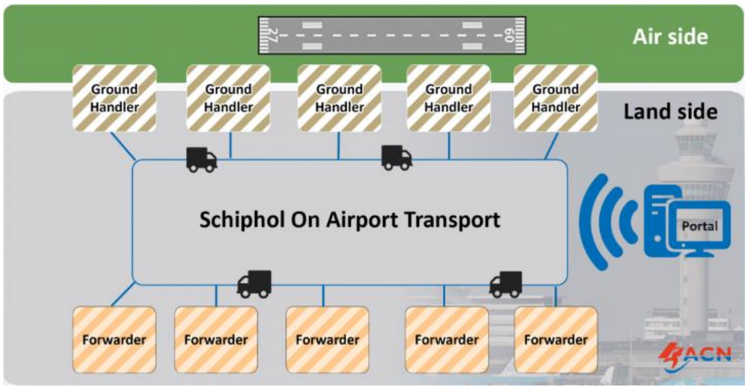


Figure 15: Milkrun Overview

Two Milkrun pilots have started at Schiphol and the results are promising. The last Milkrun was a combined effort of 11 parties: ground handler Menzies and 10 forwarders or logistic service providers. During this trial 1200 tons of cargo is delivered with combined rides. The Milkrun system has saved 112 individual truck movements, which relieved landside terrain at Menzies from 112 trucks during this .

The challenges of the Milkrun lie in the communication and collaboration between the various parties. Information sharing is necessary and an initial investment needs to be made. The more parties co-operate and value the Milkrun system the more promising the results can be.

A Milkrun configuration contributes to the implement ability of a fast-track facility. As the biggest challenge of a fast track facility is to provide seamless transhipment, Milkrun could increase the punctuality and reliability at the truck side of the Fast-Track Terminal.

Because the FTF concept is solution which can be implemented on the long run, it is assumed that the Milkrun concept will have established itself by the time a FTF is operational. The landside processes taken into account for the FTF design are thus based on the Milkrun concept.

Appendix F: Air Cargo and ULD Specifications

F1: Cargo Transport Units

In order to provide an image of the cargo flows at AAS, it is important to make a distinction between the different cargo transport units. Unit Load Devices are mainly containers and pallets, depending on the aircraft position and cargo characteristics. Containers are used for smaller shipments and as a protective case around the vulnerable cargo. There are container types differentiating in volumes, dimensions and descriptions aligned with the aircraft types and contours (Lubbe, 2015). ULD pallets are used as a base to build cargo on. These are made of aluminium and after build up secured with nets and (if necessary) covered with plastic under the net. There are also different pallet types that are aligned with the aircraft types and contours. Export cargo that is delivered at the handlers facility is required to be build up on skids. Cargo that is broken down at the handlers facilities will also be build up on skids for the transfer or end-haulage.

Figure 16: Air Cargo Transport Units: Container, Pallet, Skid

F2: Commodity Density

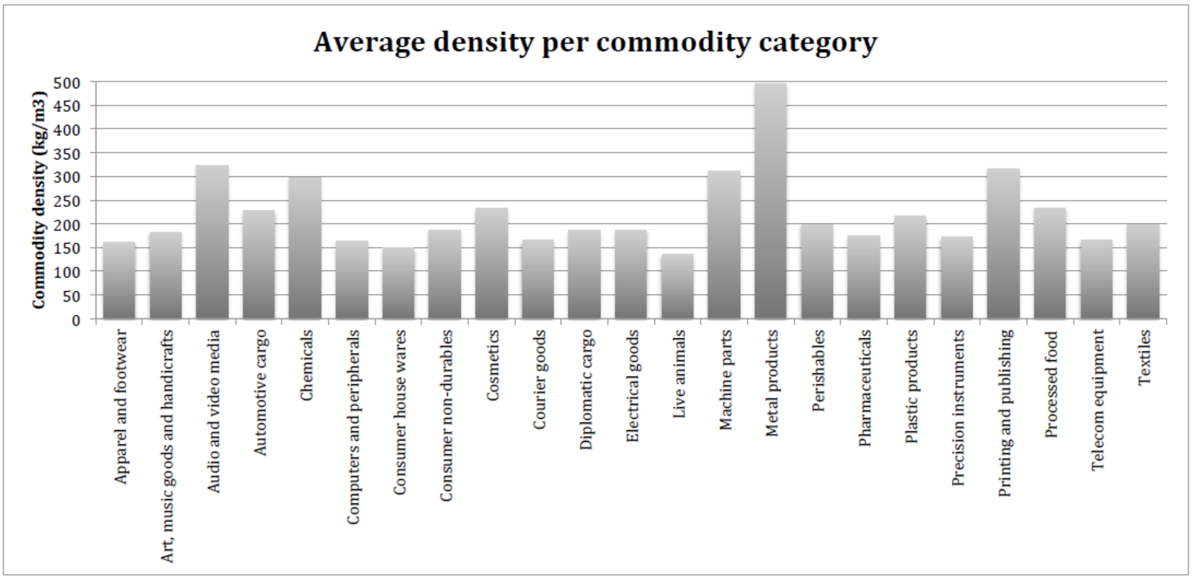


Figure 17: Commodity Densities (Van de Reyd & Wouters, as cited in (Hoeben, N.D.))

The categories in figure 17 are divided into the commodity categories used by the Traffic Analysis Department of Schiphol. The average density for each commodity is calculated in tables 13 .

Table 13: Commodity Density Calculations per Category

High Technology	Kg/m^3
Electrical Goods	180
Computers and peripherals	160
Telecom Equipment	160
Average	**+/- 170**

Machinery parts. Components, supplies & manufactures n.e.s.	Kg/m^3
Machine parts	310
Metal Parts	490
Average	**=400**

Raw Materials, Industrial consumables & Foods	Kg/m^3
Processed Food	240
Average	**=240**

Consumer Fashion Goods	Kg/m^3
Apparel and Footwear	160
Cosmetics	230
Textiles	200
Average	**= +- 200**

Consumer personal & household goods	Kg/m^3
Consumer Housewares	150
Consumer Non-Durables	180
Average	**=165**

Capital Equipment & Machinery	Kg/m^3
Comparable metal parts	400
Average	**= 400**

Chemicals & Products	Kg/m^3
Chemicals	300
Average	**= 300**

Land Vehicles & Parts	Kg/m^3
Automotive	230
Average	**= 230**

Temperature or Climate Control	Kg/m^3
Perishables	200
Pharmaceuticals	175
Average	**= 187,5**

Live Animals	Kg/m^3
Live Animals	140
Average	**= 140**

Secure or Special Handling	Kg/m^3
Art	
Average	**= 180**

F3: ULD Characteristics

Table 14: ULD Characteristics

Type	Name	IATA ULD code	Position[#]	Length[m]	Width[m]	Heigth [m]	Volume[m3]	Tare Weight [kg]	Gross Weight [kg]	Net weight [kg]
ULD	**LD-1**	AKC contoured container	0,5	234	153	163	5	70	1588	1518
ULD	**LD-2**	DPE contoured container	0,5	156	153	163	3,5	92	1225	1133
ULD	**LD-3**	AKE contoured container	0,5	201	153	163	4,5	82	1588	1506
ULD	**LD-3 Reefer**	RKN contoured cool container	0,5	201	153	163	4,5	210	1588	1378
ULD	**LD-4**	ALP rectangular container	0,5	243	153	163	5,7	120	2449	2329
ULD	**LD-6**	ALF contoured container	2	406	153	163	9,1	230	3175	2945
ULD	**LD-8**	DFQ	1	318	153	163	7,1	127	2450	2323
ULD	**LD-9**	AAP enclosed pallet op P1P base	1	318	224	163	10,8	215	2450	2235
ULD	**LD-9 Reefer**	RAP cool container on P1P base	1	318	224	163	9,6	400	6000	5600
ULD	**LD-11**	ALP rectangular container	1	318	153	163	7,4	185	3176	2991
ULD	**LD-26**	AAF contoured container on P1P base	2	406	224	163	13,3	250	6033	5783
ULD	**LD-29**	AAU contoured container on P1P base	2	472	224	163	14,4	265	6033	5768
ULD	**LD-29**	RAU contoured cool container on P1P base	2	472	224	163	11,1	450	6033	5583
ULD	**LD-39**	AMU contoured container on P6P base	2	472	244	163	15,9	290	5035	4745
ULD	**Demi**	AYY contoured container on half base pallet	0,5	224	158	201	5,8	80	3016	2936
ULD	**M-1**	AMA rectangular container on P6P base	1	318	244	244	17,6	350	6804	6454
ULD	**M1H**	AMD contoured	1	318	244	230	21,2	370	6800	6430
ULD	**M-2**	AGA 20-ft box container	2	606	244	244	33,7	1000	11340	10340
Pallet	**Half pallet**	PNA 767 half pallet with net	0,5	244	156	163	5,5	83	2449	2366
Pallet	**Half Pallet**	PLA half pallet with net	1	318	153	163	7,1	91	3175	3084
Pallet	**LD-7**	P1P flat pallet with net	1	318	224	163	10,5	105	4626	4521
Pallet	**LD-7**	PAD P1P pallet with folding wings and net	2	406	224	163	14	152	5000	4848
Pallet	**LD-7**	XAW P1P pallet with fixed-angle wings and net	2	406	224	163	14	170	5000	4830
Pallet	**P6P Pallet**	P6P 10-ft flat pallet with net	1	318	244	230	**21,2**	120		
Pallet	**Main deck pa**	PRA 16-ft pallet with net	2	498	244	244	27,6	410	11300	10890
Pallet	**M-6**	PGA 20-ft flat pallet with net	2	606	244	244	33,7	500	11340	10840
Pallet	**M-6**	PGA 10-ft high, 20-ft pallet with net	2	606	244	300	39,6	500	11340	10840

Appendix G: Air Cargo Warehouse Design

G1 Area Analysis AAS South-East

In this appendix the area of the AAS South-East is analysed. AAS South-East is the area where cargo facilities can be situated, once the A-Pier is accomplished.

Maximum Width

The maximum width of the AAS South-East area is 1620 metres. Theoretically, this means that the maximum width of the FTF is also 1620 metres.

Figure 18: AAS South-East Width

Depth

The maximum depth of the AAS South-East area is 320 metres. Theoretically, this means that the maximum depth of the FTF is also 320 metres.

Figure 19 & 20: AAS South-East Maximum and Minimal Depth

The minimum depth of the AAS South-East area is 165 metres. Theoretically, this means that the if the FTF is situated at this location, the maximum depth is 165 metres.

Furthermore, the average depth of the currently existing facilities at Schiphol is 150 to 170 metres. Measurements show that the average depth of the airside terrain is 30 metres and the average depth of a truck (landside) terrain is 40 metres. The depth of the physical handling terminals is between 80 and 100 metres. Furthermore, various handlers have stated that 100 metres is the ideal depth for a 1st line terminal (Kervezee, 2015) (Baas, 2015).

Admissible Height

Figure 21 provides the maximum building heigths of AAS South-East based on mandatory sightlines for airplanes (SRE, 2015). It shows that the maximum building height of a termial at airside is approximately 22,5 metres and the maximum building heigth at landside varies between 15 and 5 metres depending on the distance from airside.

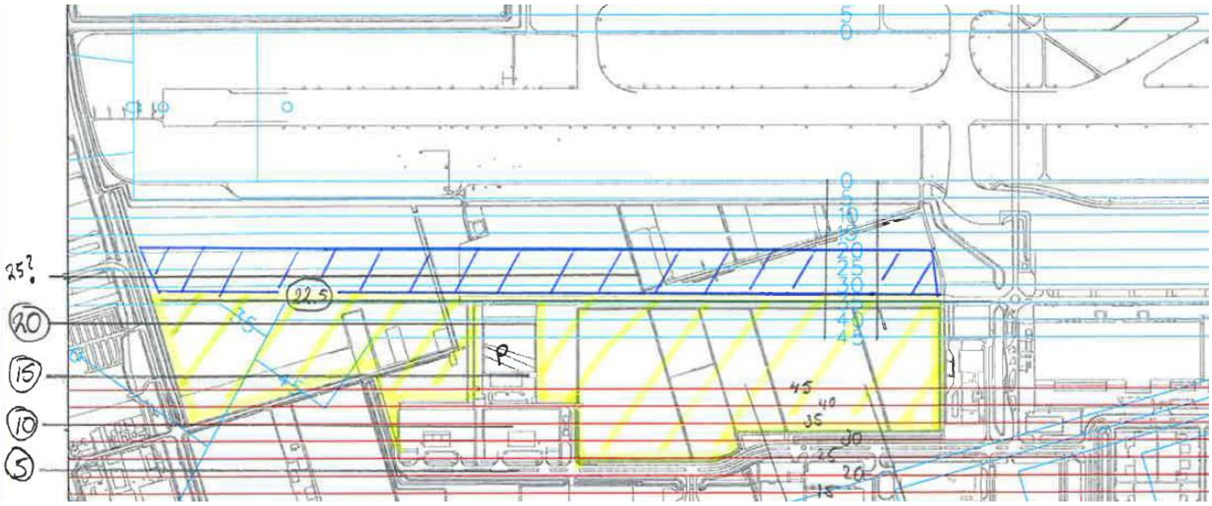


Figure 20: AAS Mandatory Sightlines and Maximum Build Height

Area Nuances

Image 22 shows the SRE plans for AAS South-East when the expansion of the passenger terminals (and it's consequences for the cargo buildings at Centre and South) was not yet planned . The white plots are currently constructed and rented out to Panalpina, Ceva Logistics and Rhenus. The red plots are not yet constructed, and therefore 'in principle' available for a fast-track facility. These plots are not directive for furture building at AAS South-East. This image is solely provided as a guideline.

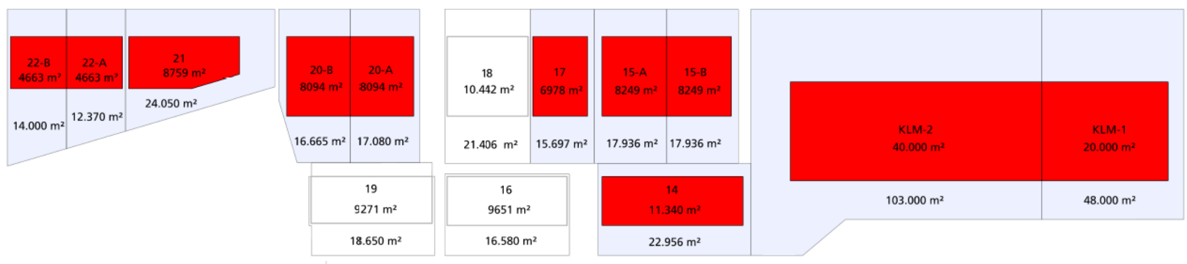


Figure 21: Area Plans (SRE, 2015)

G2 Fast-Track Terminal Design Analysis

G2.1 Terminal Shape

Three terminal shapes are most common. The I, L and T shape. Most cross docks however are I (or box) shaped (Bartholdi & Gue, 2004). This is because an I-shaped dock can usually have the smallest width and corners in a design may have constrictions for truck or trailer parking spaces as is presented in figure 23.

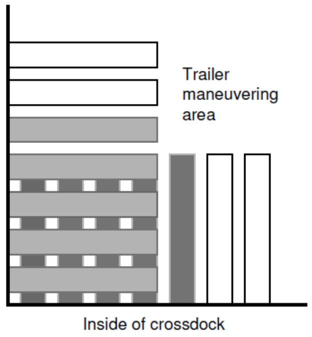


Figure 22: A Corner that constricts Parking Space (Bartholdi & Gue, 2004)

In some of the cases, L and T shapes are used when the designated area of the terminal does not allow an I-shape. Other reasons for an alternative shape are the degree of centrality of the docks. It is imaginable that the furthest docks in an I-shape are further and the docks of a T or H-shape which are have the longest distance from the middle. Bartholdi & Gue (2009) eventually argues that an I-shaped terminal is best for docks with less than 150 doors.

G2.2 Terminal Levels

The section (figure 24) of a traditional air cargo building at AAS shows that there is a large unused height, despite the two layer PCHS (Pallet Container Handling System at airside. SRE (2003) argues that the small and stretched PHCS forces the ATV to move over large distances. A more compact PCHS would therefore result in a faster and more efficient handling process. Furthermore, the PCHS uses only 20% less ground level surface than horizontal storage due to the large rollerbeds and height constraints.

Figure 23: Height Usage General Terminal (Vonk, 2003)

The British airways cargo building (figure 25) uses its height more intensely. The storage is higher and the various handling processes are situated vertically instead of linear. The ULD transhipment takes place on the floor level.

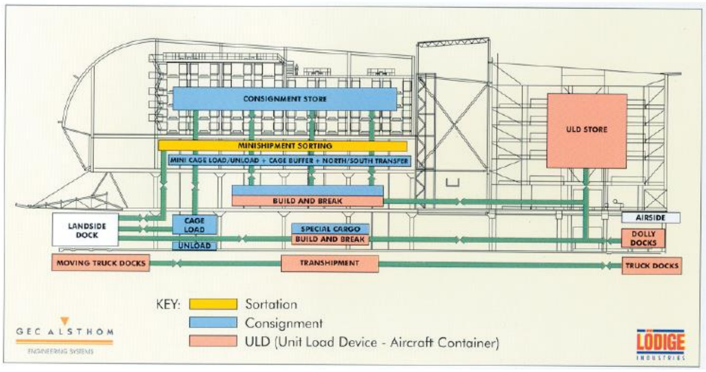


Figure 24: British Airways Cargo Building (Vonk, 2003)

The configuration of the MAS KARGO advanced cargo centre in Kuala Lumpur also uses the height of the building more intensively. However, instead of bundling the functions, this building actually placed two copies of the traditional cargo handling process on top of each other, doubling the capacity. The import

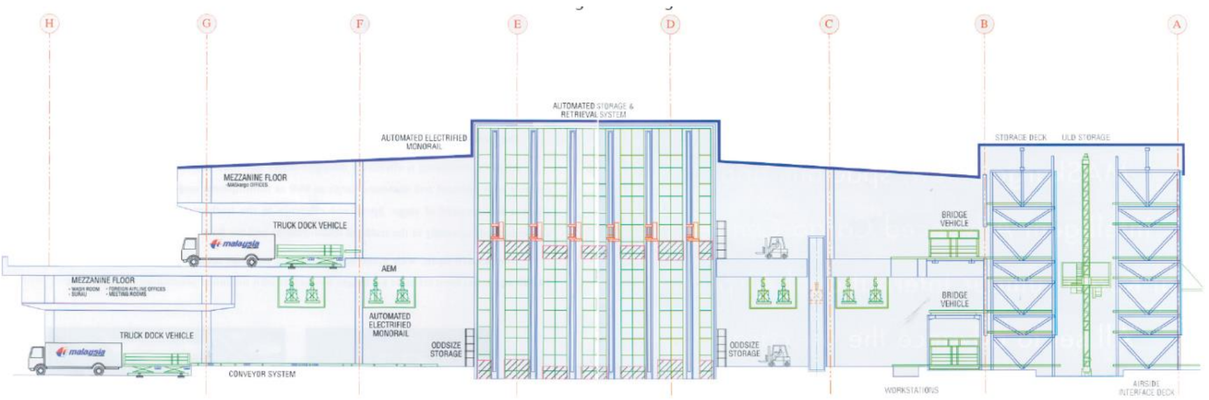


Figure 25: Cargo Centre Kuala Lumpur (Vonk, 2003)

Using multiple levels in a warehouse design is useful, but appears to be costly (SRE). Also, multiple levels require truck and transporter ramps. It is questionable whether multiple levels are useful in a Fast-Track Terminal which is as small as possible.

G 2.3 Terminal Lay-Out

According to Roodbergen (2007) two types of layout decisions are distinguished. The decision on where to place the various departments and secondly to determine the layout within the various departments.

A good example of current department placing in a traditional air cargo warehouse at Schiphol is in building 8. In this building the traditional handling process is applied. The fitment of the regular air cargo handling processes(building up/breaking down, storage & transport) in a traditional air cargo handling warehouse looks similar to the map in image 25.

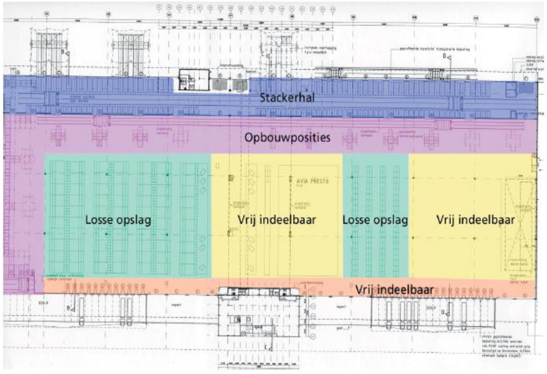


Figure 26: Basic Lay-Out Cargo Warehouse (Vonk, 2003)

A Fast-Track facility in principle only needs to place storage and a track. In order to keep the building as small as possible, the storage must be placed alongside the track.

G3 Morphological Design Approach

According to Zwicky (1998) morphology is a general method for structuring and investigating the total set of relationships contained in a multi-dimensional, usually non quantifiable, complex problem. Another view on morphology is provided by Zeiler & Savanovic (2008) which state that this approach provides a structure to give an overview of the considered parameters and aspects and their solution alternatives (Zeiler & Savanovic, 2008). The five iterative steps of the MA process according to Zwicky (1998) are presented in table 15.

Table 15: Morphological Design Approach (Zwicky, 1998)

1 Problem Formulation	The problem to be solved must be very concisely formulated
2 Design Variables	All of the variables that might be of importance for the solution of the given problem must be localized and analysed
3 Morphological Box	The morphological box or multi-dimensional matrix, which contains all of the potential solutions of the given problem, is constructed.
4 Evaluation	All the solutions contained in the morphological box are closely scrutinized and evaluated with respect to the purposes that are to be achieved.
5 Selection	The optimally suitable solutions are selected and are practically applied, provided the necessary means are available. This reduction to practice requires in general a supplemental morphological study

Step 1: Problem Formulation

The first step of the MA is performed in the problem analysis in chapter 2. The applicable part of the research question determined in the problem analysis is:

'What is the design space for a 1st line cargo fast-track terminal at AAS South-East, which increases efficiency at the 1st line in the future?

Step 2: Design variables

The parameters for the design are retrieved from literature (appendix G2) and the current BUP System Analysis in chapter 4.

Table 16: Design Variables

General Variables	Equipment Variables	Configuration Variables
Number of Terminals	Storage System	Rollerbed Lanes Import [#]
Terminal Shape	Storage Equipment	Rollerbed Lanes Export [#]
Terminal Levels	Main Transport Mean	Storage Capacity [#]
Transhipment Direction	Truck Docks	Cooled Storage Capacity [#]
Customs Control Function	Scale & Scanner (export)	Workstation [#]
Rebuilding Function	Inspection Equipment	Airside Import Docks [#]
		Airside Export Docks [#]
		Import Truck Docks [#]
		Export Truck Docks [#]
		Storage Equipment [#]

Step 3: Morphological Box

These possible design options for each variable are retrieved from different sources using the three different presented tools from the unstructured search phase in figure 27.

- Design examples from the current existing fast-tracks (dynamic confrontation)
- Literature studies and research on cargo handling equipment (Appendix H)
- Expert interviews (brainstorming)

The theoretically feasible design options per parameter are presented in a morphological overview (table 17) instead of a box.

Table I. How To Develop Design Options (after Gibson [1991])

Modern Tools for Creativity	
Phase	Tools
Unstructured search (out-scoping)	• Brainstorming • Brainwriting • Dynamic confrontation
Examine various combinations of elements	• Morphological box • Options field
Assemble elements into complete candidate solutions	• Options profile • Computer simulation • Delphi

Figure 27: Approach for developing design options (K. Preston White, 1998)

Table 17: Design Options per Alternative

Design Variables		Design Options			
		Option 1	Option 2	Option 3	Option 4
General Variables					
G1	**Number of Terminals**	1	2	3	>4
G2	**Terminal Levels**	1	2	3	>4
G3	**Terminal Shape**	Box	L-Shape	T-Shape	
G4	**Transhipment Direction**	Import	Export	Both	
G5	**Customs Control Function**	Manual Internally	Remote Scan	Externally	
G6	**Rebuilding Function**	Yes	No		
Equipment Variables					
E1	**Storage System**	Floor Storage	Rack Storage	Automated Rack Storage	
E2	**Storing Equipment**	Slave Pallet Mover	ETV	Lift	Forklift
E3	**Main transport mean**	Manual Rollerbed	Automated Rollerbed		
E4	**Truck Docks**	Mobile Truck Dock	Inside	Outside	Flexloader
E5	**Scale & Scan Equipment**	Scanner			
E6	**Inspection Equipment**	Remote Scanner			
Configuration Variables					
A1	**Rollerbed Lanes**	1	2	3	4
A2	**Storage Capacity**	<100	>100		
A3	**Cooled Storage Capacity**	<50	>50		
A4	**Workstation**	1	2	3	4
A5	**Airside Import Docks**	1	2	3	4
A6	**Airside Export Docks**	1	2	3	4
A7	**Import Truck Docks**	1	2	3	4
A8	**Export Truck Dock**	1	2	3	4
A9	**Storage Equipment**	1	2	3	4

Step 4: Evaluation

A theoretically feasible design option is stated as practically feasible design option when the it meets several requirements, which are:

1. The design option must meet the earlier stated requirements and assumptions
2. Design options must be preferable, non-preferable options are filtered out
3. The combination of design options for all variables must be able to be physically realized

Thus, the impossible design alternatives will be filtered out as well as the physically impossible design alternative combinations.

Impossible Design Options

According to the system requirements from appendix D

Table 18: Impossible Design Options

Variable	Design Option	Reason for 'Impossibility'
	General Variables	
Terminal Levels	➢ 2	AAS Height restrictions
Transhipment Direction	Export Only	Actor Requirement: 6 & 10 Fairly low Export BUP volumes. Hard to make a FTF profitable.

Non-Preferable Design Options

Table 19: Non-Preferable Design Options

Variable	Design Option	Reason for Non-Preferability
	General Variables	
Number of Terminals	➢ 1	Increase in airside and truck movements. Even more handling locations, not preferable for handlers. Furthermore, SRE (2014) has advised future cargo developments to be centralized.
Terminal Levels	➢ 1	Truck an airside ramps need to be constructed. Those are costly and take up a lot of space. Both reasons contradict the goals of the FTF.
Terminal Shape	L-Shape	Same results as an I-shaped terminal, however more corners which constrict seamless flows and parking space
Terminal Shape	T-Shape	Best for docks with over 150 doors (Bartholdi & Gue, 2004)
Transhipment Direction	Import and Export	Actor Requirement: 6 & 10
Customs Control Function	Manual Internally	Manual inspection asks for manual labour which is expensive
	Equipment Variables	
Storage System	Floor Storage	Takes up a lot of space if pallets cannot be stored on top of each other
Main transport Mean	Manual Rollerbed	A manual rollerbed system asks for manual labour which is expensive
Truck Docks		

Impossible Design Option Combinations

The impossible design option combinations are highlighted in the morphological chart in figure 27.

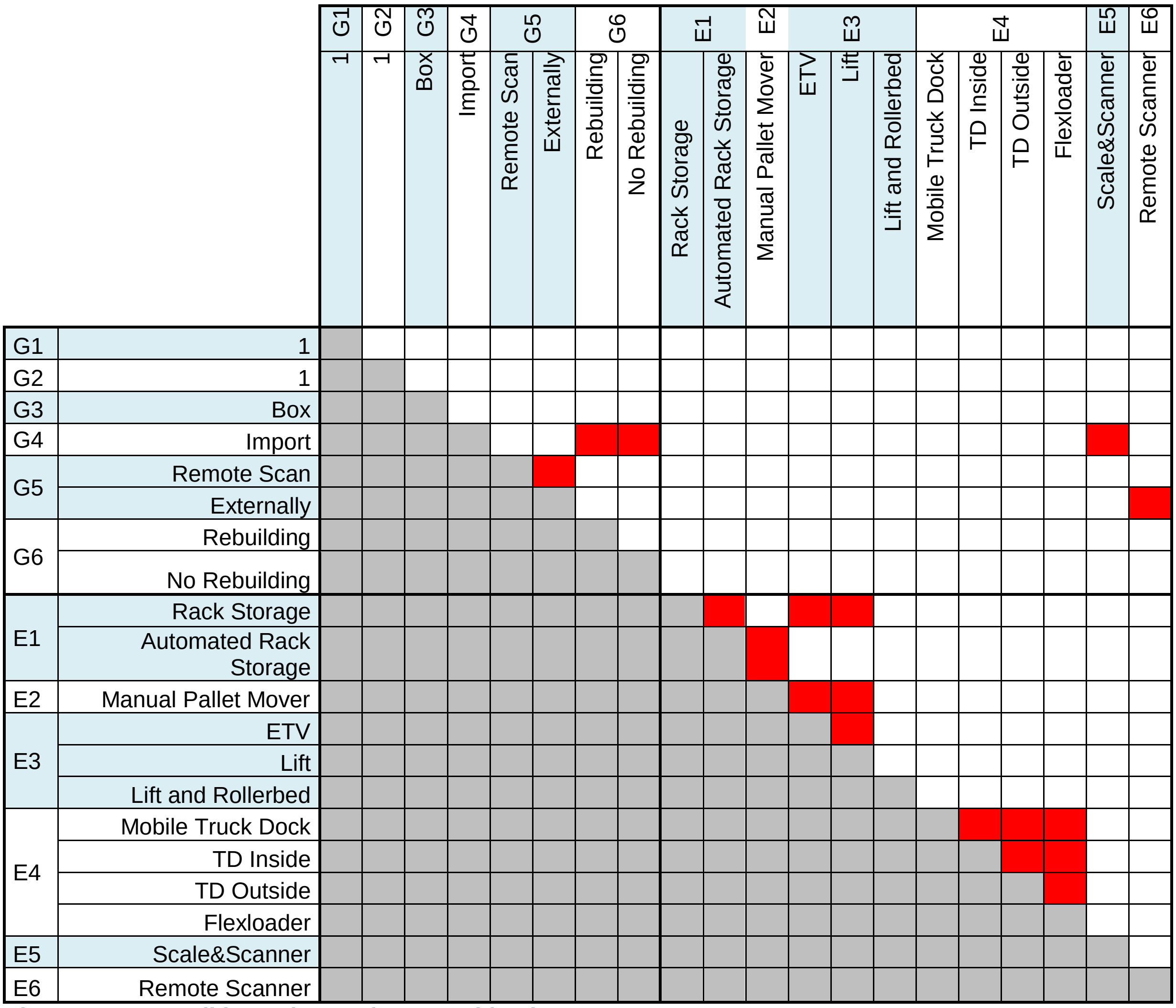


Figure 28: Impossible Design Options Combinations

Step 5: Selection

Two different combinations of design options are made. These two design combinations retrieved from the morphological overview are created based on the aim for a certain 'level of automation'. Creating one automated alternative and one manual alternative results in two fairly extreme design alternatives which tend to differ in the scores on the earlier set criteria for the terminal design. This selection method is chosen in order to retrieve diverse and broad information on the various design options. The design options are referred to as:

1. ***The Manual Design*** **Goal: Minimize Investment Costs [€]**
The starting point of this alternative is to integrate manual processes inside the fast-track terminal. The aim for this design is to be investment cost efficient which will result in a combination of cheapest design options which enhance these manual processes.

2. ***The Automated Design*** **Goal: Maximize Performance [ton/m^2/year]**
The starting point of the automated design alternative is to integrate automated processes inside the fast-track terminal with the goal to maximize the FTF performance. The aim is to exclude

manual labour as much as possible. This design alternative will enhance multiple level automated storage which results in a compact design.

The design alternatives are composed of 1 design option for each design variable. For every variable, the design option that contributes most to the alternative's goal is selected. The alternative configuration is presented in table 15. An assumption is made for the values of the configuration parameters. These values are used as initial values in the quantitative simulation analysis in chapter 6.

Table 20: Design Options per Alternative

Design Variables		**Design Options**	
		Alternative 1: The Manual Design	**Alternative 2: The Automated Design**
	General Variables		
G1	**Number of Terminals**	1	1
G2	**Terminal Levels**	1	1
G3	**Terminal Shape**	I-Shaped	I-Shaped
G4	**Transhipment Direction**	Import	Import
G5	**Customs Control Function**	Externally	Externally
G6	**Rebuilding Function**	No	No
	Equipment Variables		
E1	**Storage System**	Rack Storage	Automated Rack Storage
E2	**Storing Equipment**	Fork Lift	ETV
E3	**Main transport mean**	Automated Rollerbed	Automated Rollerbed
E4	**Truck Docks**	Outside	Outside
E5	**Scale & Scan Equipment**	Non	Non
E6	**Inspection Equipment**	Non	Non
	Configuration Variables		
A1	**Import Rollerbed Lanes**	1	1
A2	**Export Rollerbed Lanes**	0	1
A3	**Storage Capacity**	84	126
A4	**Cooled Storage Capacity**	0	0
A5	**Workstation**	0	0
A6	**Airside Import Docks**	1	1
A7	**Airside Export Docks**	0	1
A8	**Import Truck Docks**	1	1
A9	**Export Truck Dock**	0	1
A10	**Storage Equipment**	3	2

Appendix H: Air Cargo Handling Equipment and Systems

There is a various number of air cargo handling equipment and systems available. This equipment can be divided in three main categories.

- The air cargo airside handling equipment
- Mobile air cargo warehouse handling systems
- Embeddable air cargo warehouse handling systems

These categories consist of various systems which are able to perform one or multiple handling functions. A description and the characteristics of the systems are provided in the following paragraphs.

H1 Air Cargo Airside Handling Equipment

In this paragraph the airside handling equipment which is used to transport air cargo between the handler and the ramp is mentioned. Ramp handling equipment is beyond the scope of this investigation. There are two systems mainly used for the above mentioned type of transport:

- Dollies and Dollie-Trains
- Transporters

Dollie (and Dollie-trains)

Dollies are used to transport the cargo to and from the handlers facility to the airside. Multiple dollies fastened in a row are called dollie trains. However, dollie trains may include baggage carts, pallet wagons and container dollies on airside. Dollies can carry pallets and containers. A dollie train at Schiphol may have a maximum length of 27,5 metres including the truck (de Wit, 2014). This means that a maximum of 5 or 6 dollies can be fastened to the dollie truck.

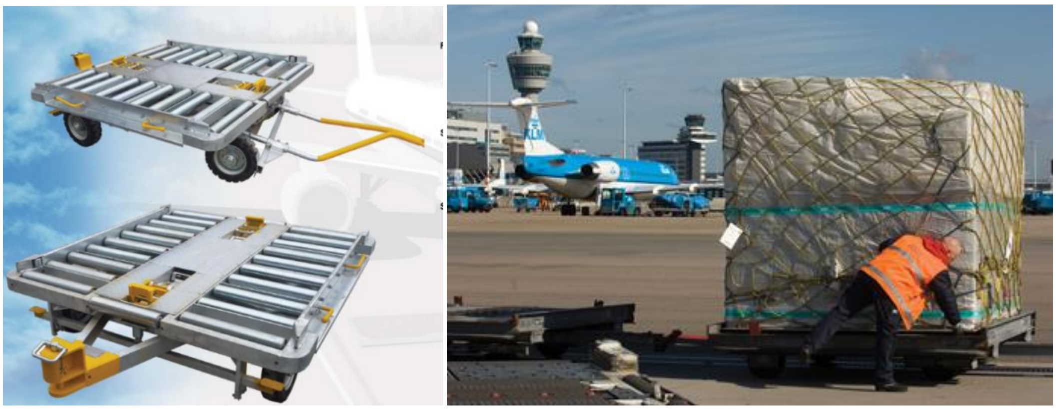


Figure 29: Dollie and Dollie Train

Table 21: Dollie Characteristics

Deadweight Dollie	6,8 tonnes
Dimensions Dollie (l x w x h)	3.600 x 2.700 x 228,2 mm
Maximum Length Dollie Train	27,5 metres (including truck)
Maximum number of Dollies in Train	5 or 6

Transporter

Transporters are used for the transport between the dollies and the high loaders on the ramp. However, when the ramp is nearby the handlers facility, the transporters transfer the cargo directly from the facility to the high-loaders. In this scenario no dollies or dollie trains are used. The transporters are usually electrically powered and are able to carry containers and pallets.

Table 22: Transporter Characteristics

Dimensions (l x w x h)	4.330 x 1.720 x 1.700 mm

Figure 30: Transporter

H2 Mobile Air Cargo Warehouse Handling Systems

There are various mobile air cargo handling systems which can be used in warehouses. These mobile system are not bound to a certain position in the warehouse and can usually perform multiple functions. The mobile systems mentioned and described in detail in this paragraph are (Lödige Industries, 2015) (Doosan, 2015):

- Fork Lift Truck
- Slave Pallets
- Slave Pallet Mover
- Manuel Pallet Mover
- Truck Dock
- Flexloader
- Workstations

Air Cargo Pallet Fork

A forklift truck is used for transportation within the handling facilities. A forklifts enables to load and unload air cargo efficiently and smoothly without hassle and it is not time consuming. The forklift can lift BUPs to an average height of 1 meter. Which means that the forklift can place and retrieve pallets from equipment such as transporters and rollerbeds but not on top of each other. The lifting of pallets currently happens , but is not ideal. The forklift has to literally shove itself underneath the pallet with quite some power. The forklift transports pallets for a short distance within the warehouse.

Table 23: Air cargo Pallet Fork Characteristics (MEC Lift, 2015)

Length	2570 mm
Maximum reachable height	3500 mm

Figure 31: Air Cargo Pallet Fork

Slave Pallet

Slave pallets are used to transport and process ULDs in non-mechanized warehouses or as secondary(back-up) transport in a mechanized warehouse. Pallets and containers can be loaded on to the slave pallets. Slave pallets allow easy lifting and transfer performed by slave pallet movers and manual pallet movers. A slave pallet has 16 non-powered rolls and anti-slip plates between the rolls.

Figure 32: Slave Pallet

Table 24: Slave pallet Characteristics (Lödige Industries, 2015)

Deadweight	6,800 tonnes
Dimensions (l x w x h)	3.300 x 2.600 x 228,2 mm
Weight	700 kg

Slave Pallet Mover

The slave pallet mover is an electrically controlled forklift truck developed fort he transfer of slave pallets. It has a fork which is compatible with the hole in the slave pallets and it can safely and quickly transfer ULDs through the warehouse. It also allows the ULD to reach the correct height for a dolly, workstation or a rollerbed.

Figure 33: Slave Pallet Mover

Table 25: Slave Pallet Mover Characteristics (Lödige Industries, 2015)

Deadweight	6,8 tonnes
Dimensions (l x w x h)	4.330 x 1.720 x 1.700 mm
Reaching Height	508 mm
Number of forks	3
Fork dimensions (l x b x h)	2.600 x 320 x 115 - 445 mm
Turning Radius	3200 mm

Manual Pallet Mover

The manual pallet mover can manually transfer Slave Pallets through the warehouse. By pushing the arm, the cargo is lifted up. An advantage of the manual pallet mover is that it takes up little space and has a small turning radius.

Figure 34: Manual Pallet Mover

Table 26: Manual Pallet Mover Characteristics (Lödige Industries, 2015)

Deadweight	6,8 tonnes
Dimensions (l x w x h)	1.870x900x680 mm
Speed$_{max}$	2.8 m/s

Truck Dock

The core-business of a truck dock is to allow safe, efficient and fast (un)loading of trucks. The truck docks are able to move in vertical direction in order to be able to place the cargo on either roller beds, slave pallets or other systems with different heights. The horizontal transportation of the ULDs happens through a powered roller bed on the truck dock or a castor deck.

There are variations possible in the truck dock configurations. The truck duck can either be placed outside or inside and the length of the docks differ. Secondly, the docks can be integrated in the warehouse or be mobile. A mobile truck dock also provides the possibility for ULD transport.

Figure 35: Truck Dock, Outside, Inside & Mobile

Table 27: Truck Dock characteristics (Lödige Industries, 2015)

Truck Dock 20 ft .	
Deadweight	14 tonnes
Dimensions (l x b)	7.585 x 2.700 mm
Reachable Height	-200 ... +800 mm
Truck Dock 10 ft.	
Deadweight	7 tonnes
Dimensions (l x w)	3.640x2.700 mm
Reachable Height	0 ... +800 mm
Rollerbed	
Width between guideways	2.540 mm
$Speed_{max}$	0.03 m/s
$Liftspeed_{max}$	0.05 m/s

FlexLoader

A flexloader combines the functions of the Truck Dock and the Slave Pallet Mover. The flexloader is electrically driven and remote controlled. It is able to transport, (un)load and lift ULDs to various heights and places. It is very manoeuvrable and allows multiple usage opportunities. On the flexloader is an automatically driven rollerbed which can move the ULDs horizontally.

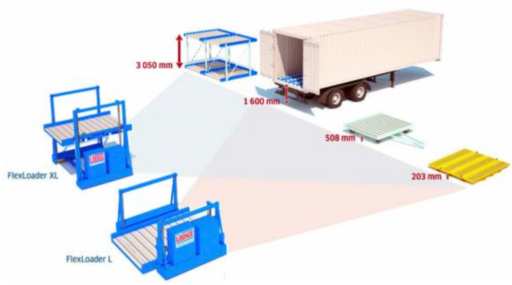


Figure 36: Flexloader

Table 28: Flexloader Characteristics (Lödige Industries, 2015)

$Deadweigth_{max}$	6,8 tonnes
Lift $speed_{max}$	0,05 m/s
$Speed_{max}$	1 m/s
Roller $speed_{max}$	0,3 m/s
Reachable $Heigth_{max}$	203 - 3.050 mm

Workstations

The workstations are used to build-up and break-down ULDs. The workstations can move vertically in order to reach the optimal building height. The workstations can therefore sink into the ground. There are also possibilities for integrating a scale into the workstations. The top of the workstation is usually a roller bed with an electrically driven horizontal moving function.

Figure 37: Workstation

Table 29: Workstation Charateristics (Doosan, 2015)

$Deadweight_{max}$	6,8 tonnes
Reachable $Height_{max}$	2.000 mm
Lift $speed_{max}$	0,05 m/s
Dimensions (l x w)	2.700 x 3.600 mm

H3 Embeddable Air Cargo Warehouse Handling Systems

Besides the mobile handling systems there are embeddable systems which need to be integrated in the warehouse. Most of these systems are build up of modules, creating a flexible system with a great possible variety. These systems are:

- Roller Bed Modules
- Crossing Rollerbed Module
- Traverse Wagon
- Elevating Transfer Vehicle

Roller Bed Module

The roller bed is developed for the horizontal transport of the air cargo. A roller bed systems consists of modules which together form a roller bed track. The roller bed tracks are able to transport to one direction and could be used as a cargo buffer as well.

Figure 38: Rollerbed Module

Figure 39: Transfer Vehicle

Table 30: Rollerbed Module Characteristics (Lödige Industries, 2015)

Deadweigth$_{max}$	6,8 tonnes/10 ft.
Transport Speed$_{max}$	0.3 m/s
Dimensions (l x w x h)	3.640 x 2.700 x 508 mm

Crossing Rollerbed Module

The crossing roller bed module is able to horizontally move the cargo in four directions. It can therefore transfer a ULD in a 90 degree angle. This is possible of the rolls and the wheels. The rolls can move the cargo towards to directions. If the rolls lower, and the wheels come up, the cargo can be moved in the other two directions.

Table 31: Crossing Rollerbed Module Characteristics (Lödige Industries, 2015)

Deadweight$_{max}$	6,8 tonnes
Transportspeed$_{max}$	0.3 m/s
Dimensions (l x w x h)	3.500 x 2.722 x 508 mm

Transfer Vehicle

The travers wagon can horizontally transport air cargo on one level. The traverse wagon can for example be situated between an integrated and an external handling system. The traverse wagon is automatically driven and has a roller bed on the surface.

Table 32: Transfer Vehicle Characteristics (Lödige Industries, 2015)

Track width	3.800 mm
Speed Wagon$_{max}$	2 m/sec
Totale dimensions (l x w)	5.680 x 5.435 mm
Roller Bed Deadweight$_{max}$	6,8 tonnes
Roller Bed Dimensions (l x w x h)	5.435 x 2.540 x 508 mm
Transportspeed$_{max}$	0.3 m/sec

Elevating Transfer Vehicle

The elevating transfer vehicle is able to transfer the cargo as well horizontally as vertically. The ETV is commonly used in mass storage systems to place the ULDs in the multi-level storage positions. The ETV is automatically driven and can be operated from the available room. The surface of the ETV is a roller bed. (Mc Grath Industries, 2015) The ETV can be equipped with an integrated weighing system.

Figure 40: Elevating Transfer Vehicle

Table 33: ETV Characteristics (Lödige Industries, 2015) (Mc Grath Industries, 2015)

Total dimensions (l x w)	3048/3572/6096 mm x 3048 mm
Weighing system	Optional
Reachable Height 1^{st} level	508 mm
2^{nd} level	4008 mm
3^{rd} level	7508 mm
4^{th} level	11008 mm
Max reach	16 metres

Friction Powered Roller Decks

Friction powered roller decks are used for storage of ULDs. They are installed in single or multi-level racking structures

Figure 41: Friction Powered Roller Decks

Table 34: Friction Powered Rollerdecks Characteristics (SACO: Airport Equipment, 2015).

Operating height (above ground)	508 mm
Dimensions (l x w)	3048/3572/6096 mm x 3048 mm

H4 Scanning & screening Devices

Scanners and screen devices are used to scan the inside of a container or pallets.

- Relocatable Container Inspection System

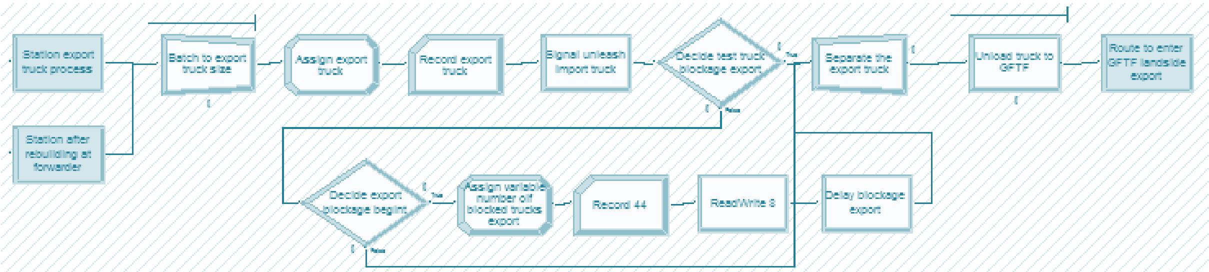
Relocatable Container Inspection System

The Relocatable Container Inspection System is an ‘Efficient and cost-effective security solution for cargo inspection at seaports, border crossings and airports’. (Excem, 2015) It is a modular gantry design which means that it is flexible and is able to be moved over ULDs.

Figure 42: Relocatable Container Inspection System (Excem, 2015)

VII

SIMULATION



Appendix I: Discrete Event Simulation

I.1 Discrete Modelling with Arena Software

According to Shannon (1975) simulation is best described as *"The process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behaviour of the system or of evaluating various strategies (within the limits imposed by a criterion or set of criteria) for the operation of the system".*

Discrete modelling is used for 'systems whose changes occur in finite quanta, or jumps, are discrete' (Pooch & Wall, 1993). The discrete units representing the BUPs entering the complex FTF system cause these jump changes in the system. At first, the BUPs enter the FTF systems as a whole in a discrete time step. Secondly, every time an entity enters or leaves the FTF system the state of the system changes. Either a resource is seized or the conveyers utilization increases or decreases. With each entity movement, various sub-parts of the system change their state. These changes do not happen continuously, but discretely, therefore Discrete Event Simulation is applicable. One of the modelling goals of Discrete Event Simulation as stated by Altiok & Melamed (2010) is to rank multiple designs and analyse their trade-offs. This is the goal applicable to the FTF model

Additional Export Scope

The processes taken into account for the simulation model are described below.

Import From unloading the transporter at the FTF airside terrain
until the loading of the import trucks at a landside truck dock.

Export From unloading the export trucks at a landside truck dock
Until placing the BUPs on the transporters at the FTF airside terrain.

I.2 Key Performance Indicators

This section clarifies the exact meaning and scope of the defined key performance indicators.

Table 35: KPI Explanation

(Key) Performance Indicators	Explanation
Throughput [ton/year] or [BUP/year]	This KPI refers to the number of pallets or tonnage which is transhipped through the FTF over a period of time.
Average Lead Time Import [hour]	The average lead time of an import pallet refers to the period that the pallet is within the FTF system. This period starts with transporter unloading and ends when a pallet is loaded into the truck. The time it takes for a truck to fully load is not included.
Average Lead Time Export [hour]	The average lead time of an export pallet refers to the period that the pallet is within the FTF system. This period starts with truck unloading and ends when the pallet is loaded onto the transporter at airside. The time the pallet waits on airside before it is transported to the VOP is not including.
Minimum Lead Time [hour]	The minimum lead time refers to the minimum time it takes to tranship a pallet through the FTF. For the minimum lead time, it is assumed that trucks drop-off and deliver the pallets exactly on time.. The minimum lead time represents a future ultimate goal for seamless transhipment processes where the FTF functions solely as a truck dock.
Truck Movements [#]	Truck movements refers to the number of trucks that enter the FTF facility at landside which are needed to drop-off and pick-up the BUPs.

I.3 Model Specification

This sections provides information on the model specification of the FTF in Arena. First, the most commonly used Arena modules are explained where after the model is explained per sub-part. Finally, the assumptions and simplifications which are made in order to model the real-life situation are described.

I.3.1 Modules

An Arena model is build up out of several modules. Each module has a specific function. The most common used modules are presented and explained below.

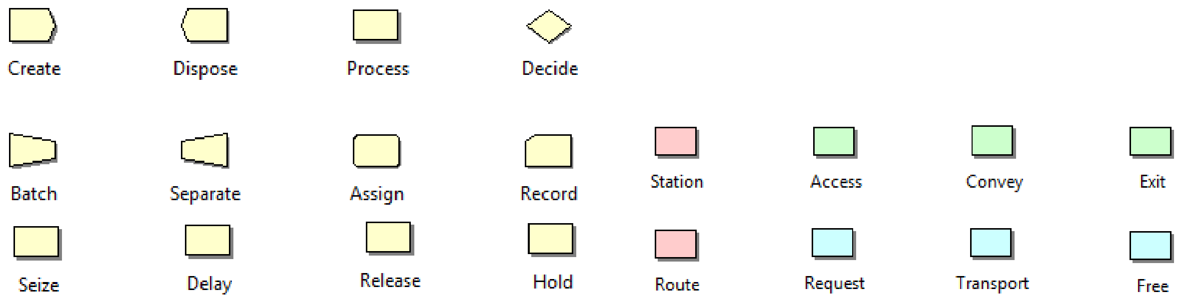


Figure 43: Arena Modules

Table 36: Arena Module Explanation

Module	Explanation
Create	Entities are created and enter the model
Dispose	Entities are leave the model
Process	The entity undergoes a certain process. This process could involve a certain resource. Resources are usually equipment or employees.
Decide	The entity is guided towards a certain direction, at a point where multiple directions are possible.
Batch	A number of entities is batched together and form one new entity.
Separate	The batched group of entities is split into the existing batch or an entity is duplicated.
Assign	the assign module various an attribute is assigned to the entity. This attribute can be seen as an entity's characteristic which could be used to influence the path of the entity through the model. The assign module can also assign a variable to the entire model.
Record	The record module is used to collect statistics throughout the model
Seize	A resource is occupied by an entity
Delay	The entity undergoes a certain delay
Release	The entity releases the previously occupied resource
Hold	An entity is held in this module until a certain conditions occurs
Station	This module indicates the arrival of an entity at a station
Route	An entity can be routed towards another station from the current station
Access	The entity accesses an conveyer in this module
Convey	The in entity is conveyed in this module according to the conveyer speed and the amount of places on the conveyer
Exit	If the module enters this module it release the allocated conveyer spots
Request	At an request module the entity calls a transporter towards itself
Transport	The entity is transported towards a station
Free	The entity releases the transporter

I.3.2 Meta-Model

The meta-model created in Arena integrates the 3 physical FTF alternatives. A model variable stating the current active alternative is integrated in various decisions made throughout the model. These decisions together eliminate or involve certain sub-models. Through these decisions, the requested alternative from is created. Only this variable, called 'Alternative' is adjusted when the model an alternative switch is required. The decisions influenced by the alternative stating variable are presented in table 37.

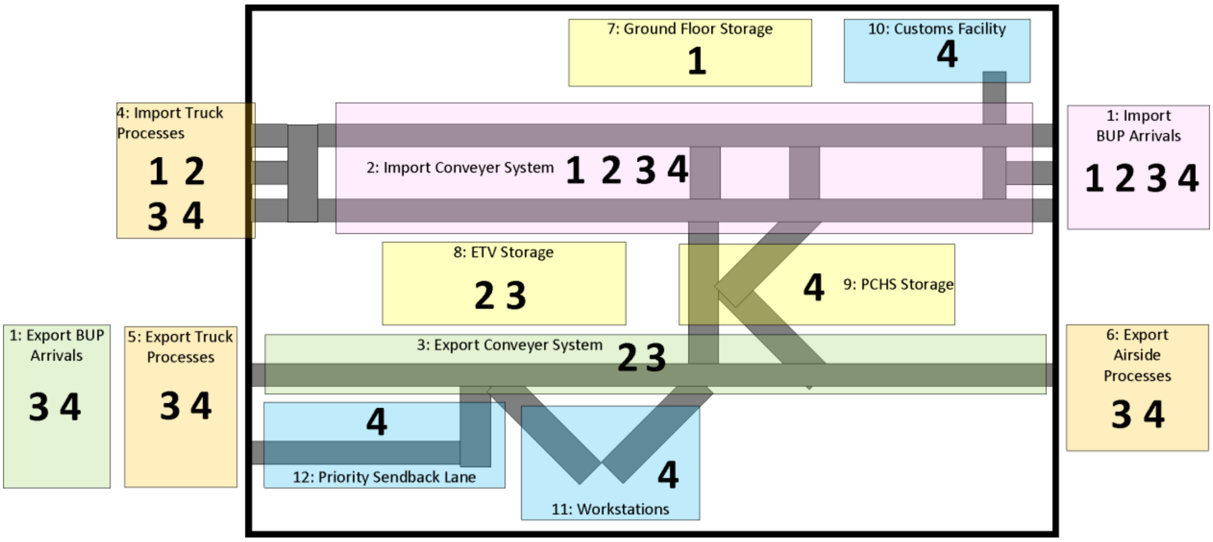


Figure 44: Total Meta-Model Lay-Out

Table 37: Variable 'Alternative' Decisions

Critical Alternative Decisions	Variable 'Alternative':	Then
Decide whether one or two import rollerbeds used.	4,2	Two rollerbeds are used
	1,3	One rollerbed is used
Decide in-house customs facility present in FTF	4	There is an in-house customs facility
	1,2,3	No customs in facility
Decide which kind of storage used in FTF	1	Then the manual storage with SPM is used
	2,3	The ETV storage system is used
	4	The PCHS is used
Decide where import BUP has been stored	1	BUP has been stored manually
	2,3	BUP has been stored in ETV system
	4	BUP has been stored in PCHS
Decide if export cargo enters FTF	1,2	Export not included in model
	3,4	Export included in model
Decide whether one or two export conveyers used	1,2	No export rollerbed is used
	3,4	One rollerbeds are used
Decide whether rebuilding BUPs and Priority 'sendback' is possible	1,2,3	No rebuilding and priority 'sendback' possible
	4	Only regular 'sendback' possible
Decide where export BUP has been stored	3	The ETV storage system is used
	4	The PCHS is used
Are export "sendback" trucks necessary	1,2,3	No priority "sendback" available
	4	Priority "sendback" trucks created
Are the amount of import trucks available dependent on export trucks	1,2	Import trucks not dependent on export trucks
	3,4	Import trucks dependent on export truck arrivals

I.3 The Model Lay-Out

The lay-out of the modelled FTF alternatives is presented in figure 45. Despite the fact that the FTF alternatives are modelled as a whole, several sub-systems are identified. The Sub-Systems are indicated with a number. The stations within are the red blocks in the image. The specification of the sub-systems is described below.

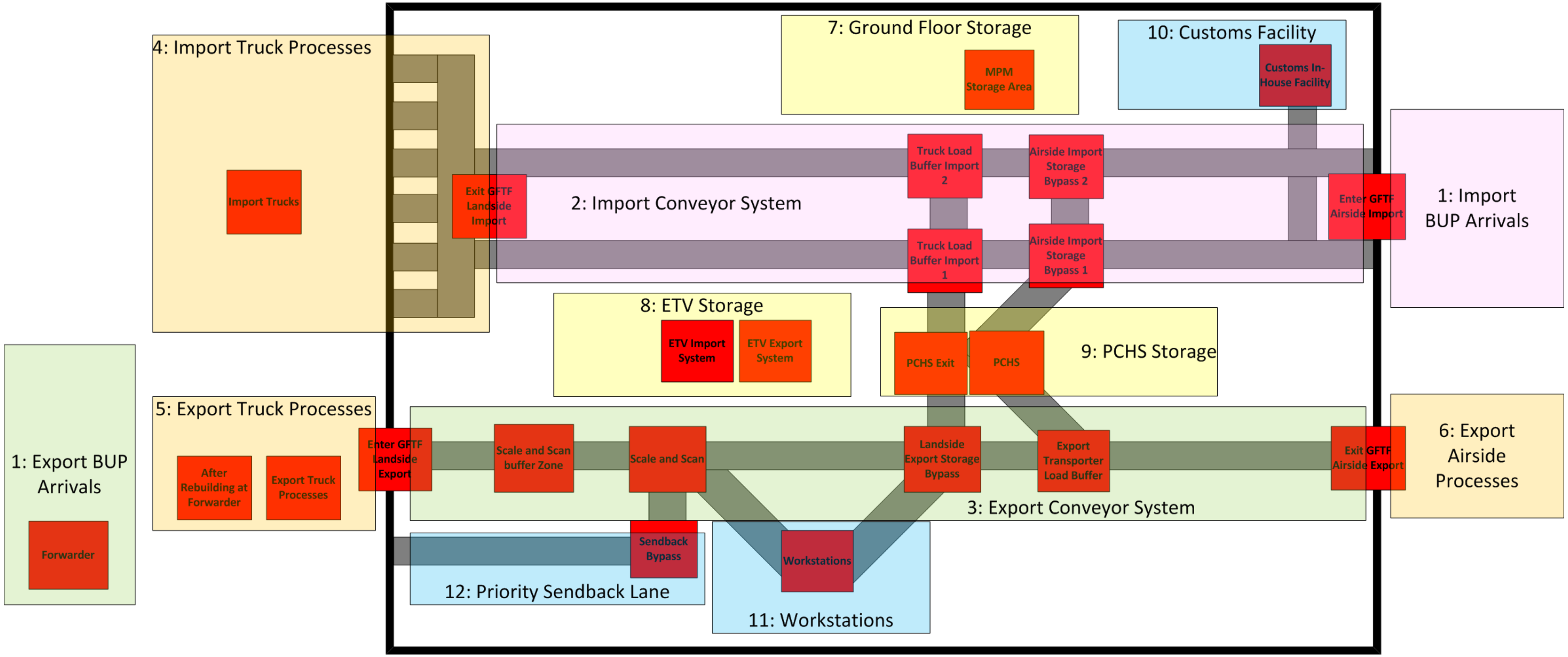


Figure 45: Meta-Model Lay-Out Including Stations

1. The Import and Export BUP Arrivals

In order to create entities that enter the FTF system according to the excel input data file, a help entity is created which reads the amount of entities to be created in every hours. The help entity reads the arrival hours, the amount of general cargo and the amount of perishables which are to be released in the associated arrival hour. The help entity enters two separate modules in which it is duplicated according to the amount of perishables and general cargo. The help entity delayed for an hour and guided back towards the read write modules.

The duplicates are assigned the perishable and general cargo entity types and delayed between 0 and 60 minutes in order to simulate the random arrivals of the number of BUPs within the hour. It is decided whether an in-house or external customs scan is performed. If there is no in-house scan, an estimation of 10% is guided towards customs. Here the BUPs are scanned in 10 minutes and 10% of this cargo requires a detailed customs scan which takes between half and one and a half hours. All BUPs are transported to the FTF and the transporters are unloaded onto conveyers 1A or 2A.

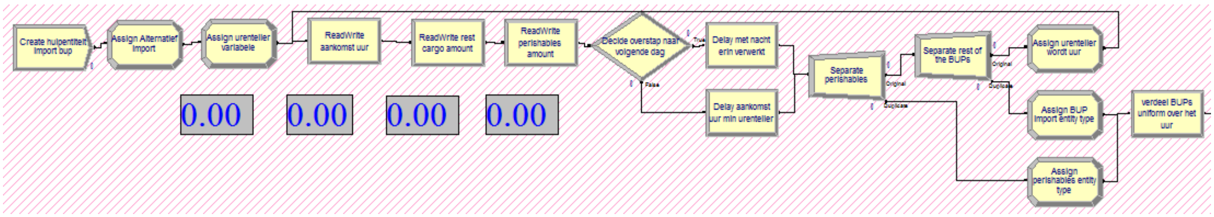


Figure 46: Model Specification Import Arrivals

2. The Import Conveyor System

Rollerbeds 1 and 2 are dedicated to import transhipment. Rollerbed 3 is dedicated to export cargo transhipment. The conveyers which connect the rollerbeds are referred to as connectors. The numbers on the rollerbeds represent the modelled capacity and the arrows represent the modelled direction.

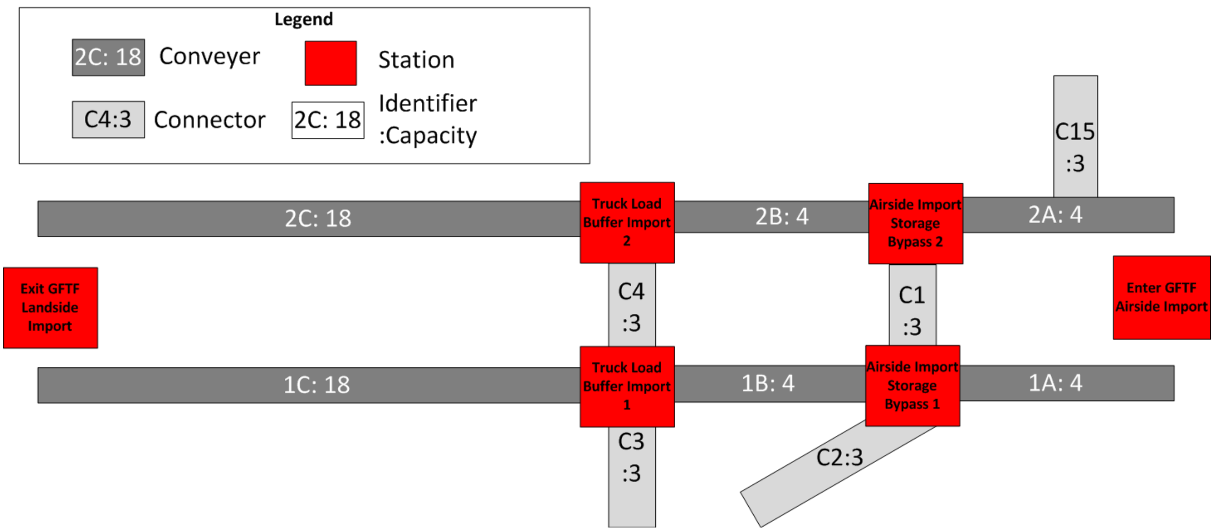


Figure 47: Model Specification Import Conveyer System

The import BUP enters the FTF at the ‘Enter FTF Import Airside’ station. In the next module it is decided whether 1 or two rollerbeds are used. In the first scenario, all BUPs are conveyed to rollerbed 1A. If both are used, 50% of the pallets is send to 1A and the rest to 1B. Before accessing conveyer 1A or 2A it is decided whether the customs facility is included in the alternative. If there is, 10% of the import cargo is send to the customs scanner. The customs processes is described in step 10. Conveyer 1A and 2A convey the BUP to the ‘airside storage bypass stations’.

Here, it is decided whether a BUP should be stored or can immediately flow towards the landside truck dock. This decision is dependent on the utilization of the conveyers and the waiting time for the conveyers. Pallet push-through occurs when the utilization rate is below 60% and the number of pallets waiting for conveyers B and C is less than 1. For a perishable BUP the maximum utilization rate is 75%. Depending on the current running alternative, the BUP is stored in the Ground Floor Storage (alt. 1), Elevating Transfer System (alt.2+3) or the Pallet Container Handling System (alt.4). These storage processes are described in step 7,8 and 9.

If the utilization rate allows push-through, the pallets access conveyers 1B or 2B which convey the BUP to the station ‘Truck Load Buffer’ 1 or 2. The truck load buffer consists of conveyer 1C or 2C,on which the pallets are conveyed towards the ‘FTF landside exit’ where the various truck docks are situated. The BUPs are held in the truck buffers until there is an available Truck with an available truck spot. The truck loading process is described in step 4.

4. The Export Conveyor System

The export BUP enters the FTF at the ‘Enter FTF landside Export’ station. All BUPs access rollerbed 3A and are conveyed to the ‘Scale and Scan Buffer’. The scale and scan buffer consists of a rollerbed on which a line of BUPs for the Scale and Scanner is situated. The BUPs access conveyer 3B and are held on this conveyer until the Scale and Scanner is available.

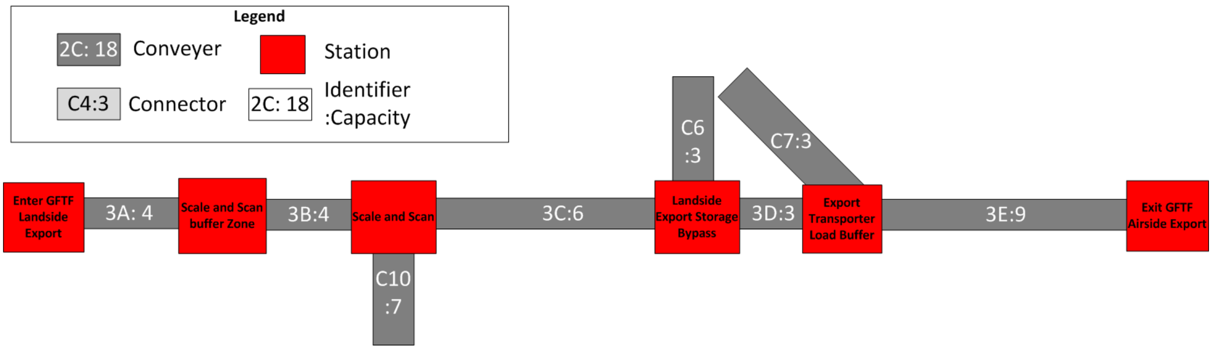


Figure 48: Model Specification Export Rollerbed System

Once it is, the BUP is placed in the scanner and the dimensions and weight is checked. If the BUP is rejected, the ‘alternative’ variable influences the decisions for further handling. A rejected BUP can be sent back. This means that the BUP flows via the storage to the import truck loading process and is brought back to the forwarder. The second option is the pallet entering the priority ‘sendback’ lane (figure 58) which brings the pallet to a dedicated ‘sendback’ truck dock where the forwarder can pick-up the priority pallet. The last option is that the BUP is conveyed to the in-house-workstations and is rebuild. The 2^{nd} and 3^{rd} option are described in step 11 and 12.

If the pallet is not rejected, it is conveyed with conveyer 3C to the ‘Landside Export Storage Bypass’ station. A decisions is made whether the export BUPs are stored or pushed through to airside. The BUPs are send to the storage when the maximum ‘airside allocation variable’ is exceeded. This variable indicates the number of BUPs which are allocated towards airside. This maximum airside allocation is dependent on the conveyer capacity (of conveyers D and E) and the number of available airside spots which are modelled as resources. If the BUP is stored, it depends on the current running alternative which storage it is directed to.

When the BUP is pushed through, it enters conveyer 3D towards the ‘Transporter Load Buffer’. At the transporter load buffer, the BUP accesses conveyer 3E towards station ‘Exit FTF Airside Export’.

5. The Import Truck Processes

Based on the amount of import BUPs created in step 1, the amount of import pick-up trucks is created. All import BUPs are duplicated and assigned a truck entity type. 4 or 5 entities are batched to a truck load, which decides the number of trucks created at the moment the import cargo lands at Schiphol. These trucks are routed to the station ‘Import Trucks’ where the trucks are delayed for a certain ‘Truck Notice Time’. This is the period that is takes trucks to reach the FTF once the signal has come that the plane with cargo has landed. If a truck blockage is recreated, a certain amount of trucks is routed towards a read write module which assign a longer TNT to the truck entity. Once the normal delay or the extended delay is over, the truck seizes an available import truck dock. The truck is held in the dock until it is fully loaded (4 or 5 BUPs).

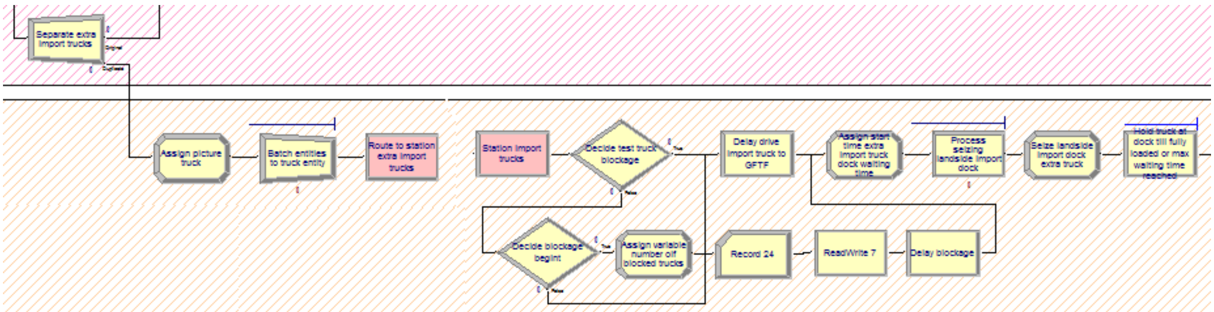


Figure 49: Model Specification Import Truck Process

The import BUPs that enter the ‘Exit FTF Landside Import’ dock are routed towards a truck dock which is occupied by a truck. The BUPs are batched to a truck load of 4 or 5. Once the truck load is complete, the batched entities enter a module which signals the truck at the hold module to release the truck dock. The truck load entities separate and are disposed.

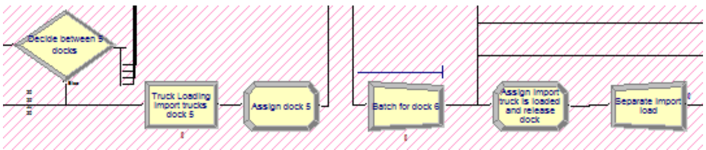


Figure 50: Model Specification Import Truck Docking

The truck hold condition is reached and the truck leaves the airside import truck dock. The time it takes for a truck to leave the dock and a new truck to occupy the dock takes 5 minutes. Another option for the truck to be released from the truck dock is when the maximum waiting time of 1 hour for the truck is reached. When this happens, the truck is released from the dock and at the same time removes 2 or 3 BUPs from the batching queue.

6. The Export Truck Processes

The export entities that are created in step 1, are batched groups of 2 or 3. These batches represent export trucks entering the FTF facility. This number of trucks is counted. If a blockage is tested, the trucks are held for a period which is retrieved from an excel file. A certain amount of trucks is held for a longer period is order to recreate a truck blockage. After this the truck loads are separated into BUPs and the trucks are loaded onto FTF rollerbed 3A. The BUPs are routed towards the ‘Enter GFF Landside Export’ station.

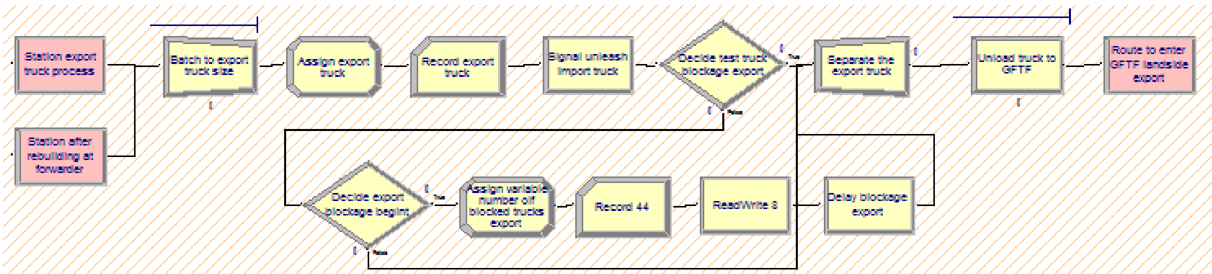


Figure 51: Model Specification Export Truck processes

7. The Export Airside processes

The export BUPs which are routed to the ‘Exit FTF Airside Export’ station are loaded onto a transporter in 5 minutes, the BUP then seizes a spot on the transporter (or dolly) on airside and waits there until the dollies are driven to the VOP. The minimum time on the export airside area is 15 minutes. Once the BUP leaves towards the VOP, the earlier seized ‘airside export spot’ is released and the entities are disposed from the system.

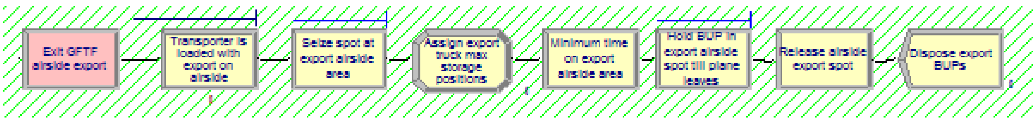


Figure 52: Model Specification Export Airside Processes

8. The Ground Floor Storage

If an import BUP requires storage during alternative 1, the import BUP is retrieved from the rollerbed at the ‘Airside Import Storage Bypass’ station with a Slave pallet mover (appendix H). This SPM which is operated by an employee places the BUP in the nearest empty pre-defined floor storage spot and releases the SPM. Import BUPs are held in the storage until the utilization of conveyer C is below the maximum allowed percentage. For normal BUPs this percentage is 60% and for perishables it amounts to 75%.

Once the pallet is released from the storage, it requests a SPM which places the BUP on the rollerbed at the truck load buffer station where it enters rollerbed 1C.

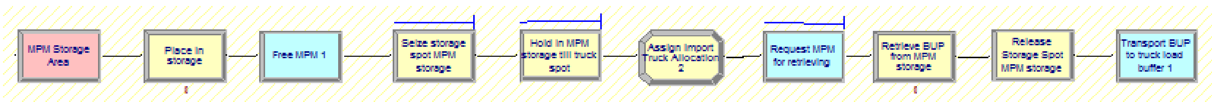


Figure 53: Model Specification Ground Floor Storage

9. The ETV storage System

If an import (or export) BUP requires storage during alternative 2(or 3), the BUP is retrieved from the rollerbed at the 'Storage Bypass' stations with an ETV (appendix H). This ETV automatically places the BUP in the nearest ETV storage spot. This means that is a spot on the 1st floor is chosen over a spot on the 3rd floor. The BUP is only placed at a higher floor storage spot once all the storage spots on the lower floors are occupied. The PCHS storage consists of 4 levels situated on top of the conveyer system.

The release condition for import BUPs is similar to alternative 1. Export BUPs are held in the storage until the critical time before departure is reached. Assuming that the export BUPs are delivered between 7 and 11 hours before departure, and the BUPs should be ready at airside between 3 and 4 hours before departure, the modelled export storage time distributed uniform between 3 and 8 hours. The entity is held in the storage until the condition is met.

Once the pallet is ready to be released from the storage, it requests the ETV. The ETV brings the import pallet to the 'Truck load buffer' station where it enters rollerbed 1C. The ETV brings the export BUP to the 'Transporter load buffer' station where it then enters rollerbed 3E.

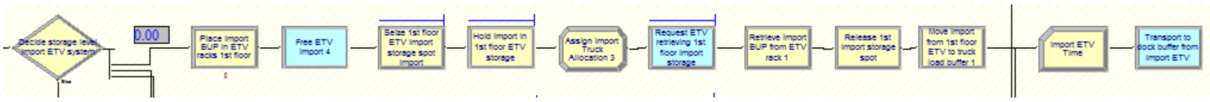


Figure 54: Model Specification ETV Storage System, 1 level

10. The PCHS storage System

For alternative 4, the import and export BUPs are conveyed to the Pallet Container Handling System entrance on connector 2 and 6 respectively. The PCHS is a mixed storage facility for import and export BUPs. However, there is a separate cooled storage facility for perishables. At the PCHS it is decided whether the pallet is a perishable or not. Perishables are stored in the cooled PCHS storage facility. The pallet, regardless of the commodity, requests lift which takes the BUP to the first storage level it passes which provides an available storage spot or cooled storage spot (for the perishables). The BUPs exit the lift and are conveyed to and placed in their storage spot at the assigned storage level. The PCHS storage consists of 5 levels including the ground floor level.

The release condition for import and export BUPs is similar to previous alternatives. When the BUPs are ready to be released, they are automatically conveyed back to the lifts, request it, and are lowered with the lift to the 'PCHS exit' station. At the exit, the import BUPs are conveyed on connectors 3 and 7 to respectively the 'Truck load buffer' and the 'Transporter load buffer'.

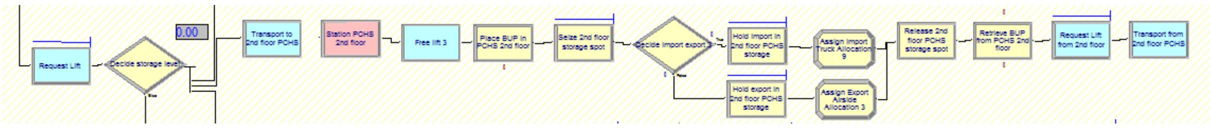


Figure 55: Model Specification PCHS Storage System, 1 level

11. The In-house-Customs Facility

When import BUPs are in need of a customs check, the BUP is send over connector 15 towards the customs scanner. The BUP is placed in the scanner and scanned in 10 minutes. During this scan, a customs employee decides whether a detailed customs check including break-down and build-up is required. 10% of the BUPs that are scanned require a detailed customs check which takes between a half an one and a half hours (triangular distribution). After this detailed check the BUP accesses connector 16 towards the 'Airside Import Storage Bypass'.

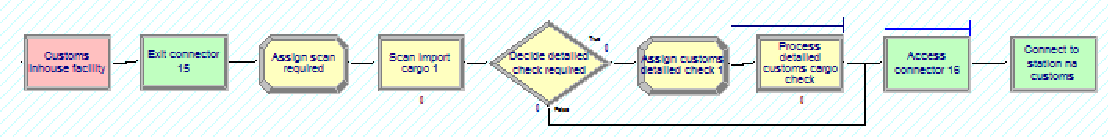


Figure 56: Model Specification In-house Customs Facility

12. The In-house Workstations

If the decision is made to rebuild a rejected export BUP, the BUP is placed on connector 12 towards the in-house workstations. Rebuilding the BUP takes between half and one and a half hours (triangular). The rebuild BUP is placed on connector 13 towards the 'landside export storage bypass'.

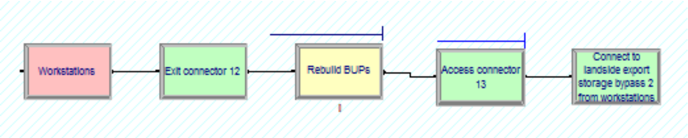


Figure 57: Model Specification Workstations

13. The Priority 'sendback' Lane

If the decision is made to send the BUP back to the forwarder via the priority lane, the BUP is placed on connector 10. The forwarder sends a priority truck and at arrival the BUP is loaded inside the truck at the dedicated 'sendback' dock. The truck leaves as soon as the BUP is loaded inside the truck in order to transport the BUP to the forwarder as soon as possible.

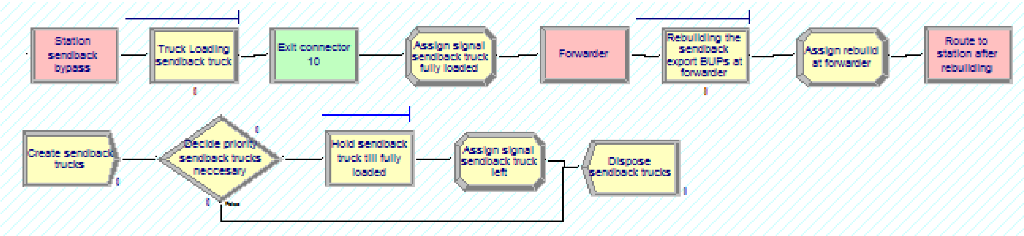


Figure 58: Model Specification Priority Send Back Lane

I.3.1 Additional Export Model Flows

The model conceptualization and specification for the alternatives 3 and 4 are described in appendix I. The entity flows through the additional export alternatives are described below. Import BUPs are marked with black arrows and export BUPs are marked with grey arrows.

Alternative 3 Export Basic

In alternative 2 the same import storage conditions are handled. In alternative 2 a decision is made whether the export BUPs are stored or pushed through towards the airside docks. As BUPs need to be ready at the FTF airside between 3 and 4 hours before actual time of departure, this condition determines whether a BUP is stored. The capacity of the export storage therefore merely depends on the 'Export Drop-Off Time' at landside. Export cargo which is not build-up correctly and rejected, is send back to the forwarder via the import truck docks.

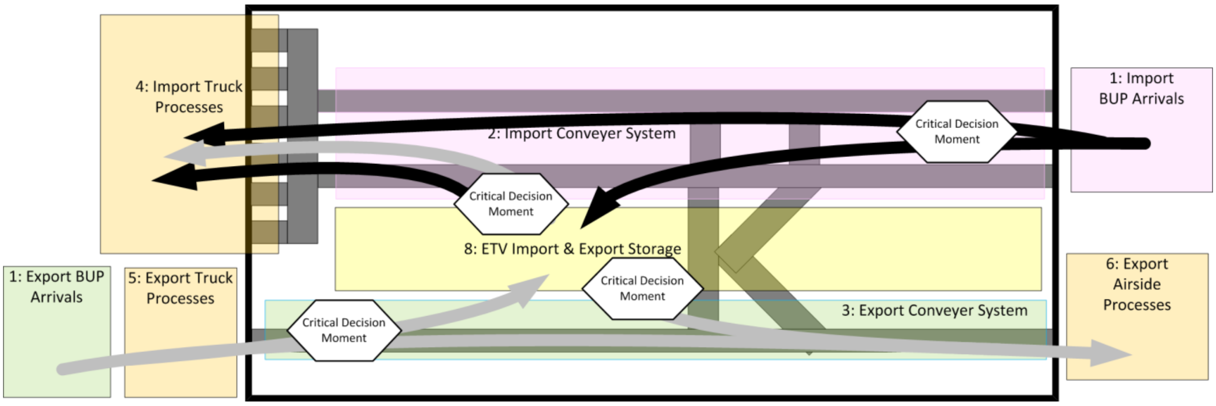


Figure 59: BUP Model Flows Alternative 3

Alternative 4 Export Extended

In alternative 3 the same import and export storage conditions are handled. Export cargo which is not build-up correctly and rejected can be handled in three different ways. It is either send back to the forwarder via the import truck docks, send back via the priority send back lane or rebuild at the workstations inside the FTF.

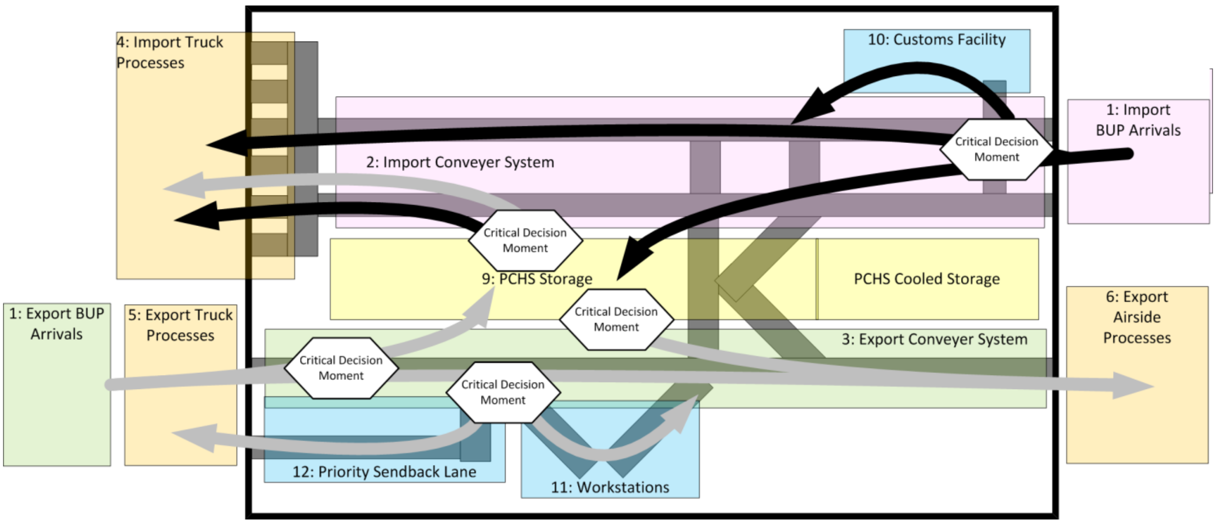


Figure 60: BUP Model Flows Alternative 4

I.4 Input Analysis

The model input consists of two types. The model constants which are based on previous investigations, measurements and assumptions are the first type. The second model input is the input datasheet which indicates the arrival hour and amount of the model entities as described in step 1 of the model specification.

I.4.1 Model Constants

Various constants are used throughout the model. The following table indicates these constants.

Table 38: Model Constants

Model constant		Source
Model Distance Unit [spot]	3,60 x 3.00 [metre]	(Boeing, 2012)
Truck (Un)loading Time	3 [minute/BUP]	(de Wit, 2014)
Transporter (Un)loading Time	5 [minute/BUP]	(de Wit, 2014)
Conveyer width	3 [metre]	(Lödige Industries, 2015)
Conveyer length	3,60 [meter/spot]	(Lödige Industries, 2015)
Conveyer Velocity	5 [spot/minute]	(Lödige Industries, 2015)
Truck Switch Time at Dock	5 [minute]	Measurement
Import Truck Load	4,5 [BUP] uniform	(Wouterse, 2015)
Export Truck Load	2,3 [BUP] uniform	Assumption
SPM placing & retrieving BUP from floor storage	3,4,8 [minute] Triangular	Assumption
SPM placing & retrieving BUP from conveyer	2 [minute]	Measurement
SPM Velocity	0.5 [spot/minute]	(Lödige Industries, 2015)
ETV Velocity	5 [spot/minute]	(Mc Grath Industries, 2015)
PCHS Lift	3 [spot/minute]	(Lödige Industries, 2015)
Export Scaling & Scanning	10 [minute]	Assumption
Export Scale & Scanner Capacity	2 [BUP]	Assumption
Import Customs Scan	10 [minute]	(Zonneveld, 2015)
Detailed Import Customs Check	0.5, 1, 1.5 [hour] Triangular	(Zonneveld, 2015)
Rebuild BUP	50,60,75 [minute]	(de Wit, 2014)

The following constants are influential assumptions which are tested in the sensitivity analysis.

Table 39: Model Constant Assumptions

Truck Notice Time	1, 2.5 [hour] uniform	Assumption
Export Drop-Off Time	3,8 [hour] uniform	Assumption
Import Customs Scan Required	10%	(Zonneveld, 2015)
Import Detailed Customs Check	10%	(Zonneveld, 2015)
Percentage Export Rejected	15%	(Kervezee, 2015) (Bruijs, 2015)
Percentage Rebuild	50%	Assumption
Percentage ‘sendback’	20%	Assumption
Percentage Priority ‘sendback’	30%	Assumption

I.4.2 Input Datasheet Entity Arrivals

The number of entities which are created in the Arena model is based on an excel datasheet. Two help entities enter the model. Only one copy of both these help entities exist and they stay in the model during the entire modelling period. These entities are named:

1. Import Help Entity
2. Export Help Entity

The help entities read from the excel dataset how many BUPs of four categories must be created. The help entities replicate itself in the required amount for every category at every hour during the simulation runtime.

This datasheet provides the help entity with information about the amount of BUPs which enter the FTF every hour during one month. The datasheet contains the number of BUPs which are transhipped during the month of February 2015 at AAS. February is a top month for BUP transhipment due to Valentine's Day and Russian Mother's day. It is chosen to focus on the maximum input for the FTF alternatives in order to prepared for extreme future scenario's and therefore use February data.

Appendix J explains the performed analysis and calculations which resulted in the input datasheet for the Arena Model. The datasheet is based on the airplane load information. It provides information about the load of each arriving or departing airplane. Therefore, the arrival data can be directly used for the Import BUPs arriving at the FTF. However, export cargo is delivered approximately 8 hours before flight departure. The export input data for the FTF is therefore shifted 8 hours earlier in order to recreate the correct drop-off time at the FTF for the export BUPs. For example: If a 10 AM flight leaves with 23 BUPs on board. The assumption is made that these BUPs are delivered around 2AM in the morning.

Additional Export Input Entities

In order to run the model with export, the model input as described in appendix I is expanded . Four BUP categories now enter the FTF model. These are:

1. Export BUPs
2. Export Perishable BUPs

Adding export trucks to the model results in the following truck entities in the model:

1. Export Trucks
2. Priority Send back Trucks

Additional Export Model Data

The model data for import and export is provided in this table.

Table 40: Flight Data February 2015

	Flights [#]	Cargo Load [ton]	[2]BUP [ton]	BUP [pallet]	BUP Perishable [pallet]	BUP Gen. Cargo [pallet]
Total	11.606	125.980	24.467	7.821	3.811	4.000
Arriving	6.007	58.580	18.965	6.146	3.081	3.065
Departing	5.598	67.399	5.502	1.675	730	935

[2] All BUP amounts are estimations.

Additional Export Model Assumptions

1. The PCHS storage is assumed to have bi-directional conveyers on all levels which place and retrieve the BUPs in the storage positions and the PCHS lift.
2. The customs facility and the workstations are both simplified to a single process.
3. It is assumed that if the BUP is rejected once and rebuild at the forwarder's facility, it is not rejected the second time it passes through the scale and scanner.
4. If the BUP is rebuild in-house, it is assumed that it is rebuild correct, and does not need to pass the scale and scanner a second time.
5. It is assumed that trucks which drop-off export cargo drive towards the import docks and are filled up with import BUPs. These trucks are used double but modelled as a single ride. The performance of the number of trucks in the model therefore subtracts the amount of export trucks from the number of import trucks.

I.5 Run Setup

In this section the run setup including the warm-up period, replication length and number of replications is argued. Furthermore, it is argued whether the model run according to the conceptualization and specification.

I.5.1 Warm-Up Period

No warm-up time required as the model is ending. As the FTF provides a fast-track system, one of the main requirements is fast transhipment. This means that the aim is to tranship pallets within a short as possible timeframe. It is therefore unwished to accommodate BUPs in the FTF overnight. In exceptional situations, the FTF should be able to accommodate overnight stays, but it is highly prevented. For this reason, it is assumed that a warm up period is not required as warm-up period are used to create a steady state in the model (Altiok & Melamed, 2010). The FTF model starts with an empty facility, assuming that there were no pallets staying overnight in the facility the previous night, as it is supposed to be.

I.5.2 Replications and Replication Length

The replication length of the simulation is chosen to be one month. The average cycle time of cargo transhipment is one week, as the landing schemes repeat itself approximately every week . As the ground rule for run length is to run at least 3 times the longest cycle time, a run length of one month is applicable (Verbraeck, 2008) Furthermore, because landing schemes are usually planned per week, it is of great importance to choose a replication length which is longer than a weekly period in order to be certain that there are no particularities over the weekly transition.

Multiple replications of a model run are performed in order to test whether the outcome of the model runs differ significantly. A significant difference is unwanted because in that case similarity between the simulation runs is not guaranteed. The number of replications should be such that the half-width of the model's key-performance indicator´s is below 5% of the key performance indicators average.

For the FTF model, including the three alternatives, an initial number of 10 replications is chosen and the key performance indicators taken into account are the lead times and storage times of the main entities, the import and export BUP´s. After 10 replications, the half-width of the total throughput time does not pass the 5% requirement. Various iterations have shown that 25 replications are necessary to comply with the half-width requirement. The basic run setup for the further analysis is therefore 25 replications with a run length of 672 hours.

I.6 Model Verification & Validation

Model verification is performed check whether the implemented model is according to specification. Model validation checks whether the model is fit to provide answers regarding the real world situation.

I.6.1 Verification

There are multiple ways to verify the correctness of the model according to the specification. The steps that have been taken are explained below.

The model constants correctness and de-bugging

- Once the modelling is finishes, the entire model is checked for bugs and errors. Once these were removed, the consistency and correctness of the model constants is checked.

Balance checks

- Flow-objects: The model is run various times in order to check whether the model is put was similar to the excel sheet which is read. After some changes in duplication modules and entity type changes, this was the case.
- Equipment: It is checked whether the equipment's total work time is similar to the number of entities which have used the equipment times the time the entities have been handled

Event Tracing

- Sendback trace: A export BUP which needed to be send back has been traced through the model to see if the sequence of events was correct. A counter has been included at the import disposer which counts the amount of export BUPs disposed. This checks whether the model works correct and is able to send back the BUPs along the import track.

Run-Time Visualization

- A visualization of the used storage capacity is used during all model runs to see when the peak capacity appeared and how the storage is used
- A variable which added several storage facilities is always present
- The conveyer belts are visualized during all simulation runs.

Verification test runs

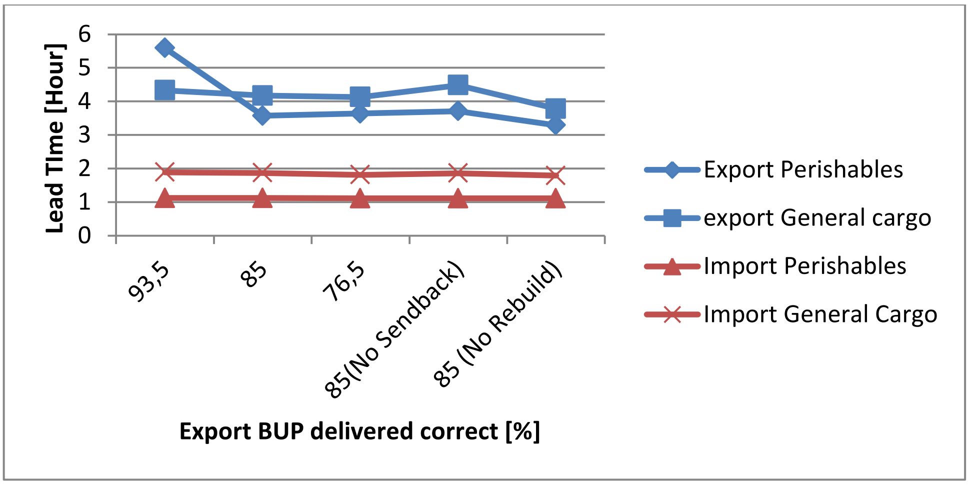
- Degeneracy test: This test was very simple top perform due to the integrated 'alternative variable'. This variable degenerated parts of the model. When this happened, no modules ran through these degenerated model sub-parts
- Fault-injection: Is performed and the model detects wrong entities, because several decisions are based on entity types.
- Continuity/Sensitivity test: The model is run with slightly different parameters for several model constants. The results are presented below.

Continuity Test: Rejected export cargo

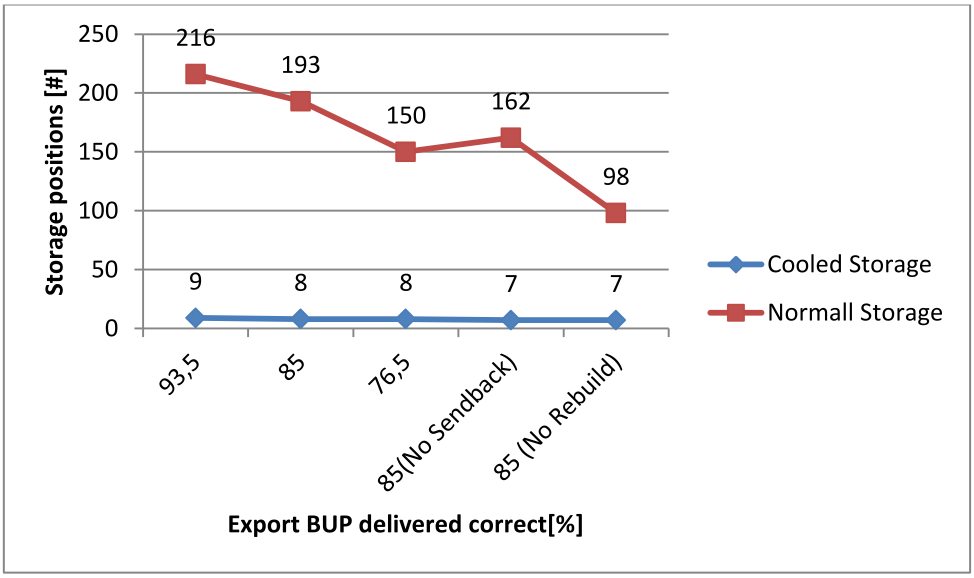
According to expert estimation (appendix N) approximately 15% of the export BUPs is rejected at the scale and scanner in the handler's facilities. An estimation is made for the next step of the rejected BUPs in the model. It is assumed that 20% is send back via the normal import dock route, 30% is send back via the priority send back lane and 50% is rebuild at the in-house workstations.

Because these values are an estimations, the model is tested for a 10% in and decrease of amount of rejected cargo. Furthermore a situation is tested where all pallets which are rejected are rebuild (so no send back is possible) and a situation where all pallets are send back via the priority send back lane. The amount of workstations is increased to 2 for the option where all rejected BUPs are rebuild.

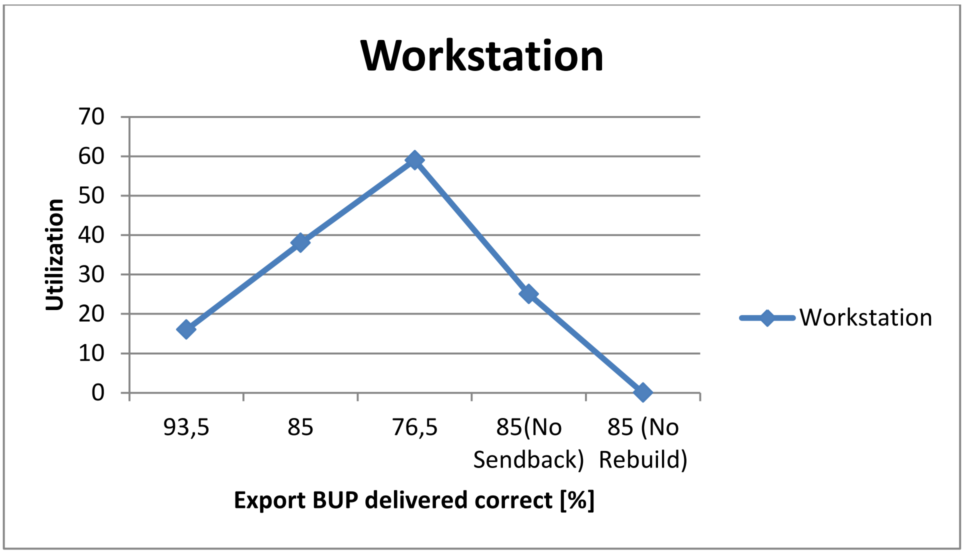
The influence of the scenarios on the lead time, the storage positions and the utilization of the workstations of alternative 4 is presented in graph 1 till 3 below. It is assumed that this also gives a good representation of a change for the rejected cargo in alternative 3.



Graph 1: Continuity Test effect on lead Time



Graph 2: Continuity Test effect on Storage



Graph 3: Continuity Test effect on Workstations

It is striking that the lead time increase when the number of rejected BUPs is reduced. This is probably due to the increase in the amount of storage positions for this situation. Furthermore, if it is decided to sendback all pallets, the amount of storage positions decreases towards 98.

I.6.2 Validation

The definition of model validation according to Schlesinger (1979) is ‘substantiation that a computerized model within its domain of applicability possesses a satisfactory range of accuracy consistent with the intended application of the model’. Various manners for validation of the model exist. One of the manners, comparing the input and output with historical data, is not possible due to the fact that this fast-track facility is design of a fictive situation of which no historical data exists. Expert validation is however possible and applicable.

Validation: BUP Input

The percentage of BUPs relative to the total amount of cargo which is transhipped at AAS is an expert estimation from several ground handlers. The same percentage is repeatedly mentioned by several experts and in previous research. The input data which enters the model seems logical according to what is seen and learned from the guided tours through handler facilities which already operate a fast-track.

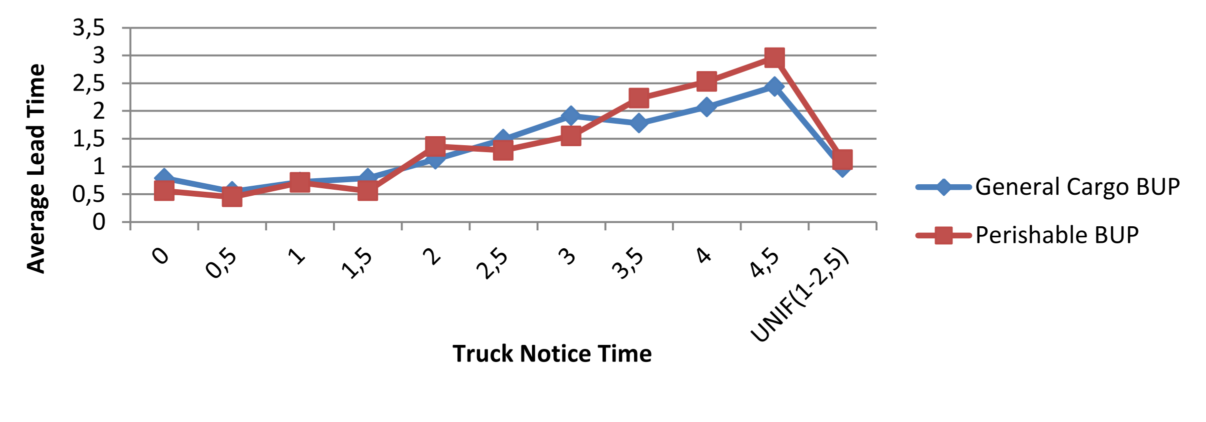
Validation: Truck Notice Time

The ‘Truck Notice Time’ indicates the number of hours that it takes the import collecting truck to report at the FTF after the pallets have entered the FTF facility at airside.

It is expected that the ‘Truck Notice Time’ has a great influence on the FTF lead time and it is therefore good to experiment with this value and decide on the best possible value for modelling. It is important to choose a realistic ‘Truck Notice Time’, which ensures that the lead time of the FTF facility meets the requirements for ‘smooth processes’. ‘Truck Notice Time’ is a complicated and special variable because it is a value that can be imposed on the trucking or forwarder companies by the FTF owner. At the same time, there needs to be a buffer in the value, for trucks will not always meet the imposed value.

An initial ‘Truck Notice Time’ of 2.5 hours is chosen. This initial value is based on the requirement for maximum import lead time. Though, it is fairly certain that a fixed value for the ‘Truck Notice Time’ is not quite realistic. Trucks will never report at the exact same time, and external factors such as traffic jams or detours must be taken into account. Furthermore, assuming that the trucks arrive via a Milkrun System, the trucks position when signalled will never be similar.

In order to find a realistic and preferable ‘Truck Notice Time’ range which can be imposed on forwarders and truckers, the influence of the truck notice time on the FTF lead time is tested and presented in graph 4. This graph presents the influence of the ‘Truck Notice Time’ on the ‘Average Lead Time’ of BUPs through the system of alternative 1 It is assumed that the influence of the export drop-off time is similar for alternative 1-4 and can therefore be tested on one alternative.



Graph 4: Validation Truck Notice Time

As previously explained, in order to gain a competitive advantage over current export handling systems, the upper boundary of the FTF lead time is 2.5 hours. This means that a ‘Truck Notice Time’ higher than 3.5 hours is not acceptable. The minimum boundary for the lead time is set at 1 hour, in order to ensure a time window of at least half an hour for FTF transhipment.

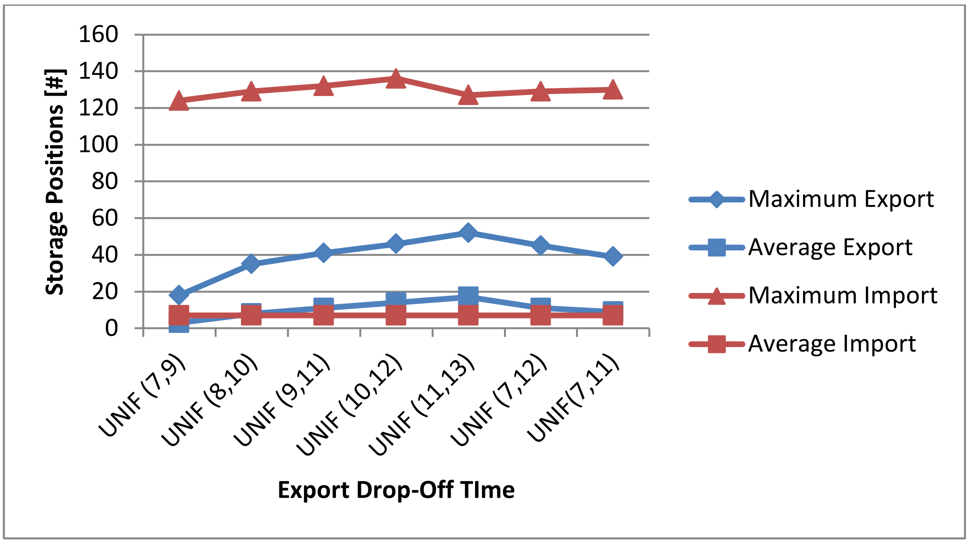
A distribution between 1 and 2.5 hours of ‘Truck Notice Time’ is therefore a solid approximation of the time needed to ensure a seamless truck and FTF connection. For this distribution the lead time results in an average of one hour and because this approaches the minimum lead time, if the ‘Truck Notice Time’ appears to be a little bit higher, there is still a buffer for this.

Validation: Export Drop-off Time

An important and influential variable for the export sub-system within the model is the export drop-off time. The ‘Export Drop-Off Time’ (EDT) represents the time between export cargo drop-off at the FTF landside and the actual time of flight departure. Experts have stated (Bruijs, 2015) (Hockemeijer, 2015) that forwarders tend to drop their cargo too early at the handlers facility. Similar to the TNT it is important to choose a correct value for this factor which represents real-life situation, but also meets model requirements.

It is assumed that cargo is dropped off at the facility between 9 and 7 hours before the actual time of departure and cargo is expected to be ready at the FTF airside approximately 3 to 4 hours before this time (Bruijs, 2015). This means that the initial estimation for the ‘Export Drop-Off Time’ is distributed uniform between 3 (7 minus 4) and 6 (9 minus 3) hours.

In order to find a value for the EDT which approaches real-life representation, the reaction of the model (in alternative 2) for an increase of the Export Drop-off Time is tested. It is assumed that the influence of the export drop-off time is similar for alternative 3 and 4. The influence of this EDT variable on the number of storage positions is presented in graph 5. Besides the export storage, the number of import storage positions is also influenced because of the combined ETV use and the amount of rejected export BUPs.



Graph 5: Validation Export Drop-Off Time

Further analysis will be conducted while taking into account an 'Export Drop-off Time' distributed uniformly between 7 and 11 hours. In real-life this means that the export cargo is held between 3 and 8 hours in storage. The adjusted values of the parameters and KPI's are presented below. These values are used in the sensitivity analysis.

I.7 Configuration Alternatives

The configuration variables of the alternatives are adjusted iteratively, such that the minimum amounts which comply with the requirements for alternative configuration are final.

I.7.1 Requirements for Alternative Configuration

Table 41: Requirements for Alternative Configuration

Requirements	Explanation
1. The amount of pallets leaving the FTF is at least 99 % of the amount which entered the FTF.	This requirement conflicts with the regenerative system. The amount of pal The requirement is set to 99% because after a run of a month, there is a small amount of pallets which is divided over one or more truck docks., resulting in a truck not leaving because the maximum waiting time has not come . This is however not influential for the model output,.
2. No bottlenecks in the form of queues or blockages can exist in the conveyer system. Conveyer queues are below 0.01 and conveyer utilization is below 50%.	The conveyers are modelled in several parts, therefore queues could arise in front of a conveyer part which is in real-life a connected system. Conveyer queues are therefore not allowed. Furthermore the utilization of the conveyers should be below 75%, meaning that they are never full and there are never blockages on the conveyers system.
3. The maximum average lead time per import BUP must not exceed 2.5 hours	This value is based on the current minimal express import lead time of 3 hours which is common for current handler facilities. Menzies (2015) for example promises to make cargo available for pick-up 3 and 5 hours after actual time of arrival for respectively passenger and full freighter aircrafts. Taking into account half an hour for airside operations (including a buffer for a possible customs check) results in an initial 'Truck Notice Time' (from the moment cargo enters the FTF) of 2.5 hours (3-0.5) in order to deliver at least the current maximum handling speed.
4. The maximum average lead time per export BUP must not exceed maximum 'Export Drop-Off Time' (Validation: Export Drop-off Time).	The lead time of an export BUP cannot exceed the EDT. If this is the case, the BUP is not on the airside platform at the critical time before departure.
5. The maximum average utilization of the mobile and embeddable equipment (besides the conveyer system) within the FTF should be between a minimum average of 30% and a maximum average of 50%.	In order to ensure efficient use of equipment, the resources must have a minimum utilization of 30%. The maximum utilization ia chosen to be 50%. This is based on various test rums where a higher utilization was allowed. Waiting times for equipment were very high in that case. With a maximum utilization of 50% there is also a buffer taken into account for employees to take a break and for equipment break down and maintenance.

I.7.2 Configuration Alternative 1: Manual

The current model is initially ran with the estimated BUP input for 2015. The values for the architectural parameters have been iteratively determined in order to meet the previously specified 5 criteria. However, in order to test whether the model can cope with the estimated BUP input for 2030, the input is adjusted with a so-called 'throughput-factor' of 2. The output for the configuration parameters and KPI's shows that initial model configuration cannot handle the increased BUP amount.

Table 42: Configuration Alternative 1

Configuration Variable	Scheduled	Average Utilization	Smooth Criteria & Utilization Check
Import Rollerbeds	1	55% (max)	No Pass
Import Truck Docks	4	38%	Pass
Import Airside Docks	4	32%	Pass
Slave pallet movers	2	96%	No Pass
Storage Positions	121	87%	No Pass
KPI's	**Score**		
Throughput	12292	BUPs	Pass
Lead time Perishable	9.37	Hours	No Pass
Lead Time General Cargo	10.44	Hours	No Pass

The architectural parameters have been adjusted such that the requirements for 'Smooth Processes and Efficient Resource Usage' are met while handling the estimated 2030 BUP input and taking into account possible blockage.

Table 43: Configuration 2, Alternative 1

Configuration Variable	Scheduled	Average Utilization	Smooth Criteria & Utilization Check
Import Rollerbeds	1	36% (max)	Pass
Import Truck Docks	5	29%	Pass
Import Airside Docks	5	30%	Pass
Slave pallet movers	6	37%	Pass
Storage Positions	1114	9%	Pass
KPI's	**Score**		
Throughput	12292	BUPs	Pass
Lead time Perishable	1.37	Hours	Pass
Lead Time General Cargo	1.19	Hours	Pass

Truck Blockage Test Alternative 1: Manual

In order to test the flexibility of the number of storage positions a road blockage right before the entrance of the FTF is simulated. Flexibility is the scheduled or planned adaption to unforeseen yet expected external circumstances (Goranson, 1992). . Because of the blockage trucks are not able to reach the FTF within the pre-defined TNT period between 1 and 2.5 hours.

For this experiment it is assumed that at 6AM on 25th of February an accident happens on the road just before the FTF. This date and time is chosen, because the maximum storage peak (of the entire month) without a blockage appears 6 hour after this moment and the accumulation of pallets is only noticeable a few hours after the bottleneck appears.

The first truck which arrives at the accident is delayed 6,5 hours instead of UNIF(1,2.5). The delays of the following trucks decrease with 15 minutes per truck. A total of 18 trucks is influenced with the blockage. The delay scheme used to simulate this blockage is presented in table 36.

Table 44: Simulated Truck Delays

Arrival trucks at accident	Delay Trucks
05:55	UNIF(1-2.5)
06:01	6.5
06:07	6.25
06:13	6
06:26	5.75
06:38	5.5
06:36	5.25
06:44	5
06:55	4.75
07:07	4.5
07:13	4.25
07:23	4
07:25	3.75
07:27	3.5
07:33	3.25
07:41	3
07:43	2.75
07:49	2.5
07:54 and later….	UNIF(1-2.5)

If a blockage appears, the maximum amount of storage positions required is 135. The maximum storage time increase to 1.07 hours. The blockage is solved within the same day. Furthermore, the average lead time increases towards 1.29 and 1.46 for respectively General Cargo and Perishables. The earlier output of 114 storage positions needs to be increased to 135 in order to be ensure agility of the system and cope with a truck blockage. These input values are used in further analysis.

Table 45: Configuration 3 Alternative 1

Configuration Variable	Scheduled	Average Utilization	Smooth Criteria & Utilization Check
Import Rollerbeds	1	36% (max)	Pass
Import Truck Docks	5	29%	Pass
Import Airside Docks	5	30%	Pass
Slave pallet movers	6	37%	Pass
Storage Positions	135	9%	Pass
KPI's	**Score**		
Throughput	12292	BUPs	Pass
Lead time Perishable	1.37	Hours	Pass
Lead Time General Cargo	1.19	Hours	Pass

I.7.3 Configuration Alternative 2: Automated

After various iterations and adjustments the values of the architectural parameters are adjusted such, that all the requirements for smooth processes and efficient equipment utilization are met. The most important change in the system as opposed to alternative two is the exclusion of the export cargo. Furthermore, a second import rollerbed is used and a distinction between cooled and normal storage positions is made.

Truck Blockage Test Alternative 2: Automated

When the same blockage is modelled as alternative 2 has experienced, the normal storage positions increase to 102 and the cooled positions stay at 4. This results in a total amount of 106 storage positions.

Table 46: Configuration Alternative 2

Configuration Variable	Scheduled	Average Utilization
Import Rollerbeds	2	32%
Import Truck Docks	5	32%
Import Airside Docks	5	30%
ETV	3	23%
Storage Positions	102	6%
Cooled Storage Positions	4	3%
KPI's	**Score**	
Import Throughput	12.292	Pallets
Import Gen. Cargo Lead Time	1.15	Hours
Import Perishables Lead Time	1.04	Hours

I.7.4 Configuration Alternative 3 Export: Basic

For the validation of alternative 2, the architectural parameters as described in the conclusion of 'base output' of alternative 1 are used as a starting point for alternative 2. However, as this alternative only includes import, the architectural parameters for the export system are estimated. This estimation is based on the export versus import ratio. The amount of export pallets transhipped through the facility is approximately 1/3 of the import cargo. The architectural parameters of the import system are therefore initially divided by 3.

However, after various iterations and adjustments the values of the architectural parameters are adjusted such, that all the requirements for 'Smooth processes and efficient equipment utilization' are met. The most important change in the system is replacing the intentionally dedicated import and export ETV's with non-dedicated ETV's which make no difference between import and export cargo.

Truck Blockage Test Alternative 3 Export: Basic

What is there is a similar road blockage and trucks cannot make it to the FTF between 1 and 2.5 hours. The delay scheme is similar to the previous blockage analysis for alternative 1 (table 44) . The test influences both the import and export side of the system. Export wise, it is expected that the storage utilization is reduced during the blockage and increases right after. Import wise, it is expected that the number of utilized storage positions increases during blockage and is released when the blockage is gone.

The maximum amount of import and export storage positions required during a blockage occurrence is respectively 149 and 78. In order to cope with a similar blockage it is wise to increase the number of required storage positions to these amounts. The values of the parameters and KPI's after the adjustments are presented below. These values are used for further validation and sensitivity analysis.

Table 47: Configuration Alternative 3

Configuration Variable	Scheduled	Average Utilization
Import Rollerbeds	1	All below 45%
Export Rollerbeds	1	All below 16%
Import Truck Docks	5	28%
Export Truck Docks	1	29%
Import Airside Docks	5	30%
Export Airside Docks	1	34%
ETV	5	33%
Import Storage Positions	149	5%
Export Storage Positions	78	17%
KPI's	**Score**	
Import Throughput	12292	Pallets
Export Throughput	3304	Pallets
Import Lead Time	1.38	Hours
Export Lead Time	4.90	Hours

I.7.5 Configuration Alternative 4 Export: Extended

For the alternative configuration of alternative 4, the architectural parameters as described in the conclusion of validation of alternative 3 are used as a starting point. However, after various iterations and adjustments the values of the architectural parameters are adjusted such, that all the requirements for smooth processes and efficient equipment utilization are met. The most important change in the system is the introduction of a second import rollerbed.

Truck Blockage Test Alternative 4 Export: Extended

When the same blockage is modelled as alternative 1,2 and 3 have experienced, the normal storage positions increase to 118 for export and 89 for import. This results in a total amount of 207 normal storage positions. The total amount of cooled storage positions required to cope with a blockage is 11.

The values of the parameters and KPI's after configuration are presented below. These values are used in the sensitivity analysis.

Table 48: Configuration Alternative 4

Configuration Variable	Scheduled	Average Utilization
Import Rollerbeds	2	All below 32%
Export Rollerbeds	1	All below 6%
Import Truck Docks	5	31%
Export Truck Docks	1	28%
Import Airside Docks	5	31%
Export Airside Docks	1	40%
PCHS Lift	1	4%
PCHS cooled lift	1	5%
Storage Positions	207	4%
Cooled Storage Positions	17	38%
Workstations	1	38%
Customs Employee	1	18%
KPI's	**Score**	
Import Throughput	12266	Pallets
Export Throughput	3306	Pallets
Import Gen. Cargo Lead Time	1.87	Hours
Import Perishables Lead Time	1.12	Hours
Export Gen. Cargo Lead Time	4.17	Hours
Export Perishables Lead Time	3.57	Hours

I.8 Experimental Plan

I.8.1 Experiment: Minimum Lead Time

Minimum Lead Time Alternative 1: Manual

In order to test what the minimum lead time for the FTF in alternative 1 is, the 'Truck Notice Time' is set to 0. The values for the minimum lead time for alternative 1 with a minimized TNT is presented in table 49.

Table 49: Minimum Lead Time Alternative 1

	Minimized settings	Normal settings
Lead time [hour] (Perishables)	0.69	1.19
(General Cargo)	1.06	1.37
Total Max. Storage Positions [#]	63	106

Minimum Lead Time Alternative 2: Automated

In order to test the minimum lead time for the FTF in alternative 2, the 'Truck Notice Time' is set to 0.

Table 50: Minimum Lead Time Alternative 2

	Minimized settings	Normal settings
Lead time [hour] (Perishables)	0.61	1.04
(General Cargo)	0.87	1.15
Maximum Storage Positions [#]	51	106

The number of required cooled storage positions decreases to 51 for a minimum lead time of which 3 cooled positions. The minimum lead time of normal cargo is just below one hour and for perishables 0.61.

Minimum Lead Time Alternative 3 Export: Basic

One of the future goals for the AAS cargo supply chain is to enhance further seamless truck transhipment. Various initiatives such as a Milkrun are initiated in order approach the cross-dock effect at Schiphol. Therefore, it is interesting to implement this future 'flawless truck pick-up' scenario on the FTF model.

In order to test the minimum lead time for the FTF in alternative 3, for import, the 'Truck Notice Time' is set to 0. For the minimum export lead time more settings are adjusted. The 'Export Drop-Off Time' is set to 0 and all export cargo is accepted instead of the 15% which was previously rejected. The values for the minimum lead time are presented in table 51. A distinction between perishables and general cargo is presented for the minimized lead time, as this is a notable difference.

Table 51: Minimum Lead Time Alternative 3

	Minimized settings	Normal settings
Lead time Export [hour]	0.67	5.78
Lead time Import [hour] (Perishables)	0.73	1.31
(General Cargo)	1.13	
Maximum Storage export [#]	2	75
Maximum Storage import [#]	57	143

Minimum Lead Time Alternative 4 Export: Extended

In order to test the minimum lead time for the FTF in alternative 4, for import, the 'Truck Notice Time' is set to 0. For the minimum export lead time more settings are adjusted. The 'Export Drop-Off Time' is set to 0 and all export cargo is accepted instead of the 15% which was previously rejected. The values for the minimum lead time are presented in table 52. A distinction between perishables and general cargo is presented for the minimized lead time, as this is a notable difference.

Table 52: Minimum Lead Time Alternative 4

		Minimizing setting	Normal settings
Lead time Export (Perishables)	[hour]	0.57	3.57
(General Cargo)	[hour]	0.60	4.17
Lead time Import (Perishables)	[hour]	0.73	1.12
(General Cargo)	[hour]	1.01	1.87
Maximum Storage Positions	[#]	36	193
Maximum Cooled Storage Positions	[#]	12	8

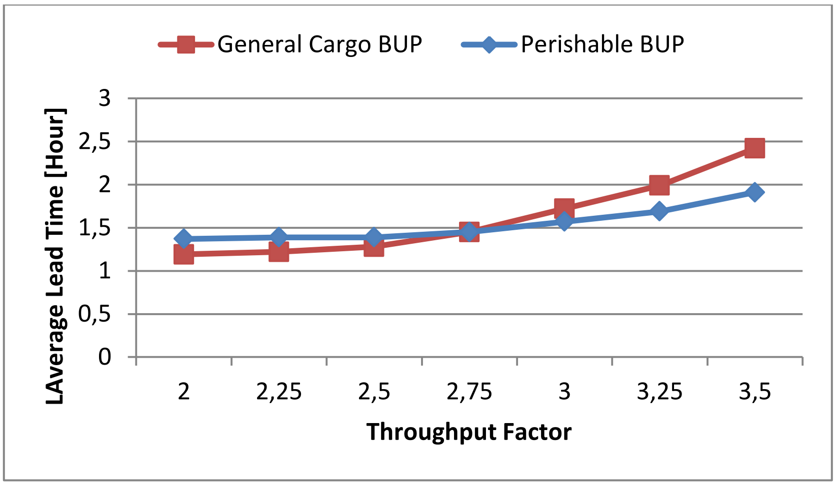
The number of required cooled storage positions increases to 12 for a minimum lead time. The minimum lead time of all cargo sorts are below 1 hour.

I.8.2 Experiment: Maximum Throughput

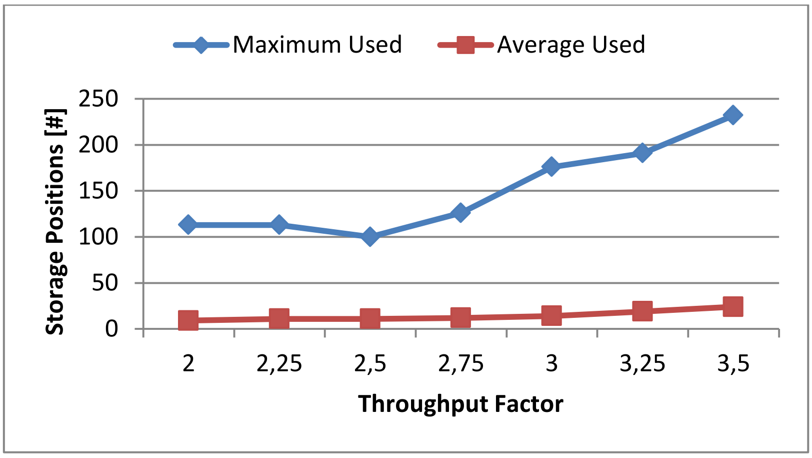
Maximum Throughput Alternative 1: Manual

In order to test the robustness of the FTF in the first alternative configuration, the maximum throughput which the FTF is able to handle, while meeting the 5 previously stated requirements, is tested.

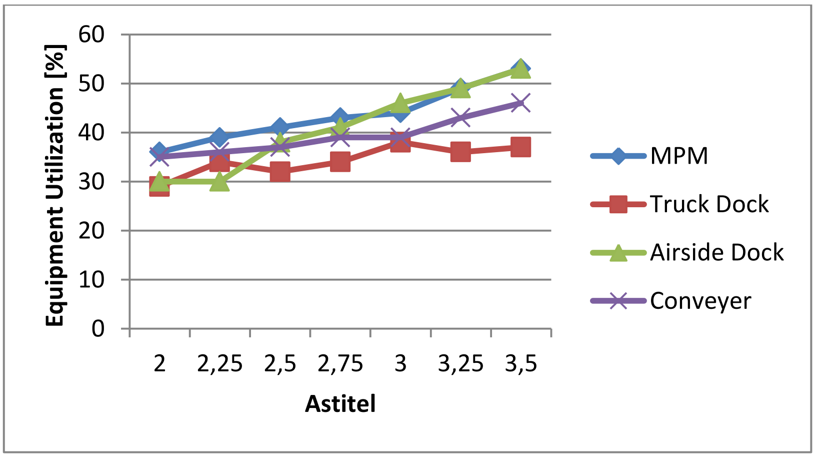
The throughput factor (TPF) indicates the number of times that the 2015 input datasheet is multiplied in order to recreate higher throughput schedules. The throughput factor(TPF) is increased in steps and the influence of this increase on the lead time, storage positions and equipment is presented in graph 6 till 8.



Graph 6: Alternative 1, Effect Throughput Increase on Lead Time



Graph 7: Alternative 1, Effect Throughput Increase on Storage



Graph 8: Alternative 1, Effect Throughput Increase on Equipment Utilization

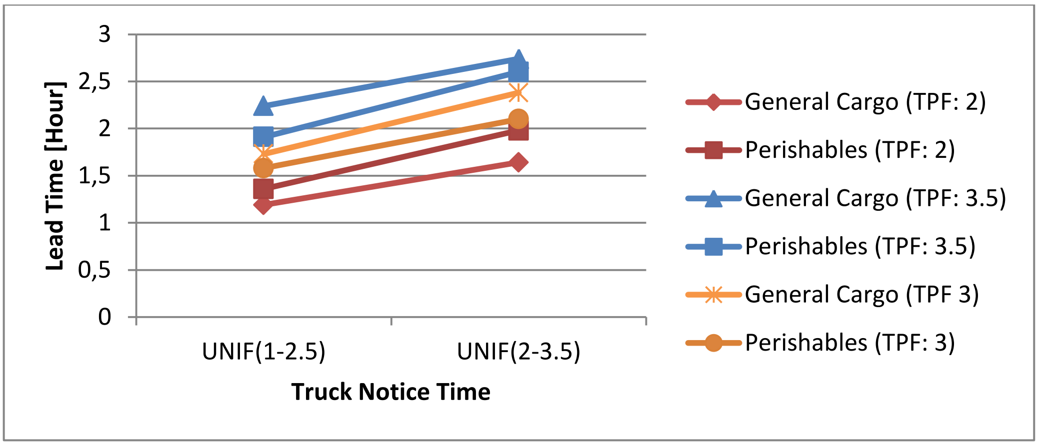
The maximum throughput factor meeting requirements is 3.5. The equipment utilization of the airside dock and the SPM rise above 50% for a higher TPF and the lead time is still below 2.5 hours.

Higher Truck Notice Time and Higher Throughput Alternative 1

The influence of the a higher TNT on the increased throughput is tested in order to see what the TNT ranges for a system with a higher throughput is. A Higher TNT for the maximum throughput factor of 3.5 is not in compliance with the lead time requirements. It exceeds the maximum lead time. To be able to guarantee the maximum lead time of 2.5 hours, in the future there are two options:

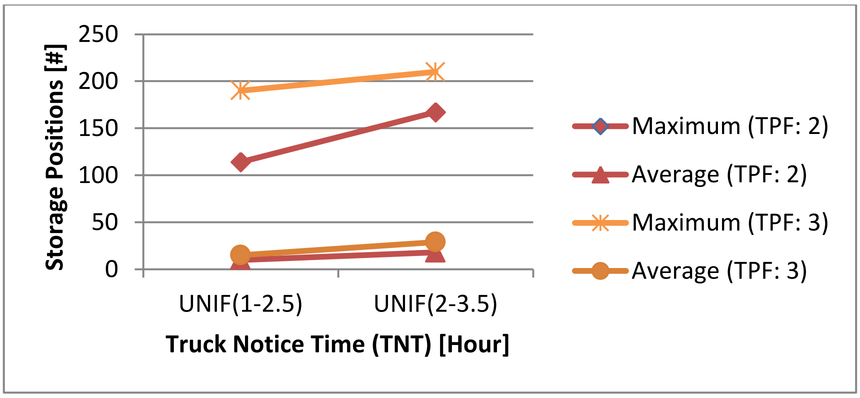
1. Either longer ‘Truck Notice Time’s are not excepted, a maximum TNT of 1-2.5 is imposed on the trucking companies/forwarders and the FTF will be able to handle TPF 3.5.
2. Longer ‘Truck Notice Time’s are accepted, but the maximum throughput factor is 3.

Taking into that a buffer is required for the TNT in the near future, option 2 is more likely.



Graph 9: Effect TNT and Throughput Combinations on Lead Time Alternative 1

For a throughput factor 3, the maximum number of storage positions with a longer TNT, is 210 (graph 11) . The model with a TPF of 2, when taken into account a longer TNT, requires a maximum of 110 storage positions. This means that an increase of 100 storage positions will allow the system to cope with a tripled throughput while taking into account possible longer ‘Truck Notice Time’s.



Graph 10: Effect TNT and Throughput Combinations on storage Positions Alternative 1

However, the odds of a higher TNT are currently higher than in the future. The goal of Schiphol and its partners is to increase seamless truck transhipment and initiatives like a Milkrun enhance these goals. Therefore it is logical to compare the maximum storage positions for a doubled throughput and a high TNT with the maximum storage positions for a tripled throughput and a low preferred TNT (table 53).

Table 53: Storage Positions TNT and throughput Combinations Alternative 1

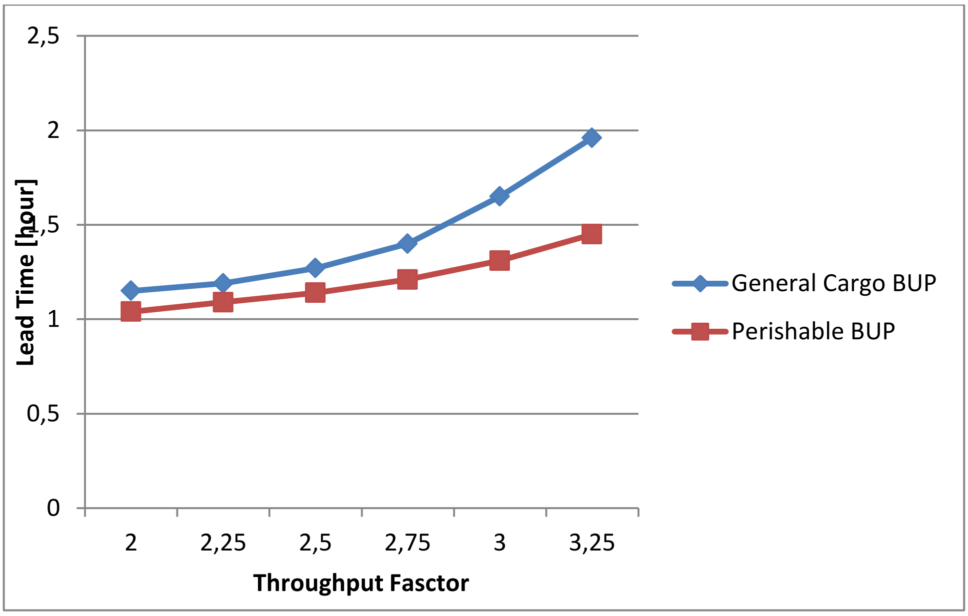
'Truck Notice Time'	1-2.5	2-3.5
Throughput Factor	3	2
Maximum Storage Positions	190	167

This situation requires a trade-off between the flexibility and the costs of the system. Because initial starting point of this alternative is 'low investment costs' and ground floor storage costs are not costly, the number of storage positions taking into account for the architectural design will be 167, which enhance the minimum cost starting point.

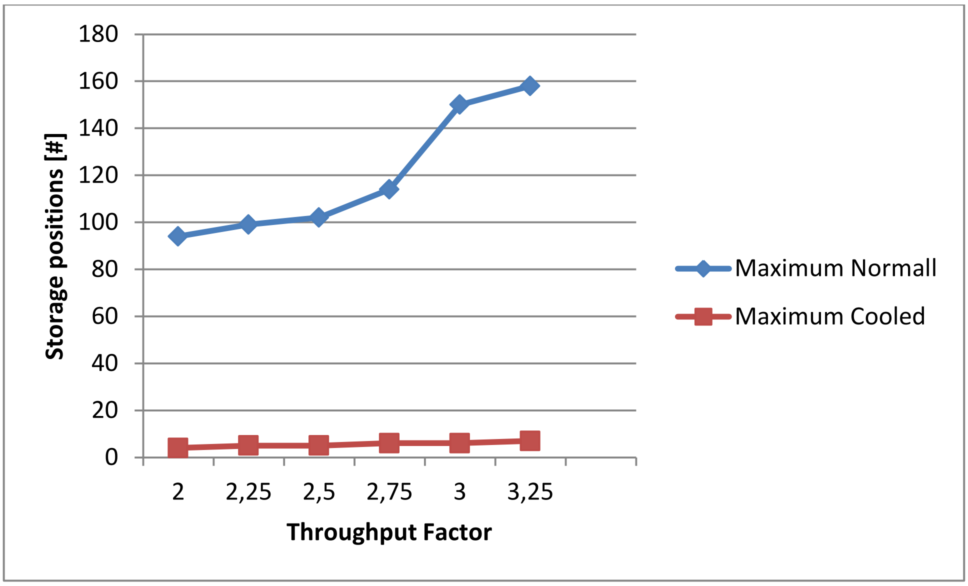
Maximum Throughput Alternative 2: Automated

In order to test the robustness of the FTF in the second alternative configuration, the maximum throughput which the FTF is able to handle, while meeting the 5 previously stated requirements, is tested. The throughput factor(TPF) is increased in steps and the influence of this increase on the lead time, storage positions and equipment is presented in graph 11 till 13.

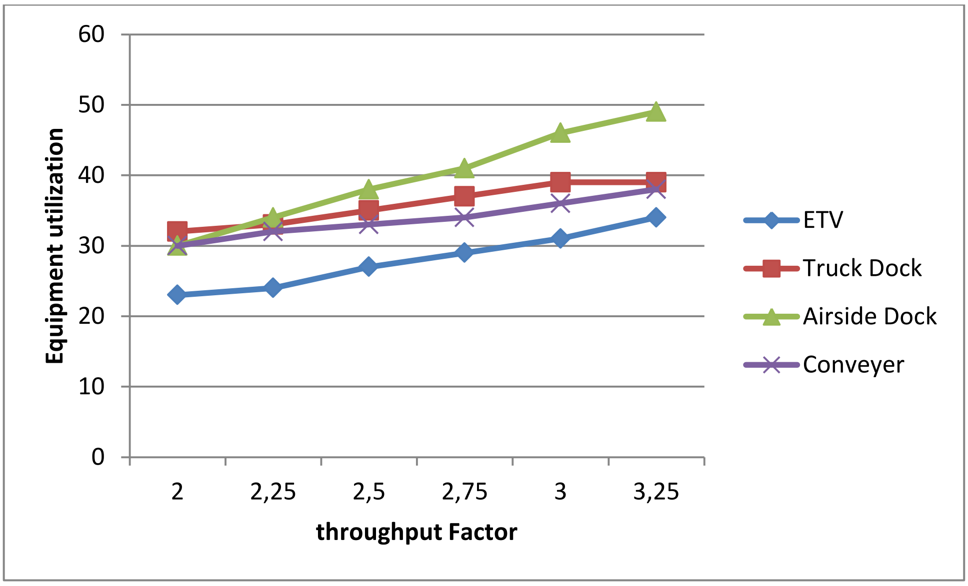
The maximum throughput factor for this configuration is 2.75. The amount of storage positions required takes a lead at throughput factor three and the equipment utilization is almost 50%.



Graph 11: Alternative 2, Effect Throughput Increase on Lead Time



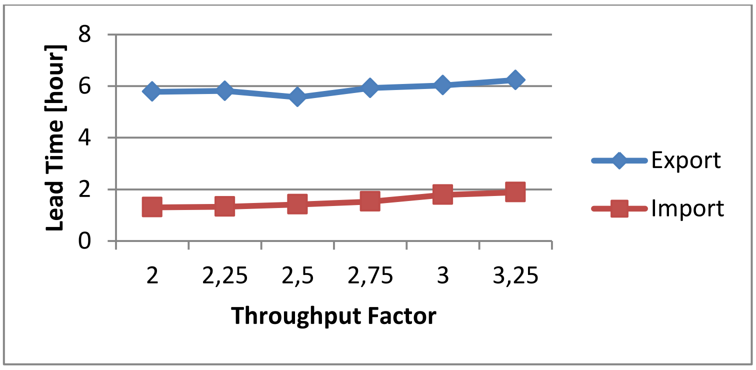
Graph 12: Alternative 2, Effect Throughput Increase on Storage



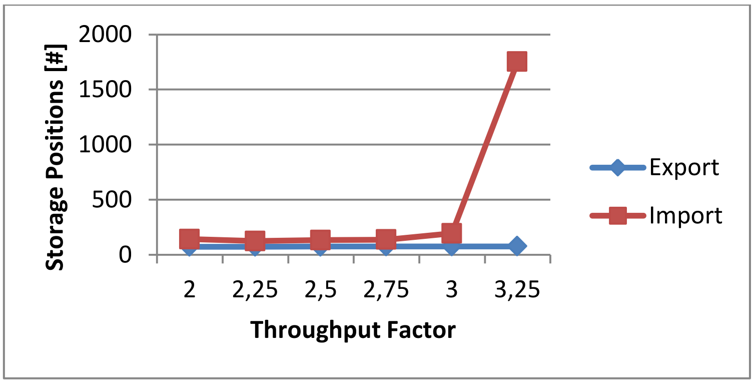
Graph 13: Alternative 2, Effect Throughput Increase on Equipment Utilization

Maximum Throughput Alternative 3 Export: Basic

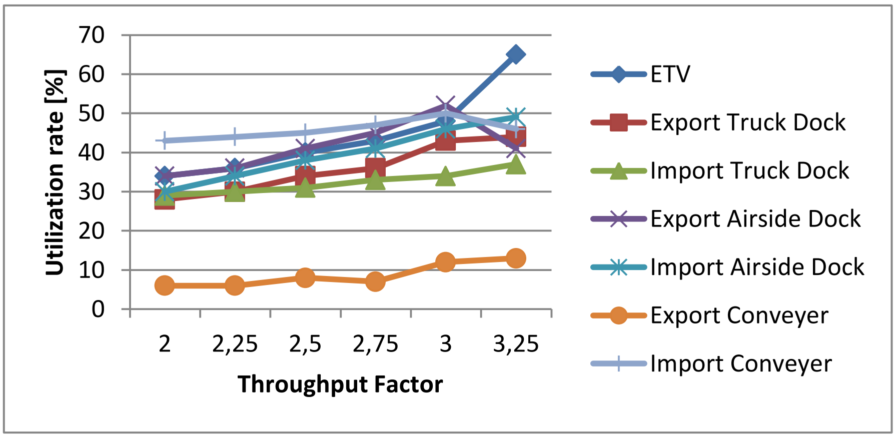
In order to test the robustness of the FTF in the third alternative configuration, the maximum throughput which the FTF is able to handle, while meeting the 5 previously stated requirements, is tested. The throughput factor(TPF) is increased in steps and the influence of this increase on the lead time, storage positions and equipment is presented in graph 14 till 16.



Graph 14: Alternative 3, Effect Throughput Increase on Lead Time



Graph 15: Alternative 3, Effect Throughput Increase on Storage

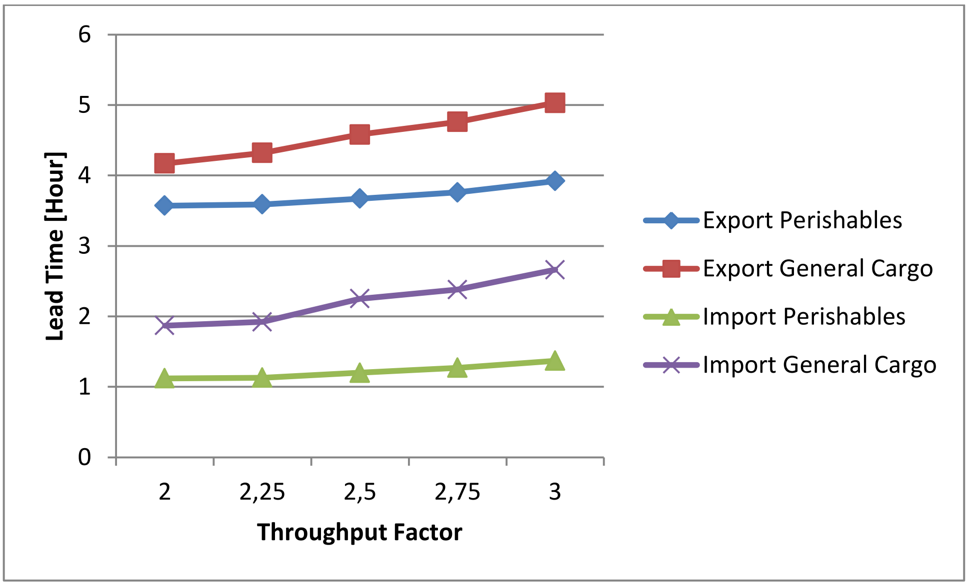


Graph 16: Alternative 3, Effect Throughput Increase on Equipment Utilization

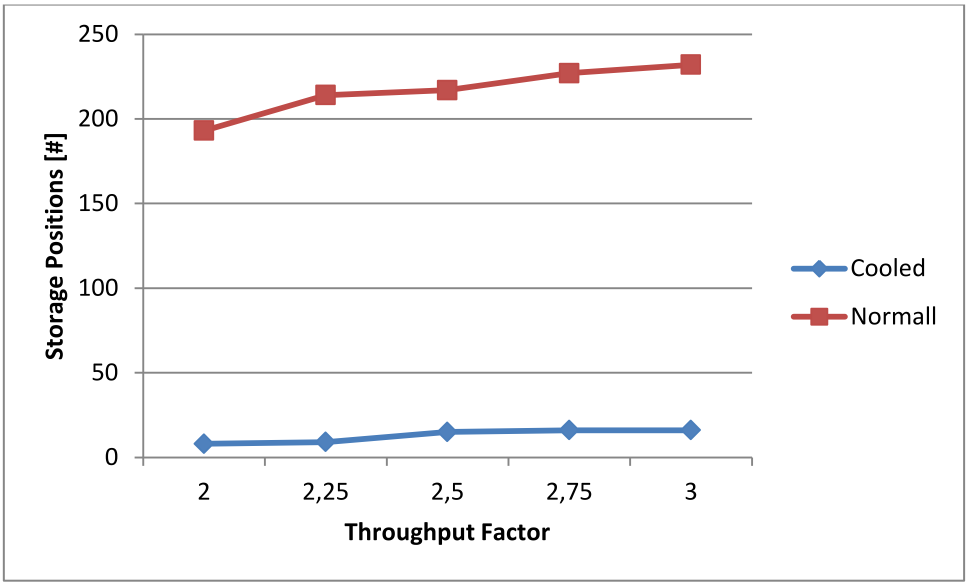
The maximum throughput factor for this alternative is 3, which means that the FTF configurations for alternative two can maximally handle 3 times the initial 2015 input. A TPF higher than three is not preferable, because of the exceeded utilization for the ETV and the extreme increase in the number of storage positions. A maximum throughput factor of 3 requires 77 export storage positions and 195 import storage positions.

Maximum Throughput Alternative 4 Export: Automated

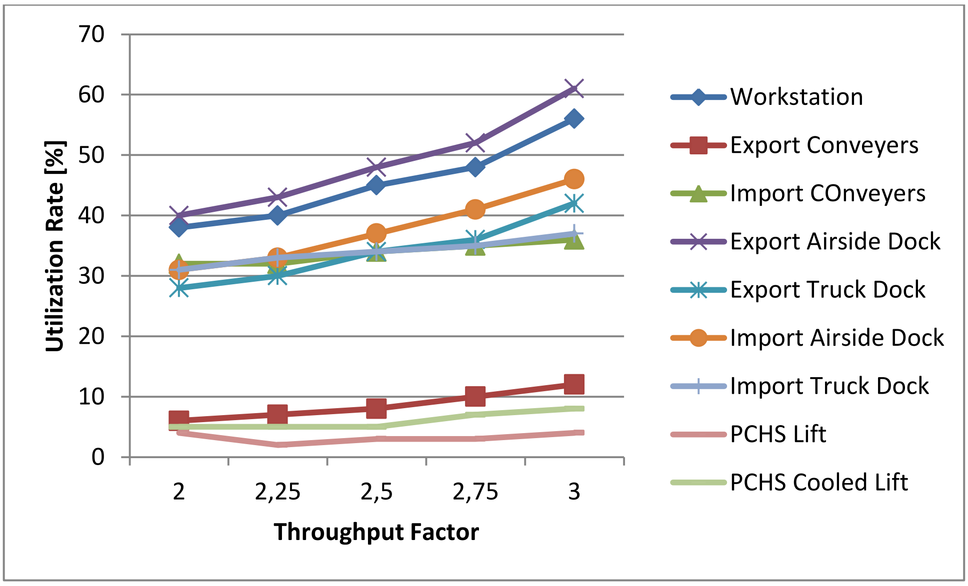
In order to test the robustness of the FTF in the fourth alternative configuration, the maximum throughput which the FTF is able to handle, while meeting the 5 previously stated requirements, is tested. The throughput factor(TPF) is increased in steps and the influence of this increase on the lead time, storage positions and equipment is presented in graph 17 till 19.



Graph 17: Alternative 4, Effect Throughput Increase on Lead Time



Graph 18: Alternative 4, Effect Throughput Increase on Storage



Graph 19: Alternative 4, Effect Throughput Increase on Equipment Utilization

The maximum throughput factor for this configuration is 2.75. Above this throughput factor, the utilization of the workstations and the export airside dock is above 50%. But more importantly, the lead time for import rises above 2.5 which is the maximum allowed lead time.

227 normal storage positions and 16 cooled storage positions are required for a TPF of 2.75. This alternative focuses on a high performance and throughput will therefore increase the configurational storage parameter to this amount.

I.9 Detailed Output Alternatives

I.9.1 Detailed Output Alternative 1: Manual

Table 54: Detailed Output Simulation Alternative 1: Manual

Configuration Variables	Base Throughput	Maximum Throughput
Rollerbeds [#]		
- Scheduled	1	1
- Average Utilization	36%	39%
Storage Positions [#]		
- Maximum	167	167
- Average Utilization	5%	9%
Import Truck Docks[#]		
- Maximum	5	5
- Average Utilization	29%	46%
Import Airside Docks [#]		
- Maximum	5	5
- Average Utilization	30%	36%
Slave pallet movers [#]		
- Maximum	6	6
- Average Utilization	37%	46%
Key Performance Indicators	Base Throughput	Maximum Throughput
Throughput Import BUPs [pallet/month]		
- Input	12292	18438
- Output	12287	18433
- [ton/year]	455160	682740
Lead time Import BUPs [hour]		
- Average	1.19	1.73
- Maximum	2.07	2.61
- Minimum	1.06	1.67
Lead time Perishable Import BUPs [hour]		
- Average	1.37	1.58
- Maximum	2.11	2.32
- Minimum	0.69	1.35
Value Added Time [hour]		
- Average	0.24	0.24
- Maximum	0.46	0.46
Storage Time [hour]		
- Average	1.07	1.36
- Maximum	1.58	2.28
Truck Movements [#]		
- Import trucks	3072	4592
- Average Truck Load	4	4.1

I.9.4 Detailed Output Alternative 2: Automated

Table 55: Detailed Output Simulation Alternative 2: Automated

Configuration Variables	Base Throughput	Maximum Throughput
Rollerbeds [#]		
- Scheduled	2	2
- Average Utilization	30%	39%
Storage Positions [#]		
- Maximum	102	102
- Average Utilization	5%	9%
Import Truck Docks[#]		
- Maximum	5	5
- Average Utilization	4%	17%
Import Airside Docks [#]		
- Maximum	5	5
- Average Utilization	30%	36%
Cooled Storage [#]		
- Maximum	4	4
- Average Utilization	4%	13%
Elevating Transfer Vehicles		
- Maximum	3	3
- Average Utilization	16%	21%
Key Performance Indicators	Base Throughput	Maximum Throughput
Throughput Import BUPs [pallet/month]		
- Input	12292	16901
- Output	12287	16895
- [ton/year]	455160	625845
Lead time Import BUPs [pallet/month]		
- Average	1.15	1.96
- Maximum	2.22	2.57
- Minimum	0.87	1.21
Lead time Perishable Import BUPs [hour]		
- Average	1.04	1.45
- Maximum	2.33	2.67
- Minimum	0.61	0.88
Value Added Time [hour]		
- Average	0.24	0.24
- Maximum	0.46	0.46
Storage Time [hour]		
- Average	0.91	1.54
- Maximum	5.26	**20.2**
Storage Time Perishables [hour]		
- Average	0.05	**0.056**
- Maximum	1.38	**3.06**
Truck Movements [#]		
- Import trucks	3073	4225
- Average Truck Load	4	4

VIII DATA

Appendix J: Data Analysis Aircraft Cargo Loads February 2015

In order to transform the cargo load tonnages to BUP numbers which can be used as an input for the simulation mode and extensive dataset analysis has been performed. The goal of the data analysis is to create a dataset which is similar to table 56 and can be used as simulation input.

Table 56: Simulation Input Data Format

		Amount entering the model in the associated hour			
Date	**Hour of the Day**	**Import BUPs**	**Perishable Import BUPs**	**Export BUPs**	**Perishable Export BUPs**
1-2-2014	3	20	4	13	2
1-2-2014	4	18	6	3	0
1-2-2014	5	28	15	8	6
…..	….				

Two main datasets which are required from the traffic analysis department of Schiphol, form the starting point of the data analysis

1. The February 2015 Commodity Shares dataset (Seabury, 2015)
2. The February 2015 Cargo Transhipment dataset (Schiphol Group: TAF, 2015)

The first dataset is used as an input for the second dataset. The cargo transhipment dataset eventually provides the required information for the Arena Model input (table 56).

J.1 The 2015 Commodity Shares Dataset

The initial commodity shares dataset has provided the following information regarding the commodity shares of exported and imported cargo from and to AAS in February 2015 (table 57). Eleven different commodity categories are defined by the AAS traffic analysis department (table 58).

Table 57: Initial 'Commodity Shares' Dataset Information

Country	Commodity category	Commodity exported from AAS to country [tons]	Commodity imported at AAS from country [tons]	Total cargo traffic between country and AAS [tons]
China	High Tech.	170,46	5365,49	5535,95

Table 58: Commodity Categories in dataset

Capital Equipment & Machinery	Live Animals
Chemicals & Products	Machinery parts, Components, Supplies & Manufactures
Consumer Fashion Goods	Raw Materials Industrial consumables & Foods
Consumer personal & household goods	Secure or Special Handling
High Technology	Temperature or Climate Control
Land Vehicles & Parts	

In order to generate the shares of each commodity for each country various steps are performed:

- The imported and exported tons of cargo are summed up for each country separately.
- The grand total per country is calculated.
- The dataset is sorted from highest to lowest grand total in order to gain insight in the country cargo shares. China and America represent the largest part of the cargo transhipments with AAS.
- The tons of cargo imported (or exported) per commodity is divided by the country's total imported (or exported) amount in order to calculate the commodities share of the total imported (or exported) cargo from that country.

Example

1. It is known that 52,8 tons of 'temperature or climate control cargo' is imported from New Zealand in February 2015 at AAS.
2. The total amount of cargo imported from New Zealand in the same month is 92,2 tons.
3. Calculating the share shows that 57% of the imported cargo from New Zealand in February 2015 is from the commodity category 'temperature or climate control'.

Performing all calculations similar to the example results in an adjusted dataset with the following available information:

Table 59: Modified 'commodity Shares' Dataset

Country	Total exported from AAS to country	Total imported at AAS from country	Commodity category	Commodity exported from AAS to country	Commodity imported at AAS from country	Export Comm. Share	Import Comm. Share
China	2871,42	10468,34	Raw Mat. Ind. Cons & Foods	2360,3	661,4	59%	6%

J.2 The February 2015 Cargo Transhipment Dataset

The initial cargo transhipment dataset has provided the following information regarding the month's flight cargo load.

Table 60: Initial 'Cargo Transhipment Dataset'

Arrival/Departure	IATA code Airport	Airline	Date & Time	Hour [3]	AAS Handler	Freight aboard [tons]
D	PVG	KLM	1-2-2015 0:26:53	0:00:00	KLM	34,68

In order to generate the required information for the Arena Model Input as shown in table 54, several steps have been performed:

- A column is added for the city of the associated airport.
- A column is added for the country of the associated city which matches the countries as provided in the 'commodity shares' dataset.
- A column is added for continent of the associated country.
- In the dataset one row represents either a departing or an arriving flight at AAS in February 2014. Every row is split into 11 rows which all represent one commodity category, simultaneously a commodity column is created.
- For every row, the total tons of cargo aboard is multiplied with the associated commodity share(dataset 1) for the right country.
- In order to convert the ULD weight to number of ULDs, the average density of the commodities is calculated. These calculations are provided in appendix F2 and the outcome is presented in table 55 below. The average weight per ULD per commodity is calculated with the following formula:

$$\frac{(Commodity\ density * Average\ ULD\ Volume)\ Average\ ULD\ Loadfactor}{1000}$$

- The following step is to divide the tonnage per commodity for every arrival or departure with the average ULD weight per commodity.

[3] This column refers to the hour in which the flight has arrived, instead of the exact time of arrival.

Example

1. A KLM flight to Sjanghai departs at AAS on the 1st of February at 3:54 AM. The flight carries a total of *34,68* tons of cargo.

2. The ‘commodity shares’ dataset shows that an average 59% of the exported cargo from AAS to China is commodity category: ‘Raw Materials, Industrial consumables & Foods’.

3. The total amount of cargo aboard is multiplied with the 59% share in order to estimate the weight of the associated category on this flight. In this case the estimated weight of ‘Raw Materials, Industrial consumables & Foods’ on board is 20,52 tons.

4. Dividing 20,46 tons with the average ULD weight for ‘Raw Materials, Industrial consumables & Foods’, which is 2,73 tons, results in a ‘possible total’ of 7,51 ULDs exported to Sjanghai for this commodity on the KLM flight.

Table 61: Average ULD weight per commodity category

Commodity Category	Commodity Density [kg/m3]	Average ULD weight per commodity [ton/ULD/commodity]
Capital Equipment & Machinery	300,00	4,77
Chemicals & Products	300,00	4,77
Consumer Fashion Goods	200,00	3,18
Consumer personal & household goods	165,00	2,62
High Technology	170,00	2,70
Land Vehicles & Parts	230,00	3,66
Live Animals	140,00	2,23
Machinery parts. Components, Supplies & Manufactures	400,00	6,36
Raw Materials Industrial consumables & Foods	240,00	3,82
Secure or Special Handling	200,00	3,18
Temperature or Climate Control	185,00	2,94
	Average ULD Weight	**3,66**

Average ULD Loadfactor	Average ULD Volume[m3]
0,75	21,1

However, far from all cargo is transported as BUPs. A common reason behind this is the lack of volume or weight to fill one BUP. It is therefore important to reshape this general *ULD amounts* towards *potential BUP amounts*. Various steps are performed in order to create data which is as close as possible to the real-life situation.

- At first, if the amount of ULDs per commodity is below 1, this row is filtered out of the dataset. It is assumed that a BUP is filled with products of one commodity category.
- A BUP can only exist as a whole, therefore the amount of ULDs/commodity is rounded down.
- The commodity categories ‘Live Animals’ and ‘Secure or Special Handling’ are currently not often transhipped as a BUP and more importantly are not suitable for fast-track transshipment in the future. The ‘BUP Possible’ factor is also adjusted to zero for these commodity categories.
- A factor is taken into account which estimates the average percentage of the total cargo which is transhipped as a BUP. This factor is based on ground handler and forwarder estimations (appendix N) as well as the percentages stated by de Wit(2014), Lubbe(2014) and van der Donk(2015). 35% of the total amount of imported cargo pallets are estimated to be BUPs and

15% of total amount of exported cargo pallets is estimated to be delivered at the ground handler as a BUP.

- The amount of ULDs per commodity should be multiplied with these factors. However, a large amount of cargo is already filtered out of the system. The filtered out cargo is summed up. This sum amounts to 22,5% of the total import cargo and 40% of the export cargo. This means that the BUP factors of 35 and 15% should be adjusted to respectively 45 and 25% in order to approximate the right percentage while leaving out a certain part of the cargo which is definitely not a BUP. The ULD/Commodities which are still potential BUPs are multiplied with these percentages.
- Import flights from Columbia and Kenya are known to carry mostly ´Temperature or Climate Control´ cargo (often referred to as 'Perishables'). The ULDs for the arriving flights of these commodity categories are therefore multiplied with an estimation of 95%.

Example:

1. The number of ULD/Commodity for the 'High Tech' on a KLM flight from Ghuangzhou is 6.85. Because this is higher then 1, it is possible that there is an entire ULD filled with cargo for the same forwarder and is packed as a BUP.
2. The number of possible BUPs is rounded down to 6.
3. Because this is an arriving flight 6 is multiplied with 45%, resulting in 2.7 'High Tech' BUPs.

Performing the steps as described above for the entire dataset results in a dataset extended with the following information.

Table 62: Modified 'Cargo Transhipment Dataset'

A/D	City	Comm-odity	[Tons/ Commodity]	[Ton/ ULD]	[ULD/ Commodity]	Potential BUP	BUP factor	BUP [#]
A	Ghuangz.	HighTech	41.20	2.70	6.85	6	45%	2.7

A pivot table with in the columns: Arrival/Departure, Date, Commodity and Hour and the number of BUPs summed up for these values results in the input dataset for Arena as presented in table 56.

J.3 Sensitivity Analysis Commodity Shares

The commodity shares information has been provided by Seabury and is an approximation of the commodity shares which are actually transhipped at Schiphol. This information is based on the commodity data provided by customs. Because of the open borders and the road feeder network through Europe, there is a gap between information flows and physical flows.

Because of the gap between the physical and information flow, customs data cannot actually not be directly linked with the AAS flight data because it is not completely similar.

Example:
A cargo sending is exported from Frankfurt to the USA. The sending is transported with Airway Bill over the road feeder network to Schiphol where it is transhipped onto a plane and flown to the USA. The only available customs data is the export customs data in Frankfurt. The Seabury commodity data of AAS can therefore lack the data of this sending.

The commodity shares data is used in the dataset analysis at two points:

1. The commodity shares are used to split the total tons on board over the eleven commodity categories for very flight.
2. The average weight per ULD per commodity is multiplied with the commodity categories tons for every flight.

In order to validate whether the commodity shares are of a great influence for the total Arena input, another dataset analysis is performed which excludes the commodity shares data. The following steps are performed in the dataset analysis:

- The total tons on board of a flight is divided by the average ton/ULD which is calculated to be 3,66 (table 55) resulting in the possible number of ULDs on board the flight.
- At first, if the tons per ULDs on a flight is below 2, the odds of the cargo being shipped as a BUP are fairly low. 2 tons is 75% (average BUP load factor of the average ULD weight of 3,66 tons. A 'BUP Possible' column is created in the dataset which displays either a 1(total load larger than 2 tons) or a 0(total load smaller than 2 tons). This factor is multiplied with the number of ULDs.
- The number of ULDs are multiplied with the BUP factor which is 35% for import cargo and 15% for export cargo in order to retrieve the possible number of BUPs on the plane.
- Import flights from Columbia and Kenya are known to carry mostly ´Temperature or Climate Control´ cargo (often referred to as 'Perishables'). The ULDs for the arriving flights of these commodity categories are therefore multiplied with an estimation of the BUP factor of 95%.
- Eventually, the BUP amounts are rounded down. Because half a BUP does not exist.

For Example
The Total tons of cargo on the Sjanghai flight 34,68 are divided by the average weight of a ULD of 2,62, resulting in a possible amount of 13,24 ULDs on that flight. Because this amount is above 2 tons, it is possible that there is at least one BUP exported on that plane. Multiplying the ULD amount with the 15% BUP factor results in a possible amount of 1,98 BUPs on this KLM flight. This number is rounded down do 1 possible BUP on the flight t Sjanghai.

Comparing the BUP amounts from the 'dataset with integrated commodity shares' and the 'dataset without integrated commodity shares' provides the following table.

Table 63: Dataset Sensitivity Analysis

	Data set with int. commodity shares	Data set not int. commodity share	% lowered
Import BUPs	6354	5161	23,1%
Export BUPs	1410	884	37,3%
Total BUPs	7764	6045	22,1%

The table shows that including the Seabury data for refinement of the TAF data results in higher BUP amounts. The goal of the simulation is to see whether a design is able to cope with peal volumes. Therefore it is no problem to use the Seabury data. Any design which can handle that amount of pallets can also handle the possibly lower amount. The only problem can be that the designed solution is too big, which results in unnecessary costs and area usage. This should be take into account when concluding and recommending.

J.4 Sensitivity Assumed Data Variables

The data analysis is based on various assumptions. The assumptions for the BUP shares, the average BUP volume and the average ULD load factor are estimated. The sensitivity of the data for a change in these assumed values is tested and the outcome is presented in the tables below.

Table 64: Import BUP Factor Sensitivity

Estimated variable		-10%	+10%
Import BUP factor	**35%**	31,5	38,5%
Total Nr. of BUPs	**7821**	7388	8155
Growth or Decrease with respect to Scenario 2015		**5,5% Decrease**	**4,2% Growth**

Table 65: Export BUP factor Sensitivity

Estimated variable		-10%	+10%
Export BUP factor	**15%**	13,5%	16,5%
Total Nr. of BUPs	**7821**	7612	7935
Growth or Decrease with respect to Scenario 2015		**2,7% Decrease**	**1,5% Growth**

Table 66: ULD Volume Sensitivity

Estimated variable		+10%	-10%
Average ULD Volume	**21,2 m3**	23,32	19,08 m3
Total Nr. of BUPs	**7821**	7041	8664
Growth or Decrease with respect to Scenario 2015		**10% Decrease**	**10,8% Growth**

Table 67: ULD Load factor Sensitivity

Estimated variable		+10%	-10%
ULD Load factor	**75%**	82,5	67,5%
Total Nr. of BUPs	**7821**	7039	8821
Growth or Decrease with respect to Scenario 2015		**10% Decrease**	**12,8% Growth**

Table 68: All Assumptions Minimum and Maximum Sensitivity

Estimated variable		*Max Decrease*	*Max Growth*
Import BUP factor	**35%**	31,5	38,5%
Export BUP factor	**15%**	13,5%	16,5%
Average ULD Volume	**21,2 m3**	23,32	19,08 m3
ULD Load factor	**75%**	82,5	67,5%
Total Nr. of BUPs	**7821**	5911	9942
Max. Growth or Decrease with respect to Scenario 2015		**24,4% Decrease**	**27,1% Growth**

It can be concluded that is al variables are estimated 10% too broad, the maximum decrease in the amount of BUPs which are transhipped in February 2015 is 24,4%. The maximum increase in the number of BUPs if all estimations were too skinny is 27%.

Appendix K: Technological Criteria Assessment

K.1 FTF Throughput

Table 69: FTF Throughput Import calculations

Import		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Throughput	[pallet]	12287	12287	12287	12287
Throughput	[ton/year]	455160	455160	455160	455160
Area	[m^2]	6460	2200	2600	4500
Throughput	[ton/year/m^2]	70	207	175	101

Table 70: FTF Throughput Export Calculations

Export		Alternative 3	Alternative 4
Throughput	[pallet]	3286	3286
Throughput	[ton/year]	132048	132048
Area	[m^2]	2600	4500
Throughput	[ton/year/m^2]	51	29

Table 71: FTF Throughput Total calculations

Total		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Throughput	[pallet]	12287	12287	15573	15573
Throughput	[ton/year]	455160	455160	587208	587208
Area	[m^2]	6460	2200	2600	4500
Throughput	[ton/year/m^2]	70	207	226	131

K.2 AAS Throughput

In order to calculate the maximum AAS throughput in 2030, first the AAS throughput of 2014 is calculated based on the available Schiphol data. The total AAS throughput in 2014 amounts to 9.23 ton/year/m2. Table 72 shows the calculations which are performed in order to reach this number. This is calculated with the following steps:

- The handled ton/year for each handler is retrieved from TAF data and presented in column 2.
- The share of the total handled volumes is calculated and presented in column 3.
- The area occupied by the handlers facilities in 2015 are shown in column 4.
- The throughput per handler is calculated by dividing the ton per handler by the occupied area. This value is presented in column 5.
- A weighed average for the throughput, based on the percentage handled by the handler, is calculated and amounts to 9,23.

The FTF has been included as a facility, but the values for the FTF throughput are set to 0, as the facility does not exist in 2014 yet.

Table 72: AAS Throughput Calculations 2015

AAS THROUGHPUT 2015	[ton/year] 2014	% Total AAS	Area [m2]	[Ton/m2/Year]	< *Weighed*
Aviapartner Cargo	350830	0,21	42200	8,31	1,79
DHL	7529	0,00	10040	0,75	0,00
KLM	522337	0,32	71500	7,31	2,34
Menzies Cargo	558768	0,34	44000	12,70	4,34
Skylink	12759	0,01	10000	1,28	0,01
Swissport Cargo	139710	0,09	18744	7,45	0,64
WFS	41218	0,03	9200	4,48	0,11
FTF	**0**	0	0	0	
	Total	**Total**	**Total**	**Weighed Av.**	
	1633151,06	1,00	205684	**9,23**	

The second step is to calculate the weighed throughput average for AAS in 2030, assuming that the FTF is not operational yet. In order to estimate the 2030 throughput for the handlers, it is assumed that the handlers all handle double the amount they did in 2014. Because all numbers are doubled in the table, the estimated weighed average for the AAS throughput in 2030 amounts to 18.46.

The third step includes the FTF as an operational facility in the throughput calculations. Table 73 till 76 represent the estimated 2030 AAS throughput when including FTF alternative 1 to 3. In these calculations the designed area and throughput is taken into account in the calculation steps as presented above.

Table 73: AAS Throughput Calculations, Alternative 1

AAS THROUGHPUT 2015	[ton/year] 2030 FTF	% Total AAS	Area [m2]	[Ton/m2/Year]	< *Weighed*
Aviapartner Cargo	603883,73	0,18	42200,00	14,31	2,65
DHL	12960,15	0,00	10040,00	1,29	0,01
KLM	899097,59	0,28	71500,00	12,57	3,46
Menzies Cargo	961807,79	0,29	44000,00	21,86	6,44
Skylink	21961,67	0,01	10000,00	2,20	0,01
Swissport Cargo	240482,81	0,07	18744,00	12,83	0,94
WFS	70948,39	0,02	9200,00	7,71	0,17
FTF	**455160,00**	0,14	6460,00	70,46	9,82
	Total	**Total**	**Total**	**Weighed av.**	**Weighed av.**
	3266302,13	1,00	212144,00	incl. FTF	excl. FTF
				23,49	**13,68**

Table 74: AAS Throughput Calculations, Alternative 2: Automated

AAS THROUGHPUT 2015	[ton/year] 2030 GFTF	% Total AAS	Area [m2]	[Ton/m2/Year]	*< Weighed*
Aviapartner Cargo	603883,73	0,18	42200,00	14,31	2,65
DHL	12960,15	0,00	10040,00	1,29	0,01
KLM	899097,59	0,28	71500,00	12,57	3,46
Menzies Cargo	961807,79	0,29	44000,00	21,86	6,44
Skylink	21961,67	0,01	10000,00	2,20	0,01
Swissport Cargo	240482,81	0,07	18744,00	12,83	0,94
WFS	70948,39	0,02	9200,00	7,71	0,17
FTF	**455160,00**	0,14	2200,00	206,89	28,83
	Total 3266302,13	**Total** 1,00	**Total** 207884,00	**Weighed av.** incl. GFTF **42,51**	**Weighed av.** excl. GFTF **13,68**

Table 75: AAS Throughput Calculations, Alternative 3, Export Basic

AAS THROUGHPUT 2015	[ton/year] 2030 FTF	% Total AAS	Area [m2]	[Ton/m2/Year]	*< Weighed*
Aviapartner Cargo	575517,46	0,18	42200,00	13,64	2,40
DHL	12351,37	0,00	10040,00	1,23	0,00
KLM	856864,20	0,26	71500,00	11,98	3,14
Menzies Cargo	916628,72	0,28	44000,00	20,83	5,85
Skylink	20930,06	0,01	10000,00	2,09	0,01
Swissport Cargo	229186,60	0,07	18744,00	12,23	0,86
WFS	67615,73	0,02	9200,00	7,35	0,15
FTF	**587208,00**	0,18	2600,00	225,85	40,60
	Total 3266302,13	**Total** 1,00	**Total** 208284,00	**Weighed av.** incl. FTF **53,02**	**Weighed av.** excl. FTF **12,42**

Table 76: AAS Throughput Calculations, Alternative 4, Export extended

AAS THROUGHPUT 2015	[ton/year] 2030 FTF	% Total AAS	Area [m2]	[Ton/m2/Year]	*< Weighed*
Aviapartner Cargo	575517,46	0,18	42200,00	13,64	2,40
DHL	12351,37	0,00	10040,00	1,23	0,00
KLM	856864,20	0,26	71500,00	11,98	3,14
Menzies Cargo	916628,72	0,28	44000,00	20,83	5,85
Skylink	20930,06	0,01	10000,00	2,09	0,01
Swissport Cargo	229186,60	0,07	18744,00	12,23	0,86
WFS	67615,73	0,02	9200,00	7,35	0,15
FTF	**587208,00**	0,18	4500,00	130,49	23,46
	Total 3266302,13	**Total** 1,00	**Total** 210184,00	**Weighed av.** incl. FTF **35,88**	**Weighed av.** excl. FTF **12,42**

K.3 Investment Costs

Table 77: FTF Investment costs Approximation

Costs Approximation		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Terminal Building	[million €]	3.5	1.2	1.5	2.5
Equipment	[million €]	0.5	2.5	3.8	5
Total	[million €]	**4.0**	**3.7**	**5.3**	**7.5**
Extra storage			4.0		

The calculations for the various cost categories are explained in table 78 to 82 below.

Table 78: Costs Breakdown

	Terminal Building		
Building Costs (Warehouse including office)	**[€/m^2]**	550	(Bouwkostenkompas, 2015)
Mobile Equipment			
Customs Scanner	**[million €]**	1.8	(Perez, 2015)
Slave Pallet Mover	**[€]**	80.000	(Lodige, 2015)
Flexloader	**[€]**	120.000	(Lodige, 2015)
Workstation	**[€]**	30.000	(Lodige, 2015)
Manual Rollerbed 10ft.	**[€]**	2500	(Lodige, 2015)
Automated Rollerbed 10ft.	**[€]**	5000	(Lodige, 2015)
Dock	**[€]**	25.000	(Lodige, 2015)
Elevating Transfer Vehicle	**[€]**	250.000	(Lodige, 2015)
High level rack storage Position	**[€]**	5000	(Lodige, 2015)
Complete simple fast-track system (1 track, 2 docks, turn-table, weighing system, workstation)	**[€]**	275.000	(Lodige, 2015)
Software	**[€]**	250.000	(Lodige, 2015)
Cool Cel	**[€]**	20.000	Assumption & (Celtic Cooling, 2015)

Table 79: Alternative 1 Equipment Costs Approximation

Alternative 1: Manual Equipment Costs Approximation		
	[#]	**[€]**
Complete System	1	275.000
Docks (additional)	8	200.000
Rollerbed 10ft. (additional)	10	50.000
Total		**525.000**

Table 80:Alternative 2 Equipment Costs Approximation

Alternative 2: Automated Equipment Costs Approximation		
	[#]	**[€]**
Complete System	2	550.000
ETV	3	750.000
Docks (additional)	6	150.000
Rollerbed 10ft. (additional)	6	30.000
Racks	130	650.000
Cooled Storage	6	120.000
Software	1	250.000
Total		2.500.000
Additional Racks 3rd Level	70	350.000
Total (extra storage level)		2.850.000

Table 81: Alternative 3 Equipment Costs Approximation

Alternative 3, Export: Basic Equipment Costs Approximation		
	[#]	**[€]**
Complete System	2	550.000
Docks (additional)	8	200.000
ETV	5	1.250.000
Racks	273	1.365.000
Rollerbed 10ft. (additional)	30	150.000
Software	1	250.000
Total		**3.765.000**

Table 82: Alternative 4 Equipment Costs Approximation

Alternative 4, Export: Extended Equipment Costs Approximation		
	[#]	**[€]**
Complete System	3	825.000
Lift	2	500.000
Docks (additional)	6	150.000
Rollerbed 10ft. (additional)	200	1.000.000
Racks	227	1.135.000
Cooled Storage	16	320.000
Software	1	250.000
Customs Scanner	1	1.800.000
Total		**4.981.000**

K.4 Extra: Required 1st line width for Aviapartner, KLM and the FTF

Alternative 1: Manual

Table 83: Required 1st line width Aviaparther, KLM and FTF, Alternative 1: Manual

AREA	[m2] area reduction	[m] width reduction	[m] width 2030 FTF	[m] depth	[m2] area with FTF
	Estimation naar rato				
Aviapartner Cargo	5880,58	93,36	576,64	62,99	36319,42
DHL	1399,08	17,06	105,38	82,00	8640,92
KLM	9963,54	82,50	509,50	120,78	61536,46
Menzies Cargo	6131,41	47,16	291,30	130,00	37868,59
Skylink	1393,50	10,72	66,20	130,00	8606,50
Swissport Cargo	2611,98	20,73	128,03	126,00	16132,02
WFS	1282,02	10,02	61,86	128,00	7917,98
FTF		0,00	68,00	95	6460,00
	Total	**Total**	**Total**	Total AAS S-E	**Total**
	28662,12	281,55	1806,91	**1154,14**	183481,88

Alternative 2: Automated

Table 84: Required 1st line width Aviaparther, KLM and FTF, Alternative 2: Automated

	[m2] area reduction	[m] width reduction	[m] width 2030 GFTF	[m] depth	[m2] area with GFTF
AREA	*Estimation naar rato*				
Aviapartner Cargo	5880,58	93,36	576,64	62,99	36319,42
DHL	1399,08	17,06	105,38	82,00	8640,92
KLM	9963,54	82,50	509,50	120,78	61536,46
Menzies Cargo	6131,41	47,16	291,30	130,00	37868,59
Skylink	1393,50	10,72	66,20	130,00	8606,50
Swissport Cargo	2611,98	20,73	128,03	126,00	16132,02
WFS	1282,02	10,02	61,86	128,00	7917,98
		0,00	22,00	100	2200,00
	Total	**Total**	**Total**	Total AAS S-E	**Total**
	28662,12	281,55	1760,91	**1108,14**	179221,88

Alternative 3 Export: Basic

Table 85: Required 1st line width Aviaparther, KLM and FTF, Alternative 3, Export: Basic

AREA	[m2] area reduction	[m] width reduction	[m] width 2030 FTF	[m] depth	[m2] area with FTF
	Estimation naar rato				
Aviapartner Cargo	7586,62	120,45	549,55	62,99	34613,38
DHL	1804,97	22,01	100,43	82,00	8235,03
KLM	12854,10	106,43	485,57	120,78	58645,90
Menzies Cargo	7910,21	60,85	277,61	130,00	36089,79
Skylink	1797,78	13,83	63,09	130,00	8202,22
Swissport Cargo	3369,75	26,74	122,02	126,00	15374,25
WFS	1653,95	12,92	58,95	128,00	7546,05
FTF		0,00	26,00	100	2600,00
	Total	**Total**	**Total**	Total AAS S-E	**Total**
	36977,38	363,23	1683,23	**1061,12**	171306,62

Alternative 4 Export: Extended

Table 86: Required 1st line width Aviaparther, KLM and FTF, Alternative 3, Export: Extended

AREA	[m2] area reduction	[m] width reduction	[m] width 2030 FTF	[m] depth	[m2] area with FTF
	Estimation naar rato				
Aviapartner Cargo	7586,62	120,45	549,55	62,99	34613,38
DHL	1804,97	22,01	100,43	82,00	8235,03
KLM	12854,10	106,43	485,57	120,78	58645,90
Menzies Cargo	7910,21	60,85	277,61	130,00	36089,79
Skylink	1797,78	13,83	63,09	130,00	8202,22
Swissport Cargo	3369,75	26,74	122,02	126,00	15374,25
WFS	1653,95	12,92	58,95	128,00	7546,05
FTF		0,00	45,00	100	4500,00
	Total	**Total**	**Total**	Total AAS S-E	**Total**
	36977,38	363,23	1702,23	**1080,12**	173206,62

Appendix L: Export Design Alternatives

L1 Conceptual Export Design Alternatives

Two conceptual alternatives are created which include export transshipment. The alternatives are both automated but differ in the amount of extra export functions which are available. The alternatives are referred to as:

Alt. 3 Export: Basic **Goal: Maximize Performance [ton/m^2/year]**

This design alternative is similar to the automated design alternative from the research, but extended with an export transhipment function. The starting point of the automated design alternative is to integrate automated processes inside the fast-track terminal with the goal to maximize the FTF performance. The aim is to exclude manual labour as much as possible. Rejected export cargo is immediately removed from the facility and sendback towards the responsible party.

Alt. 4 Export: Extended **Goal: Maximize Performance [ton/m^2/year]**

This design alternative is similar to the export: basic alternative. The basic alternative is extended with an export rebuilding function. The starting point of the automated design alternative is to integrate automated processes inside the fast-track terminal with the goal to maximize the FTF performance. The aim is to exclude manual labour as much as possible.

Table 87: Design Options per Alternative Export

Design Variables		Design Options	
		Alternative 3 Export: Basic	**Alternative 4 Export: Extended**
	General Variables		
G1	**Number of Terminals**	1	1
G2	**Terminal Levels**	1	1
G3	**Terminal Shape**	Box	Box
G4	**Transhipment Direction**	Both	Both
G5	**Customs Control Function**	Externally	Remote Scan
G6	**Rebuilding Function**	No	Yes
	Equipment Variables		
E1	**Storage System**	Automated Rack Storage	Automated Rack Storage
E2	**Storing Equipment**	ETV	Lift & Rollerbed (PCHS)
E3	**Main transport mean**	Automated Rollerbed	Automated Rollerbed
E4	**Truck Docks**	Outside	Inside
E5	**Scale & Scan Equipment**	Scale & Scanner	Scale & Scanner
E6	**Inspection Equipment**	Non	Remote Scanner
	Configuration Variables		
A1	**Import Rollerbed Lanes**	1	2
A2	**Export Rollerbed Lanes**	1	1
A3	**Storage Capacity**	126	142
A4	**Cooled Storage Capacity**	0	24
A5	**Workstation**	0	1
A6	**Airside Import Docks**	1	2
A7	**Airside Export Docks**	1	1
A8	**Import Truck Docks**	1	2
A9	**Export Truck Dock**	1	1
A10	**Storage Equipment**	2	4

L1.1 Alternative 3 Export: Basic

Alternative Export: Basic (figure 61) tranships import and export BUPs. The initial design of the facility ground floor consists of an import and an export rollerbed which are both linked to one airside and one landside dock were pallets enter and leave the physical FTF. The dedicated ETV's (to import or export) can move alongside the rollerbeds in the middle. The export ETV can retrieve from and place BUPs on the export rollerbed. This ETV places export pallets in need of storage as far at the airside as possible in the storage racks. The import ETV can retrieve from and place BUPs on the import rollerbed'. This ETV places import pallets in need of storage as far at the landside as possible in the storage racks. There is a scale and scanner incorporated in the export rollerbeds at landside which checks the export BUPs for correctness. A controller with mechanic knowledge is required for the maintenance and control of the automated storage and rollerbed system. A control room is integrated in the design for the employees.

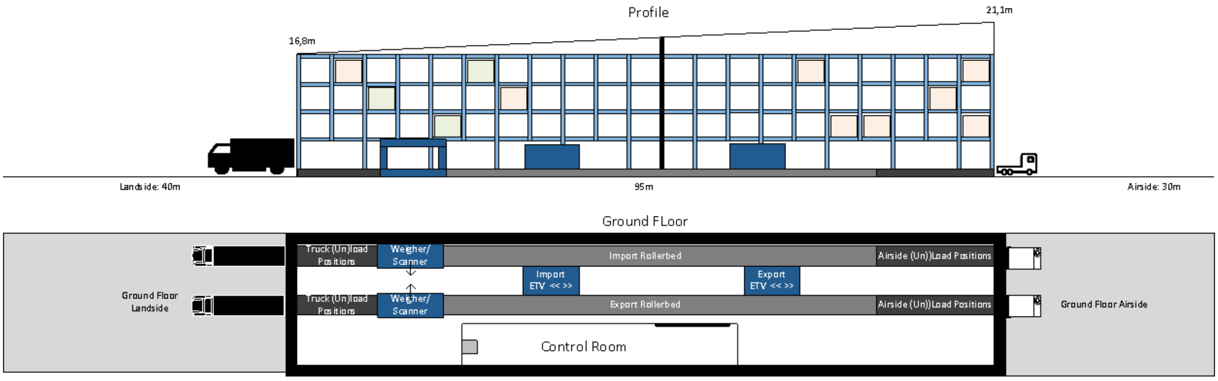


Figure 61: Alternative 3 Export Basic (lay-out & profile)

L1.2 Alternative 4 Export: Extended

This FTF alternative (figure 62) tranships import and export BUPs. The conceptual design of alternative 3 consists of two import and two export rollerbeds which are all linked to one airside and one landside dock were pallets enter and leave the physical FTF. A pallet container handling system is placed in the middle of the facility. This PCHS includes BUP lifts which can lift BUPs to rollerbeds on different levels. The rollerbeds convey the BUPs into the higher level storage positions. The export rollerbeds are provided with scales and scanners which check the build-up restrictions. After the scanners there is a bypass for rejected BUPs directed towards a priority truck dock. Workstations are available for rebuilding export BUPs. The import rollerbed is provided with a bypass for import BUPs which need customs scanning and potential inspection. This bypass directs BUPs towards the in-house customs facility. A control room and customs office is integrated in the design. A controller employee with mechanic knowledge is required for the maintenance and control of the automated storage and rollerbed system. Another employee who rebuilds the BUPs is required.

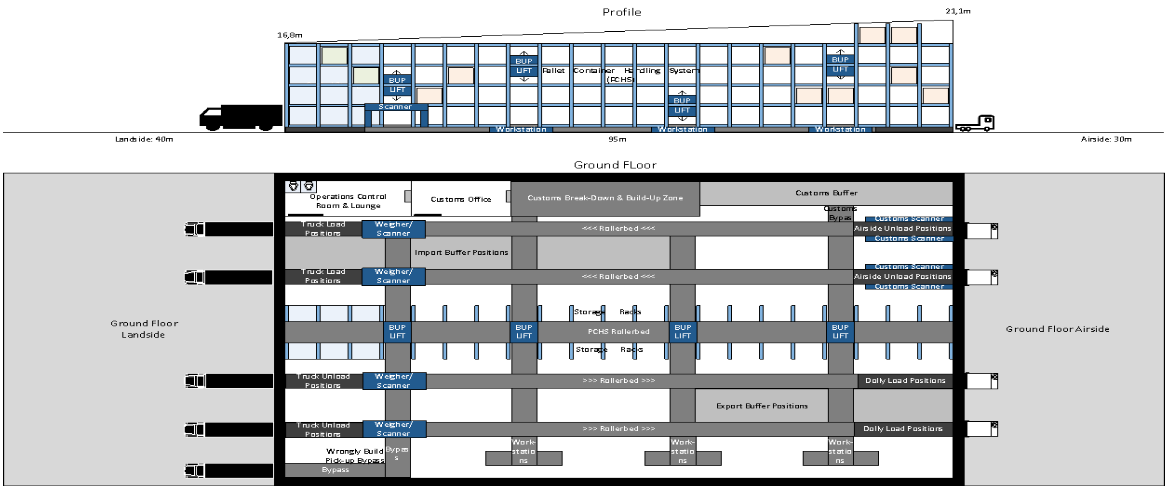


Figure 62: Alternative 4 Export Extended (lay-out & profile)

L2 Simulation Output Export Alternatives

The simulation specification and setup is described in appendix I. The simulation is performed with the overarching meta-model which integrates the export modules in the import module.

L2.1 Detailed Output Alternative 3 Export: Basic

Table 88: Detailed Output Simulation Alternative 3 Export: Basic

Configuration Variables	Base Throughput	Maximum Throughput
Import Rollerbeds [#]		
- Scheduled	1	1
- Average Utilization	48%	49%
Export Rollerbeds[#]		
- Scheduled	1	1
- Average Utilization	6%	12%
Import Storage Positions [#]		
- Scheduled	149	149
- Average Utilization	5%	9%
Export Storage Positions [#]		
- Scheduled	78	78
- Average Utilization	24%	32%
Import truck Docks [#]		
- Scheduled	5	5
- Average Utilization	29%	45%
Export truck Docks [#]		
- Scheduled	1	1
- Average Utilization	28%	53%
Import airside Docks [#]		
- Scheduled	5	5
- Average Utilization	30%	46%
Export airside Docks [#]		
- Scheduled	1	1
- Average Utilization	34%	52%
ETV [#]		
- Scheduled	5	5
- Average Utilization	33%	48%
Key Performance Indicators	Base Throughput	Maximum Throughput
Throughput Import BUP [pallet/month]		
- Input	12292	18438
- Output	12287	18433
- [ton/year]	455160	682740
Throughput Export BUPs [pallet/month]		
- Input	3304	4956
- Output	3286	4929
- [ton/year]	132048	198072
Lead times Import BUPs [hour]		
- Average	1.31	1.78
- Maximum	14.87	21.53
- Minimum	0.76	1.44
Storage Time Import BUPs [hour]		
- Average	0.96	1.23
- Maximum	10.52	18.97
Lead times Export BUPs [hour]		
- Average	5.78	6.03
- Maximum	8.83	9.55
- Minimum	0.97	1.18
Storage Time Export BUPs [hour]		
- Average	5.03	4.46
- Maximum	7.89	8.35
Value Added Time [hour]		
- Average	0.24	0.24
- Maximum	0.46	0.46
Truck Movements [#]		
- Import trucks	3073	4609
- Export Trucks	1723	2590
- Average Truck Load	5.1	5.1

L2.2 Detailed Output Alternative 4 Export: Extended

Table 89: Detailed Output Simulation Alternative 4 Export: extended

Configuration Variables	Base Throughput	Maximum Throughput
Import Rollerbeds [#]		
- Scheduled	2	2
- Average Utilization	32%	35%
Export Rollerbeds		
- Scheduled	1	1
- Average Utilization	6%	12%
Import Storage Positions Perishables		
- Scheduled	6	6
- Average Utilization	33%	34%
Import Storage Positions Gen. Cargo		
- Scheduled	99	99
- Average Utilization	4%	14%
Export Storage Positions Perishables		
- Scheduled	10	10
- Average Utilization	50%	56%
Export Storage Positions Gen. Cargo		
- Scheduled	128	128
- Average Utilization	6%	18%
Import Truck Docks		
- Scheduled	5	5
- Average Utilization	31%	35%
Export Truck Docks		
- Scheduled	1	1
- Average Utilization	28%	35%
Import Airside Docks		
- Scheduled	5	5
- Average Utilization	31%	36%
Export Airside Docks		
- Scheduled	1	1
- Average Utilization	6%	52%
PCHS Lifts		
- Scheduled	1	1
- Average Utilization	2%	4%
PCHS Cooled Lift		
- Scheduled	1	1
- Average Utilization	5%	8%
Workstation		
- Scheduled	1	1
- **Average Utilization**	40%	48%
Key Performance Indicators	Base Throughput	Maximum Throughput
Throughput Import BUPs [pallet/month]		
- Input	12292	16901
- Output	12287	16895
- [ton/year]	455160	625845
Throughput Export BUPs [pallet/month]		
- Input	3304	4543
- Output	3286	4519
- [ton/year]	132048	181566
Lead time Import General Cargo [hour]		
- Average	1.87	2.38
- Maximum	1.08	118.96

- Minimum	1.01	1.83
Storage Time Import General Cargo [hour]		
- Average	2.37	2.76
- Maximum	103.72	116.47
Lead time Import Perishables [hour]		
- Average	1.12	1.27
- Maximum	13.17	18.69
- Minimum	0.73	1.13
Storage Time Import Perishables [hour]		
- Average	0.45	0.48
- Maximum	2.92	10.43
Lead times Export General Cargo [hour]		
- Average	4.17	4.76
- Maximum	89.27	113.2
- Minimum	0.6	1.52
Storage Time Export General Cargo [hour]		
- Average	3.38	3.26
- Maximum	88.24	112.75
Lead times Export Perishables [hour]		
- Average	3.57	3.76
- Maximum	11.59	16.65
- Minimum	0.57	1.13
Storage Time Export Perishables [hour]		
- Average	2.77	2.17
- Maximum	4.72	4.51
Value Added Time [hour]		
- Export General Cargo	1.29	1.78
- Export Perishables	0.54	0.54
- Import General Cargo	0.89	1.39
- Import Perishables	0.16	0.16
Truck Movements [#]		
- Import trucks	3073	4226
- Export Trucks	1729	2590
- ‘sendback’ priority Trucks	153	224
- Average Truck Load	4.8	4.8

L3 Refined Export Alternatives

L3.1 Alternative 3 Export: Basic

Refining the second alternative with the simulation results, provides the following lay-out and profile design. An extra import rollerbed is integrate, because the amount of required storage positions is this high, that four rows of storage racks are required. Four storage rack rows need to be served by ETV's which are rail-mount on two rail lanes. An extra rollerbed is necessary in order for the ETV to be able to reach the import cargo. If the extra rollerbed was not included, the amount of import versus export storage positions reachable by the ETV's would not meet the configuration requirements retrieved from simulation.

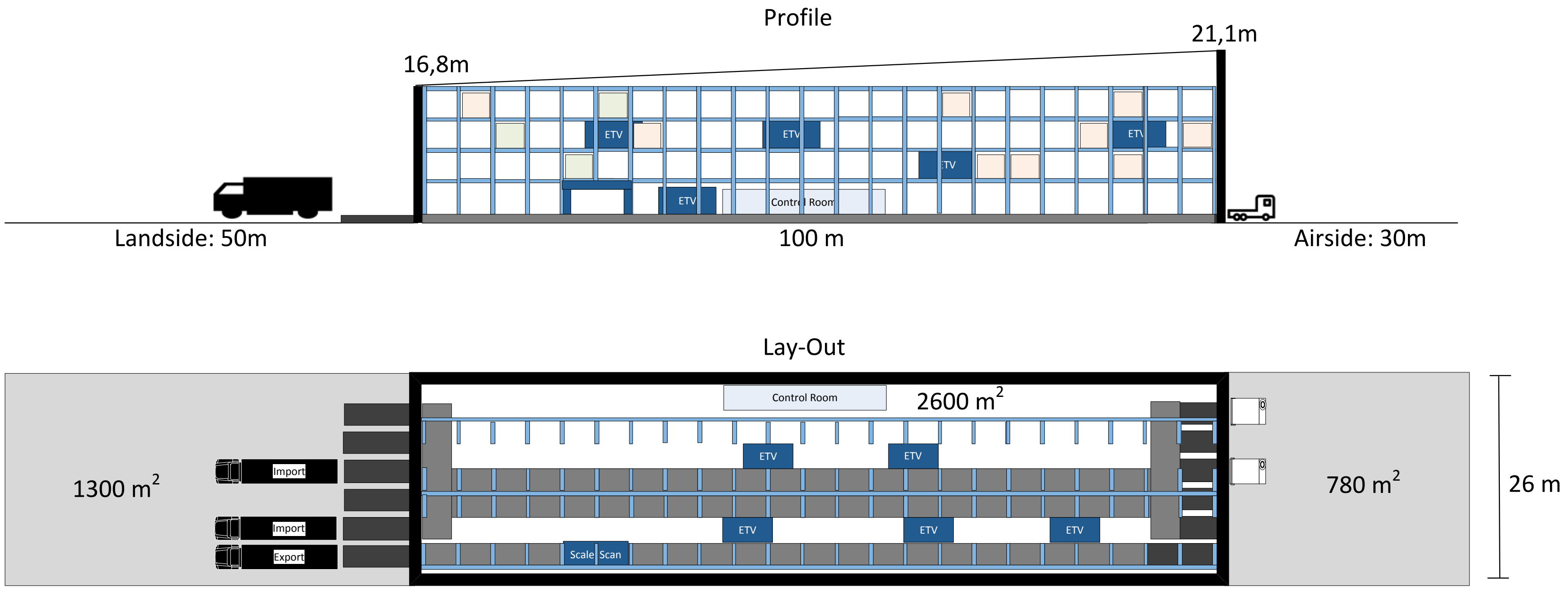


Figure 63: Refined Alternative 3 Export: Basic

L3.2 Alternative 4 Export: Extended

Refining the second alternative with the simulation results, provides the following high performance lay-out and profile design.

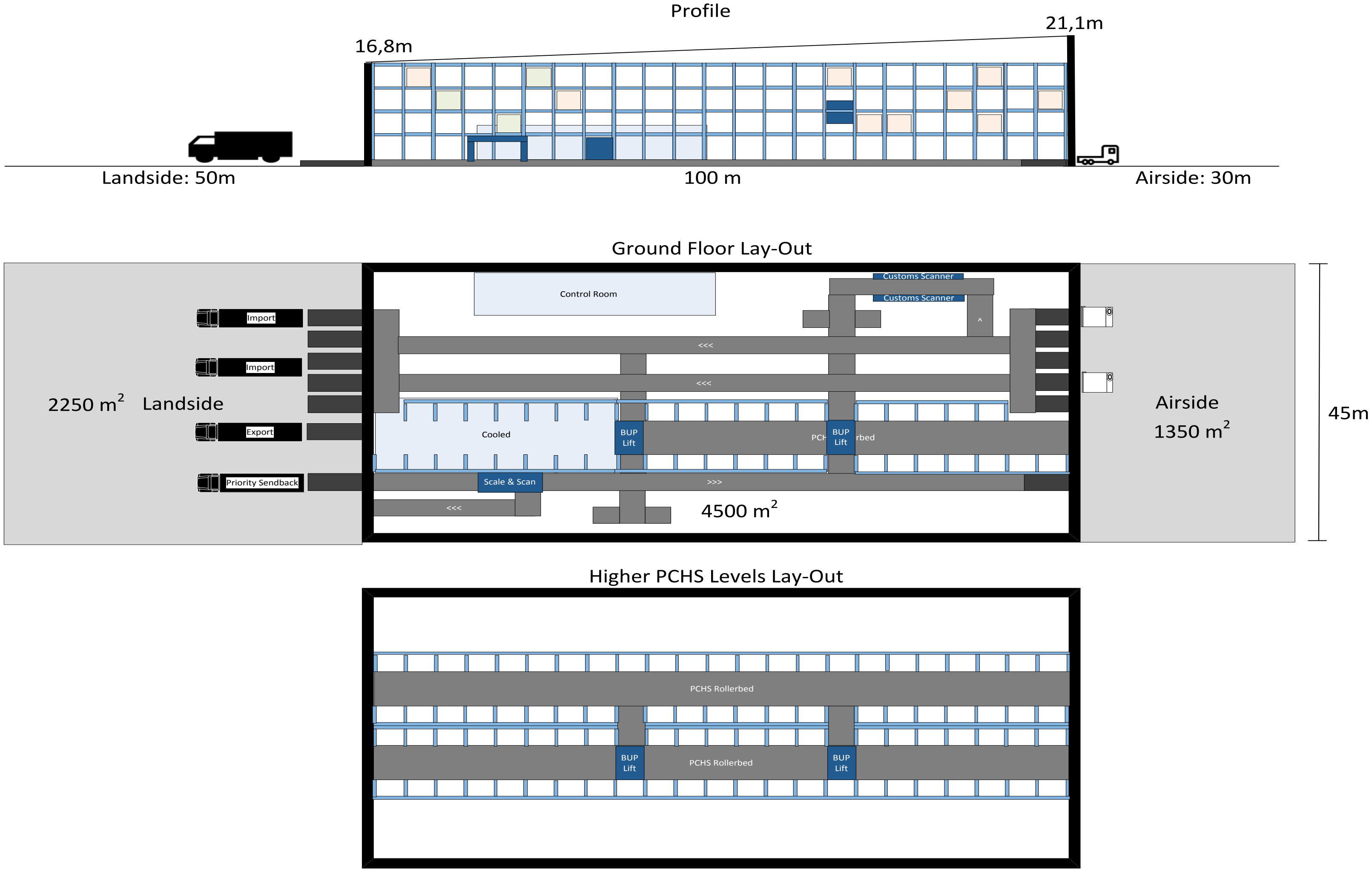


Figure 64: Refined Alternative 4 Export: Extended

L3.3 Assessing Technological Designs

The refined technological designs are assessed on the previously identified technological criteria. The criteria are explained in chapter 6.1. The calculations of the scores of the AAS and FTF productivity and the Investment Costs are presented in appendix K.

Table 90: Assessment Refined Alternatives on Technological Criteria

	Technological Criteria	Unit	Alternative 3: Export Basic	Alternative 4 Export Extended
C1	**Productivity AAS**[4] **2015: 9.3 & 2030: 18.6**	[ton/year/m^2]	53.0	35.88
	Required Handler Productivity	*[ton/year/m^2]*	*12.4*	*12.4*
C2	**Productivity FTF**[5]	[ton/year/m^2]	226	131
C3	**Occupied Area**	[m^2}	2.600	4.500
	Occupied 1st line width	*[m]*	*26*	*45*
C4	**Max. Throughput FTF**[6]	[ton]	880812	807411
C5	**Lead Time FTF (Import)**	[hour]	1:19	1:30
C6	**Investment Costs FTF**	[million €]	5.3	7.5

[4] Based on AAS throughput of 3 million tons
[5] Based on AAS throughput of 3 million tons
[6] Import & Export if both included in alternative functions

Appendix M: Model of Costs and Gains Sharing

Table 91: Handling Costs Current (Menzies, 2015)

Current Handling Costs Import				
Menzies	**All Cargo**	85,75 €	Per 10 ft. ULD	
	Express Import Shipments	46,35 €	Per 10 ft. ULD	Additional to normal charges
Aviapartner	**All Cargo**	82,23	Per 10 ft. ULD	
	Express Import Shipments	48,89 €	Per 10 ft. ULD	Additional to normal charges
Current Storage Costs Import				
Menzies	**General Cargo**	31,35 €	Minimum per AWB	
		0,063 €	Per kg/Per Day	
		18	Hours	Free storage period
	Cooled Shipments	154,50 €	Per ULD/Per Day	
		0,104 €	Per kg/Per Day	

Table 92: Approximation Employee Costs

Approximation Employee Costs FTF				
Employee		**Shifts**		
	Alternative	1	2/3	4
Equipment Operator	Day Evening Night	6 3 1		
Rebuilder	Day Evening Night			1 1 1
Controller/Mechanic	Day Evening Night	1 1 1	2 2 2	2 2 2
Total FTE	[# FTE]	13	6	9
Wage Operator (Loonwijzer, 2015)	[€]	25.000	25.000	25.000
Wage Rebuilder (Loonwijzer, 2015)	[€]	22.500	22.500	22.500
Wage Controller Mechanic (Loonwijzer, 2015)	[€]	27.500	27.500	27.500
Total Employee Costs per Year	[€/year]	332.500	165.000	232.500

Table 93: Approximation Rental Costs FTF

Approximation Employee Costs FTF	Unit	Alternative 1 Manual	Alternative 2: Automated	Alternative 3: Export Basic	Alternative 4: Export Extended
Occupied Area	[m^2]	6460	2200	2600	4500
Rent Price 1st line SRE	[€/m2/year]	120	120	120	120
Approximation Rental Costs FTF	[€/year]	775.200	264.000	312.000	540.000

IV: INTERVIEWS

Appendix N: Interviews and Tour Reports

This appendix includes the reports regarding the interviews and guided tours with actors from the various pre-defined clusters. The interview and tour reports are included in Dutch as they were performed, verified and adjusted by the interviewee in Dutch.

N1: Interview Achim van der Graaff – Emirates Cargo – 16th of April 2015

Emirates cargo general

Achim van der Graaff is cargo manager bij Emirates SkyCargo en leid een team van 13 werknemers. Emirates SkyCargo heeft een contract met Menzies die alle vracht voor hun afhandelt op Schiphol.

Emirates SkyCargo vervoert alle soorten vracht, een groot deel van deze vracht zijn 'perishables'. Zo'n 90% van de export vracht wordt direct op Schiphol afgeleverd. 10% hiervan zijn de zogeheten 'Pre-Build Units/Build Up Pallets' (volle vliegtuigplaten). De 90% die niet opgebouwd wordt afgeleverd wordt door Menzies opgebouwd in de 1e linie loodsen.

De verwachting is dat het aantal opgebouwde pallets wat wordt aangeleverd groeit in de komende jaren. Dit is ook gewenst want: de airline (heeft dan een beter afhandeling tarief) (minder opbouw) en de airline zou dan eventueel in staat zijn een concurrerende prijs aan de expediteur te berekenen. De expediteur heeft op die manier ook meer toezicht op hoe de vracht wordt opgebouwd (volgens de eisen van de airline waar zij een contract mee hebben).

Vracht die niet op Schiphol wordt opgebouwd wordt door Menzies in bijvoorbeeld Rotterdam (of andere steden) opgebouwd of door de expediteur. Deze pre-build units zijn vaak voor een agent maar er kunnen zendingen voor 10 verschillende klanten op liggen.

Groente Fruit Export

Een voorbeeld van vracht die opgebouwd wordt aangeleverd vanuit Rotterdam zijn groente en fruit wat naar Japan gaat. Dit moet extra netjes worden opgebouwd omdat er strikte eisen aan deze vracht zitten in Japan. Dit moet dus onder toezicht van de verhandelaar gebeuren. De verhandelaar zit dicht bij Rotterdam en daarom is het dus handiger voor hen om dit hier bij Menzies te laten doen en zelf toezicht te houden. Deze vracht wordt vervolgens naar Schiphol vervoerd door een weg vervoerder van Emirates SkyCargo. De vracht komt aan op Schiphol, wordt gewogen (voor de loadplan) en de opbouw wordt nogmaals gecontroleerd. Meestal wordt deze vracht niet meer aangeraakt verder. (Behalve als het fout is opgebouwd, maar dit gebeurt nauwelijks omdat het toch al door Menzies is opgebouwd.) Vervolgens gaat de vracht naar het platform.

Mocht deze vracht over een fast-track vervoerd worden in de loods, dan moet het al gewogen en gemeten zijn bij Menzies Rotterdam. De vracht zou hier dan over een fast-track kunnen, maar het moet wel nog steeds in de kist belanden: daar zou menzies schiphol dan wel weer voor moeten zorgen.

Bloemen Fast-track Menzies

Er is momenteel een fast-track in gebruik in de loods van Menzies. Deze track wordt alleen gebruikt voor de import van bloemen. Emirates levert zo'n 4 a 5 keer peer week een vlucht met bloemen aan die over de fast-track gaan. Een volle vlucht bevat tussen de 28 en 37 pallets. Er is een afspraak gemaakt tussen de airline, afhandelaar en expediteur dat de pallets met verschillende aantallen pakjes niet hoeven worden afgebouwd in de loods, maar meteen op de fast-track geplaatst mogen en afgehaald mogen worden. Worden dus niet gecontroleerd, maar wel voor getekend. Soms gaat de vracht niet eens door de loods, maar direct vanuit de kist naar klanten die ook aan de 1e linie zitten.

Fast-track import

Het meest logisch lijkt een fast-track voor import te zijn, en dan wel voor bepaalde producten. Charters die voor een klant zijn met een contract, of perishables en bloemen. Voor import zijn er al voorbeelden van een fast-track en voor het import proces hoeft er niet zo veel meer te gebeuren in de loods. Het is vooral voor grote hoeveelheden handig omdat het voor de afhandelaar niet gewenst is als er 37 pallets waar hij mee hoeft te doen in zijn loods staan. Het enige wat de afhandelaar moet zien is dat het aantal afgesproken pallets over de fast-track vervoert wordt.

Het handigst is om een fast-track in de loods van de desbetreffende afhandelaar te plaatsen. Hoe meer vracht er over deze fast-lane gaat, hoe meer ruimte voor de processen waar de afhandelaren geld aan verdienen. Wat ook kan gebeuren is dat er minder personeel nodig is omdat een groot deel van de vracht over de fast-track gaat.

Goed om te weten is dat een afhandelaar meer geld verdient aan een import lading dan een export lading. Naast de standaard prijs die de airline meer kilo aan de afhandelaar betaalt voor het afbreken van de vracht, wordt er ook loodshuur gevraagd aan de expediteur.

Fast-track export

Een fast-track voor export lijkt een minder goed idee dan voor import. Volle vliegtuigplaten worden momenteel afgeleverd door de expediteurs worden altijd nog gecontroleerd op gewicht (voor het load plan) en of ze safe&secure zijn opgebouwd.

Als je het soort vracht wat logischerwijs in aanmerking komt voor een fast-track, namelijk perishables, via een fast-track afhandelt dan heb je grote kans dat het alsnog een tijdje moet wachten voordat het de kist in aan airside. Als er 4 pallets over de fast-track kunnen en de rest van de vlucht niet dan staan die 4 pallets ergens te wachten. Hier moet je dan alsnog gekoelde opslagruimte o.i.d. hebben. Deze koelcellen zijn vaak wel in de loods te vinden, als je deze aan de airside van de fast-track wilt realiseren zijn het grote investeringen die de afhandelaren moeten maken.

Daarnaast hebben expediteurs hebben niet de expertise om de pallets goed en volgens de eisen van de airline op te bouwen. De pallets die binnen zouden komen

Wat zou er gebeuren als een export pallet die via de fast-track gaat fout is opgebouwd? Dan moet die pallet toch weer terug naar de loods van de afhandelaar en dat kost tijd en geld.

Voor export vracht verdient de afhandelaar alleen geld aan de airline per kilo opbouwen.

Fast-track faciliteit (gecombineerd/buiten de loodsen)

Fast-track heeft het meest nut als het gaat om grote hoeveelheden vracht die je snel door de loods moet krijgen. Vanaf welke hoeveelheid het dan nu heeft is lastig te zeggen.

Als je een fast-track introduceert die buiten de loodsen van de afhandelaren omgaat, dan moeten alle afhandelaren ook personeel bij de fast-track plaatsen om te zorgen dat de afhandeling juist gaat.

Stel dat een fast-track bediend wordt door de expediteurs, en deze zich dus meer als afhandelaren gaan gedragen, dan wordt de concurrentie nog heviger. Prijzen zullen dalen en dat moet ergens in terug komen. Dat reflecteert bijna altijd op de kwaliteit van de operatie. Daarnaast zal een afhandelaar niet gelukkig worden als een airline de helft van hun cargo door een expediteur (getraind in op en afbouwen) laat afhandelen. Daarvoor heeft de airline een afhandelingscontract bij de loods afhandelaar.

Een fast-track gecombineerd voor meerdere afhandelaren is niet wenselijk. Dat betekent een gescheiden operatie en deze wordt door de afhandelaren niet gewenst. Je wil het liefst al je eigen vracht bij elkaar houden. Als dus een deel over een fast-track gaat en een deel gewoon door de loods. Dit is lastig met elkaar af te stemmen. Daarnaast zorgt het voor de aanschaf van meer equipment en meer personeel is nodig om beide processen te controleren.

Stel dat een neutrale partij dit ‘fast-track centre’ runt dan moeten de airline en de afhandelaar hier een contract mee maken. Wie wordt die derde partij? En wat gebeurd er als een pallet een keer niet goed is opgebouwd?

Douane
De douane processen worden volledig tussen de expediteur en de douane geregeld.

N2: Guided Tour - KLM Cargo - Willem Wouterse – 1st of April 2015

Mister Wouterse is the manager of the transport department at KLM Cargo since 34 years.

KLM works together with various forwarders and trucking companies. The largest airlines clients they have are besides KLM (Martinair), Delta airlines and Koeweit airlines.

Facilities
Warehouse 1: Handling special cargo+ belly flights
Warehouse 2+3: Handling Full Freighters..?
WH 2: Europort Import
WH 3: Worldport

Cargo
One pallet can maximally carry 6800 kg**.** Every ULD unique ULD number on the iron pallet edge. Last two letters of de code show the owner of the pallet.

There are two sorts of cargo. The so called T-ULDs (through ULDs or BUPs) and Break-Down ULD. T-ULDs are handled via the PCHS on the first floor and the Break-down ULDs are broken down or build up at a workstation..

An estimation of mr. Wouters is that about 30% of the ULDs are T-ULD?. There are also ULDs which do not pas the KLM facility but are delivered directly at the Menzies facility. Those pallets are not in the estimation yet and those are primarily flowers for the Kuehne Nagel track in the Menzies warehouse.

What cargo
Import: flowers and general
Export: Fruits & Vegetables (perishables)

Normal processes

Import
Gets broken down, or flows through as a whole
At Arrival + 2 hours, the import freight must be in the PCHS

Export
Report truck, park truck, to docs department, get unloading document, when it's their turn they unload truck at the dock. Entire pallets are weighed on the rollerbed 'train' behind the docks. Loose packages are measured with a volume scanner

BUP (T-ULD) processes

Import
T-ULD > Import for one client
Total pallet flows through 1st floor PCHS

Export
T-ULD > Export for one destination**.** The T-ULDs come in, are weighed on the 'train' (rollerbeds) and then tilted with the lift onto the PCHS. They are stored there (1st floor) until the containers are needed for the flight: few hours in advance? The pallets are then rolled onto a automated mover of a dolly and driven to the platform.

Load planning
In the load planning they work with weight ranges

Customs
Customs aims at certain cargo. Cargo goes directly from platform to Customs (Handlers know I advance which cargo they need to bring)**.** KLM brings cargo, it is scanned, the handlers wait, and they take it back to the warehouse**.** For export, customs request certain cargo. This cargo is brought by from the PCHS to the customs and then to the platform.

Time schedules
36 hours in advance (of departure time) start planning (load planning?)
16 hours in advance release planning to 'buil-up department'
2 hours in advance the freight must be at the PCHS at airside.
80 min in advance cargo on the platform, sometimes 60 minutes if it's only a small amount of cargo
2,5 hours in advance on platform for a full freighter (36 ULDs?)

Cargo Handling Equipment
There is a Pallet Container Handling System (PCHS) stationed on the 1st floor over the entire KLM cargo facility.
Besides the 1st floor PCHS, there is a smaller PCHS at the airside of the facility. The pallets which need to be on a flight together are stored there.

N3: Ouke Boot - Swissport – 7th of May 2015

Swissport General

Grootste afhandelaar ter wereld. Op 3 na grootste afhandelaar op Schiphol. Doen zaken met 5 grote airlines: China, Saudi, Korean, Qatar, Lufthansa. Ze hebben 4 freighter klanten. Deze 5 grote airlines doen zaken met 5 grotere expediteurs: DHL (global forwarding), panalpina, expeditors, Kuehne Nagel… (dit zijn de grote spelers die volle platen kunnen aan en afvoeren). Deze grote expediteurs hebben in principe wel de expertise om opgebouwd aan te leveren en doen dit zo nu en dan.

Swissport slaat zo'n 46.000 ton vracht per week over. Op de piekmomenten staat de loods van 19.000 m2 bomvol en wordt het volgens Ouke zelfs 'gevaarlijk'. De export piek is op vrijdag avond en de import piek op zondag. Van pieken op de dag zelf heeft Swissport niet zoon last.

De kisten van de gecontracteerde airlines staan vaak recht voor de loods. De dollies staan vaak standaard opgesteld op de VOP's. Ze gebruiken transporters om de pallets van de dollies naar de fast-track te krijgen. Swissport heeft net als aviapartner, KLM en Menzies platform toegang en doet ook platform afhandeling.

Fast-track bloemen bij Menzies (Kuehne-Nagel dedicated lane)

Swissport doet de platform afhandeling van de bloemen BUPs. Ze brengen deze BUPs als het vliegtuig dichtbij staat met de transporters naar de fast-track van Kuehne-Nagel, als het vliegtuig verder weg op een VOP staat dan zetten de transporters de BUPs wel op dolly's en rijden ze deze naar de fast-track. Dit zijn vaak gehele vluchten die allemaal over deze track gaan.

Fast-track import

Ze hebben een import fast-track, ongeveer 40% van de vracht is 'Intact-ULD', oftewel BUP. Deze fast-track wordt beladen vanaf de airside met de transporters. De vracht komt erop, wordt doorgeduwd, gaat eventueel op een buffer zone, of wordt direct doorgeduwd tot aan de andere kant van de track zo de truck in. De buffer zone is ongeveer 20 bij 20m. De buffer zone wordt vooral gebruikt om de volgorde van de BUPs te kunnen veranderen.

Midden in de track is ook nog een plek waar vracht van de fast-track afgehaald kan worden. Dit wordt gebruikt wanneer de trucks niet op tijd klaar staan. Op deze manier staat er dus nog aardig wat vracht naast de track te wachten.Douane lijkt niet echt een probleem te zijn bij deze track. Bij de bloemen doen ze de check vaak in Aalsmeer en bij andere vracht wordt het vanaf het platform langs de Douane geredenVan de airline krijgen zij te horen welke ULDs er moeten worden afgebroken en welke niet. De vracht wordt naar de loods gereden,

Fast-track export

Voor export hebben ze niet een daadwerkelijke fysieke fast-track, maar dit noemen ze wel zo. De vracht wordt vanaf een klein rollerbedje de loods in genomen. De vracht wordt dan gewogen en 'gemeten' (op het oog) en als het klopt wordt het weer op een klein rollerbed gezet richting de Ongeveer 10 a 20% van de export vracht wordt opgebouwd aangeleverd door de expediteurs. Laatste jaren hebben de forwarders geleerd mooi pallets op de bouwen.

Equipment

In deze loods is de equipment van Weber koeltechniek (koelingsinstallaties), Saco airport Equipment (Rollerbeds), Nergeco (ook rollerbeds)

N4: Gerard Kervezee – Aviapartner – 8th of May 2015

Huidige structuur Aviapartner
Aviapartner probeert het totale pakket de bieden aan de klanten. Zowel het laden/lossen van kisten als het operaten en het aanbieden van truck faciliteiten. Aviapartner kan eigenlijk alle commodities behalve 'valuables' overslaan en wil steeds meer ondersteunende activiteiten aanbieden. Er is een animal centre en een perishables centre en daarnaast regelt aviapartner alle post op Schiphol.

Aviapartner heeft contracten met 28 airlines waarvan 8 grote airlines die ook met full freighters vliegen. Dit zijn bijvoorbeeld Singapore, Nippon cargo & China Southern. Zo'n 20 a 25% van de luchtvracht wordt door AP afgehandeld. AP is de grootste afhandelaar voor onafhankelijke vracht buiten de home-carrier.

Momenteel werkt de bestaande cargo infrastructuur op Schiphol goed. Er is nagedacht over het verplaatsten van de 1^{e} linie capaciteit naar de 2^{e} linie. De platform capaciteit is voldoende, er is wel veel capaciteit nodig om je aan en afvoer te kunnen borgen. De 1^{e} linie loods capaciteit is ook voldoende, maar je moet hier wel je process op inrichten. Het lastige hierbij is dat je afhankelijk bent van zoon 100 verschillende partijen: expediteurs, vervoerders en transit partijen.

Voorbeelden voor een cargo structuur als Frankfurt zijn hier onwenselijk. Ze zijn daar minder flexibel en hebben last van zeer lange transport afstanden tussen de 2^{e} linie loodsen en het consolidatie centrum. Daarnaast is er een probleem met empty truck kilometers en erg veel ritten.

Loodsen die gelijk aansluiten aan de eerste linie met behulp van fast-tracks zou bijvoorbeeld wenselijker zijn.

Cargo process
Om zo optimaal mogelijk op te bouwen heb je zoon 80% procent van je vracht nodig. Optimaal opgebouwde platen geeft een betere performance voor de carrier. In de praktijk lukt dit vaak nog niet omdat de vracht ofwel te laat binnen komt en je weet niet niet hoe de vracht eruit ziet. Je weet de kilo's, maar je hebt geen idee wat het volume of de vormen van de vracht zijn.

De maximale aanrijtijd voor export vracht is ongeveer 4 uur van tevoren voor kleine vracht. In principe wil aviapartner graag 80% van de vracht 12 uur voor vertrek binnen krijgen.

Er wordt een pre-planning gemaakt voor de weight and balance 4a5 uur voor vertrek. De grote en moeilijke vracht die op de vleugelposities worden geladen is al opgebouwd. AP maakt zelf de weight and balance planning voor elke full freighter klant. De belly vluchten wordt bij de passage operations gemaakt.

Fast-track en BUPs
AP maakt heeft momenteel 5 fast-track's in gebruik. 3 voor export en 2 voor import. Er wordt ongeveer zoon 40% van de vracht aangeleverd als BUPs. Bij import is het percentage wel iets groter dan bij export. Ongeveer 20% van dit geheel bestaat uit de bloemen BUPs. De BUPs zijn ongeveer 90% vliegtuigplaten en 10% containers. In deze containers zitten vooral producten die gekoeld moeten worden. Regelmatig moeten de BUPs die opgebouwd worden door de expediteurs nog heropgebouwd worden. Bij de import vracht kan deze er wel binnen 2,5 uur na de 'Actual time of Arrival' van de vlucht uit zijn (mits de truck op tijd is). Export BUPs worden regelmatig foutief aangeleverd. In 10 tot 15% van de gevallen zijn de BUPs niet goed opgebouwd.

Het is voor de expediteur de ene keer wel rendabel om BUPs aan te leveren en de andere keer niet omdat ze het niet kunnen optimaliseren. Als ze de pallets niet vol krijgen dan betalen ze alsnog de volle prijs voor de pallet. Het beste is als je een aantal dense en volumineuze partijen kan combineren.

In de loods is een ETV systeem aanwezig. Dat is een automatisch systeem die de pallet opslag doet. Hier worden ook import BUPs in geplaatst als de buffer naast de track vol is. Het idee zou zijn dat de buffer (waar ook op gesorteerd wordt groot genoeg is) maar vaak is dit niet het geval. Als de BUP aan airside op de track wordt gezet en het is bekend dat de truck er al is wordt deze direct doorgeduwd. Als de truck heeft laten weten dat hij komt gaat het op de buffer en als er nog niks bekend is gaat de vracht naar de pallet opslag plaats.

De pallets worden, indien de kist voor de deur geparkeerd staat tussen het vliegtuig en de loods vervoerd met transporters. Bij belly vluchten gaat de vracht op een dolly. De vracht staat klaar op het platform als het lekker weer is maar niet klaar als het slecht weer is. Dan staat het op de unloading docks/ ETV system klaar om eruit gehaald te worden.

Douane
Douane bekijkt met risicoanalyses welke zendingen ze moeten checken. Dit kunnen ze bij de afhandelaar doen, maar ook bij de expediteur. De afhandelaar wil graag dat het bij de expediteur al gebeurt, omdat het proces bij de afhandelaar tijdgevoel is. De douane wil natuurlijk liever naar 5 afhandelaard, dan dat ze langs 100 expediteurs moeten.

In de praktijk gebeuren fysieke inspecties tegenwoordig best weinig. Er is goede samenwerking, de expediteurs zijn gerenommeerde partijen met gerenommeerde verschepers.

Er gebeuren meer checks bij de import. Dan geeft de douane van tevoren aan, op basis van de risico analyse, welke pallets ze via de X-ray scan willen. Deze pallets worden direct vanaf het platform naar de scan gereden. Deze check levert ongeveer anderhalf tot 2 uur vertraging op. He tis vaak een preventieve check omdat veel mensen weten dat dit gebeurt in Amsterdam.

Toekomst
Er ligt toekomst in de samenwerking tussen de verschillende partijen in de luchtvracht keten en dan met name in de informatie-uitwisseling tussen de afhandelaren en de expediteurs. Het zou erg mooi zijn als bijvoorbeeld de expediteurs de vracht informatie aanbieden aan de afhandelaren i.p.v. de airlines. Dit gebeurt nu namelijk slecht en soms helemaal niet.

De toekomst voor AP ligt daarnaast ook in de pharma industrie. AP heeft de expertise hiervoor in huis en wil een pharma centre ontwikkelen op Schiphol.

Het heeft nog geen zin om over 3D-printers en de bloemen zeevracht innovaties na de te denken. Dit is nog niet concreet genoeg om mee te nemen in toekomstanalyses.

N5: Freshport – Annemiek Ploumen – 12th of May 2015

Freshport
11 jaar, het is gestart in 2004. Freshport is eigenlijk een afhandelaar voor import goederen.

Goederen
Veterinaire goederen van buiten de EU. Deze goederen hebben inspectie nodig, anders mogen ze de EU niet in. De voedsel en waren autoriteiten voeren deze inspectie uit. De VWA heeft een kantoor in de Freshport loods. Ze hebben hier ook een lab en een loods. Freshport heeft allerlei voorzieningen om te voldoen aan de eisen om gecertificeerd deze producten de EU in te laten.

De zendingen kunnen variëren van 20 ton vis tot 1 kreeft. Alles wat van een dier komt moet gecontroleerd worden door een erkend bedrijf. De EU wil precies kunnen traceren waar en wanneer het mis is gegaan met de inspectie of de afhandeling.

Klanten
Alle 'dode' veterinaire producten heeft KLM uitbesteed aan Freshport. Zij hadden een verouderde faciliteit en wilden niet investeren in een nieuwe. Daarom hebben ze besloten deze producten uit te besteden aan Freshport. Freshport krijgt alle veterienair producten van de klanten van KLM binnen.

Naast KLM heeft Freshport afspraken met Menzies, WFS en Swissport. Zij hebben geen faciliteit binnenshuis om deze inspecties uit te voeren en contracteren hier dus ook Freshport voor. Aviapartner heeft wel een eigen controle faciliteit.

Overslag
Freshport telt in het aantal zendingen dat gecontroleerd wordt. Dat zijn gemiddeld zo'n 10 a 20 zendingen per dag.

Freshport process / Inspectie

Iedere zending wordt gecontroleerd, maar steekproefsgewijs. Meestal wordt een paar procent van de zending gecontroleerd. De producten kunnen dan goed zijn en direct worden doorgevoerd. Als de producten niet de EU in mogen kunnen de producten ofwel aangehouden worden. Dan kan het wellicht nog gefixd worden. Producten kunnen ook geweigerd worden, dan worden ze ofwel onder toezicht van de douane en de VWA vernietigd, of ze worden terug gestuurd naar het land van herkomst (maar hier zitten wel kosten aan verbonden). Gemiddeld zit er 6 a 7 uur tussen het landen van het vliegtuig en het laden van de truck.

Meestal wordt de vracht voor freshport met belly vluchten vervoerd. Die vluchten zijn betrouwbaarder aangezien ze ook passagiers vervoeren. Als de pallets geheel voor Freshport zijn worden ze direct vanaf het platform naar de loods van Freshport gereden. Meestal komt de vracht 's ochtends aan. Freshport breekt dan zelf de pallets af. Als het maar een pakketje is dan wordt de vracht naar de afhandelaar gereden en afgebroken. Dan komt Freshport het pakketje bij de afhandelaar ophalen. Freshport handelt weinig BUPs af maar als ze binnenkomen is dit vaak 's ochtends.

Douane
Zendingen worden in de Freshport loods gecontroleerd door een combinatie van de douane en de VWA.

Prijzen en kosten

De kosten zijn vast voor controle en opslag. Daarbovenop komt een bedrag per kilo /per dag. Freshport wil het liefst zo min mogelijk storage in de loods. Ze streven naar een proces zonder hold-ups en zullen de klanten hier ook zo vele mogelijk mee helpen.

N6: Interview Joep Bruijs – DB Schenker - 18th of May 2015

DB Schenker

DB Schenker wilde een aantal jaar geleden in eerste instantie opereren in een faciliteit op de 1e linie of 1 ½ linie (zoals Rhenus en Panalpina). Echter bleek na financiele berekeningen dat dit niet het beste concept was en heeft het bedrijf toentertijd dus besloten om op de 2e linie te blijven. Maar, een versnelling was gewenst aan de import zijde en daarom hebben ze een trial opgezet voor een dedicated fast-track faciliteit op de 1e linie. Deze trial is uiteindelijk doorgezet naar een vast concept.

De fast-track faciliteit van DB Schenker is gevestigd in de loods van Skylink. Doordat Skylink een relatief kleine afhandelaar is, krijgt de fast-track van DB hier genoeg aandacht.

DB gebruikt de track voornamelijk voor import en heel af en toe voor export. De focus ligt op import omdat de export processen flexibeler zijn. Bij export kan vracht bij hoge uitzondering wel eens tot 2/3 uur voor vertrek aangeleverd worden (normaal is 6 a 8 uur). De airline zal er alles aan doen om de vracht op hun vlucht te krijgen (airlines moeten hun loadfactor behalen). De prioriteit van de airline (en dus ook hun afhandelaar) ligt veel meer in het faciliteren van het export proces. Daarom, valt bij de snelheid van het import proces voor de expediteurs meer winst te behalen.

Na 18 uur betalen de expediteurs opslag kosten in de loodsen van de afhandelaren en soms staan trucks uren te wachten. Hier hebben ze weinig grip op.

De processen op de VOP behoeven grote snelheid. Het is van belang dat het vliegtuig zo snel mogelijk omdraait en daarom moet de vracht zo snel mogelijk van de VOP verwijderd worden. Dit push-principe op het platform en de vertraging die dit oplevert bij de afhandelaar heeft DB Schenker aangezet tot het initiëren van het pull-principe: zelf de vracht zo snel mogelijk wegtrekken bij de afhandelaar. Dat is nu precies wat de fast-track van DB bij Skylink verzorgd.

Fast-track proces

DB Schenker krijgt van de 'origin' door welke pallet nummers bestemd zijn voor de fast-track. Deze nummers speelt DB door aan de airside afhandelaar. De afhandelaar scant de vracht die uit het vliegtuig komt op de VOP en splitst daar de pallets die naar de loods van de afhandelaar moeten en die naar de fast-track bij Skylink moeten.

Twee verschillende dolly-ritten worden dan vanuit de VOP gereden naar twee verschillende 'loodsen' (Er is momenteel een afhandelaar die voor deze 'extra rit' geld in rekening brengt). Als de vracht aankomt bij de loods van Skylink dan tekent Skylink 'on behalf of DB'. Juridisch en inhoudelijk gezien neemt DB Schenker op dit punt de vracht over van de afhandelaar (het papierwerk ook). De fysieke handelingen van het plaatsen van de vracht op de fast-track (rollerbed systeem) wordt hier door Skylink (onder contract van DB) gedaan. DB Schenker betaalt hiervoor een bepaalde fee per pallet aan Skylink.

De pallets worden op de track gezet en doorgeduwd naar de landside waar de shuttlebus van DB de pallets kan inladen en naar de loods op de 2e linie kan brengen. Op de 2e linie breekt DB zelf de vracht af. Vracht die in aanmerking komt voor een fast-track zijn Build-Up Pallets die volledig voor 1 expediteur bestemd zijn. Zo'n 95% van de vracht van DB Schenker is BUP.

Implementatie en resultaten

Het heeft zo'n 8 maanden geduurd voordat het idee van de fast-track geïmplementeerd is. Afhandelaren voelden zich bedreigd omdat ze natuurlijk een deel van hun business dreigen te verliezen. Echter, DB heeft ervoor gezorgd dat dit geen commerciële strijd ging worden. DB heeft afgesproken om dezelfde afhandelingstarieven aan de afhandelaren te betalen.

Op deze manier zitten er voor de afhandelaren eigenlijk alleen maar voordelen aan. De vracht hoeft niet meer door de loods: dit scheelt ruimte en mankracht en ze voelen dit financieel niet. Het enige wat er extra moet gebeuren is het gesplitste ritje vanaf de VOP.

DB kan het maken om het zelfde bedrag te betalen aan de afhandelaren omdat de winst bij hen te behalen valt op de efficiëntie bij andere processen. De truckbewegingen kunnen verminderd (en daardoor de kosten) en de opslagkosten bij de afhandelaren vallen weg. Hierdoor is de implementatie van de fast-track bijna kostenneutraal. Ook zijn er nog andere positieve neveneffecten zoals; het meer efficiënt kunnen gebruiken van de eigen loods omdat de import vracht 's avonds al afgebouwd kan worden en 's ochtends doorgevoerd. Het scheelt DB Schenker soms bijna een dag aan transport tijd waardoor ze meer bestemmingen kunnen aandoen dan voorheen. In de praktijk begint, kijkend naar het vervoer uit het netwerk, DB Schenker Schiphol een Hub te worden. Alleen is formeel Frankfurt de Hub in het DB Schenker netwerk. Een zwak punt van de track is echter dat dit DB afhankelijk maakt van Skylink.

Gedeelde fast-track in de toekomst?

Ondanks dat een gedeelde fast-track voor DB betekent dat er concurrenten zijn die dezelfde snelle service aan kunnen gaan bieden, is het toch een aantrekkelijk idee.

De zekerheid die een gedeelde track zou bieden op de lange termijn en de onafhankelijkheid weegt op tegen de concurrentie.

Dit is natuurlijk wel het geval als deze fast-track faciliteit op de 1^{e} linie door een onafhankelijke partij gerund wordt. Daarnaast adviseert DB dat deze faciliteit zich vooral niet moet gaan focussen op andere 'Value added services'. Gewoon, simpel het doorduwen van vracht. Het liefst zou DB werken met timeslots voor de fast-track waarop expediteurs zich kunnen inschrijven.

Het positieve effect op de snelheid, grip & zekerheid die dit heeft op keten van de expediteurs moet duidelijk gecommuniceerd naar de verschillende partijen. Daarnaast is het zeer belangrijk dat de belangen van de verschillende partijen worden meegenomen in het ontwerp aangezien Schiphol een oligopolie is.

N7: Interview Aad Zonneveld - Douane Nederland – 18th of May 2015

Wanneer controle?
Alle controle wordt steekproefsgewijs uitgevoerd a.d.h.v. een aantal criteria. Het land van herkomst is een van die criteria, maar vaak wordt vracht natuurlijk met een transfer vlucht vervoerd en daar moet ook rekening mee gehouden worden. De Douane krijgt via het computersysteem informatie over de vracht binnen van de afhandelaren en expediteurs.

Controle expediteur?
Dit gebeurd momenteel ook weleens. De Douane stelt zich hierin zeer flexibel op. De vracht kan zowel bij de import als export stroom gecontroleerd worden bij de expediteur.

Import Douane processen
De Douane weet in principe 4 uur van tevoren welke vracht er binnenkomt op Schiphol. Met deze informatie bepaald de Douane a.d.h.v. de criteria welke pallets ze willen controleren. De vracht kan op 2 plekken gecontroleerd worden: het kan door de scan worden gehaald van de Douane of het wordt in de loods van de afhandelaar met het blote oog gecontroleerd (de scan zien niet alles). In het geval van de scan splitst de airside afhandelaar de vracht al op de VOP en rijden de pallets die gescand moeten worden met dollies naar de scan. Deze vracht wordt in 10 minuten gescand en daar weer naar de loods van de afhandelaar gebracht. Soms wacht de afhandelaar op de scan en in andere gevallen vertrekt de afhandelaar en haalt de gescande vracht binnen een uur weer op.

Export Douane processen
Export processen zijn iets minder belangrijk voor de Douane dan import omdat hier minder risico is (geen namaak business in NL en geen beschermde exotische diersoorten bijv.) maar desalniettemin is er genoeg reden om export ook goed te controleren (geestverruimende middelen).

Export vracht kan al bij de expediteur worden gecontroleerd, maar wordt meestal bij de afhandelaar gecontroleerd. Ook in dit geval weet de Douane 4 uur voor vertrek welke vracht er op de vlucht meegaat en beslist a.d.h.v. de criteria welke vracht ze willen controleren.

Vereiste aan een general fast-track faciliteit voor de Douane
In principe zijn er qua Douane processen geen expliciete eisen aan een fast-track faciliteit. Wel is het zo dat als er vanuit de fast-track vracht direct wordt doorgevoerd naar de 2^{e} linie bij een import proces, dat de truck waarmee de vracht vervoerd wordt goed geseald moet zijn en aan de standaarden van de Douane moet voldoen. De vracht verlaat in dit geval ongecontroleerd het Schiphol terrein en het is daarom belangrijk dat dit gecontroleerd gebeurd. De Douane heeft hier in dit geval in principe niks op tegen. Een eigen scan in de fast-track faciliteit is ook een mogelijk. Deze scans zijn wel duur dus de vraag is dan natuurlijk wie hier de kosten voor moet dragen.

Nieuwe douane complex
Het nieuwe Joint Inspection Centre is bevat een scan die voornamelijk voor export vracht bedoeld is. De vraag is nog of de vracht die door deze scan heen gaat via air of landside dan naar de afhandelaar wordt vervoerd.

Deze export scan neemt zowel Build-up pallets (BUPs) als losse vracht aan. In dat geval worden de losse pakketjes door de scan gehaald.

Toekomstige trends
Het is belangrijk om de trends binnen E-commerce te bekijken. Is de vracht over 10 jaar nog hetzelfde als nu? Doordat mensen meer op internet bestellen is de verwachting dat de vracht meer in losse pakketjes binnenkomt ipv bulk bestellingen door bedrijven.

Daarnaast is de verwachting dat de ULDs wellicht nog meer bij de expediteur worden opgebouwd in de toekomst. Als de expediteurs de opbouw en afbreek expertise hebben die de afhandelaren op de eerste linie momenteel hebben dat is hier in principe een mogelijkheid.

Verticale integratie van de vrachtketen is een uitdaging voor de toekomst, maar is zeker een manier om de keten efficiënter te laten werken.

N8: Dimitri Brink – Panalpina – 20th of May 2015

Dimitri leidt het Milkrun project. Dit project heeft hij toegelicht en resulteert in een sterke vermindering van het aantal truckbewegingen op Schiphol. Momenteel is de trial bezig. Voor de echte run zijn er al zo'n 17 aanmeldingen

Cargo
Zo'n 2/3 van de vracht die Panalpina overslaat is import, 1/3 is export. Van het totaal zijn zo'n 30% BUPs. Momenteel zijn de processen van Panalpina 2-voudig. Of de vracht wordt op de normale manier via de loodsen van de afhandelaren overgeslagen. De tweede manier is dat de vracht op de VOP gesplitst wordt en aan de airside kant van de afhandelaren blijft staan. Panalpina haalt (of brengt) dan aan airside de vracht op. Panalpina breekt en bouwt zelf op in hun loods. Deze expertise hebben ze zeker in huis. In de afgelopen jaar zijn er (naar schatting) slechts enkele pallets fout opgebouwd.

General Fast-Track
Voor expediteurs zoals Panalpina is het alleen maar voordelig als zij hun vracht op minder verschillende plekken aan hoeven te leveren. Een gecombineerde fast-track faciliteit is voor hen dus een prima optie. Mits, deze faciliteit door een onafhankelijke partij gerund word. Panalpina stelt dat geen enkele expediteur aan elkaar wil laten zien welke vracht zij exact vervoeren en dat airlines het niet zouden accepteren als hun vracht 'onder contract bij de ene afhandelaar' door een andere afhandelaar wordt doorgevoerd. De faciliteit moet dus hermetisch afgesloten worden.

Momenteel betalen de expediteurs een fee om import BUPs door de loods van een afhandelaar heen te duwen, maar deze fee betalen ze niet voor de export BUPs.

N9: Cargonaut – Nanne Onland – 4th of June 2015

Cargonaut Algemeen
Cargonaut is een community platform die informatieve informative uitwisseling ondersteunt binnen de partijen op en om Schiphol. Cargonaut verzameld en verwerkt data voor de hele supply chain en stimuleert innovaties voor of tussen verschillende partijen b innen de chain.

Cargonaut heeft heel veel informatie van alle partijen. De informatiedichtheid is tot zo'n 95%. Ze beschikken ook over data op commodity niveau. Dit is wellicht te delen voor dit onderzoek.

Projecten
Nieuwe initiatieven waar Cargonaut mee te maken heeft gehad of heeft geïnitieerd zijn bijvoorbeeld het Smartgate concept en de Milkrun.

Het smartgate concept heeft inmiddels geleid tot de bouw van het Joint Inspection Centre op Schiphol Zuid-oost en de Milkrun ondergaat momenteel een trial. De trial wordt gedaan door afhandelaar Menzies, Jan de Rijk als truck maatschappij en verschillende expediteurs.

Je zou Cargonaut wel een soort consultant voor de vrachtsector kunnen noemen.

Schiphol en Projecten
'Eigenlijk komt het er op neer dat er in de toekomst op Schiphol meer bedrijvigheid op minder grond moet' aldus Nanne. Schiphol is een van de weinige spelers naast Cargonaut die met een lange termijn blik naar de toekomst van Schiphol kijkt. Het vorige CPD idee is volgens Nanne op zich een goed idee maar was wel erg direct gepresenteerd aan de verschillende partijen.

'Als je een idee presenteert moet het op een zachtere manier, omdat je anders de partijen niet goed mee krijgt. Probeer je beweegredenen te verduidelijken en te zorgen dat hier begrip voor is. Als je dit probleem gaat presenteren voor stakeholders: proberen het toekomst probleem te schetsen en te laten zien hoe dit voor iedereen een oplossing is.'

General Fast-track
Een general fast-track facility is een oplossing voor het probleem 'Je wilt meer in minder'. Op zich een goed idee alleen moet er wel draagvlak voor zijn en moeten de volumes groot genoeg zijn. Er vooral: iemand (in dit geval waarschijnlijk schiphol) moet het initiatief nemen om de dergelijke faciliteit te bouwen. Dit zou dan volgens het Build- Operate-Transfer principe kunnen gaan.

De echte uitdaging bij een green fast-lane is de truck kant. Je wilt een hoge load factor, Just in Time pick up en een seamless aansluiting. Daarnaast is een interessant vraagstuk hoe je wellicht kan stimuleren tot het uitplaatsen van pallet opbouw (bijvoorbeeld extern experts plaatsen).

Het institutionele ontwerp is interessant en dan vooral: Hoe ga je het implementeren en aan de man brengen?

N10: Tour Menzies – Ramon Baas – 10th of June 2015

Menzies General
Menzies heeft een grote import en export loods waarin de vracht per bestemming gescheiden staat. Er is een groot deel gereserveerd voor vracht van KLM (voormalig Martinair).

In de loods liggen in totaal 4 fast-tracks. Hiervan worden er 3 door Menzies zelf bediend. 1 van deze drie tracks wordt voornamelijk voor bloemen gebruikt, de andere twee tracks voor alle andere vracht. Deze twee tracks liggen naast elkaar en hebben een ETV systeem in het midden. De opslag (oftewel de buffer) van de track zit er bovenop. De tracks worden beide voor import en export gebruikt, ze zijn dus flexibel.

De 4^{e} track is een dedicated import track voor de bloemen van Kuehne Nagel. Kuehne opereert zelf aan deze track. De verantwoordelijkheid voor de vracht is als het ware verschoven van het laden van de trucks aan landside tot aan het laden van de track aan airside. Eigenlijk verzorgt Menzies alleen nog maar de airside handling voor deze vracht.

Proces import
Op de VOP weten de airside handlers van Menzies welke vracht naar welke ingang van de loods moet. Er kunnen bijvoorbeeld 30 pallets BUPs zijn waarvan er 20 naar de Kuehne track moeten en 10 naar de eigen track. Deze informatie krijgen de airside handlers mee van de control room.

Deze informatie komt uit de Final Flight Manifest die via de computer op 'de point of no return' wordt nagestuurd na een vlucht. Vaak week je dus al een uur na vertrekt van de vlucht wat er *echt* aan boord zit. Want soms komt een pallet toch niet mee en zit het papierwerk wel aan boord van de vlucht.

Proces export
8 uur van tevoren moet de vracht zijn aangeleverd en 4 uur van tevoren moet de vracht klaarstaan om naar de VOP te gaan. Gebeurt dit niet dat wordt de airline gecontact. Soms is de zending zo belangrijk dat de airline hierop wil wachten. Op de export track wordt de vracht gecontroleerd op gewicht en afmetingen. Als deze niet goed is opgebouwd wordt het eraf gehaald en wordt de airline gebeld. Als het een transfer pakket is of internationale vracht dan wordt op een van de 'workstations'(opbouwplekken) de pallet heropgebouwd. Komt de vracht gewoon uit NL dan wordt vaak gevraagd of de expediteur het weer komt op halen of tegen betaling in de loods heropbouwen.

N11: Interview ACN – Ben Radstaak 11th of June

Air Cargo Nederland

ACN is de brancheorganisatie van de luchtvracht sector in Nederland. Ze vertegenwoordigen alle partijen in deze sector en stimuleren partijen om samen te werken en te innoveren. Voorgaande projecten waar ACN een actieve rol in heeft gespeeld zijn onder andere het Smartgate concept, E-link en de ACN-kaart. Momenteel zit ACN ook verwikkelt in het Milkrun concept. Dit is nu aan de gang (er is al eerder een trial geweest) met een afhandelaar en meerdere expediteurs maar de verwachting is dat dit snel uitbreidt mocht het succesvol zijn.

De general fast-track faciliteit

Het is goed om voor het ontwerp van een FTF een greenfield te schetsen. Alle afhandelaren zitten op Zuid-Oost en er is bijvoorbeeld een partij die hieraan meedoet. Kijk in zo'n situatie eens hoe het zou werken.Het is handig om te weten uit hoeveel pallets een AWB bestaat. Omdat alleen als je kleinere aantallen BUPs die nu naar verschillende afhandelaren gaan kan combineren dan reduceert het aantal truck bewegingen. Cargonaut kan waarschijnlijk wel Airway bill data verstrekken. Het is belangrijk om te controleren of hier ook de AWB's van het road feeder network tussen zitten.

Je kan ook naar het aantal colli's kijken, vaak is het een BUP als er een colli op een plaat staat. Maar bij bloemen zitten er vaak wel meerdere colli op en is het toch allemaal voor Aalsmeer, dus dat maakt het weer lastig.Wellicht de expediteurs bellen om te vragen uit hoeveel pallets gemiddeld een BUP zending bestaat. Dit om hier wat grip en gevoel voor te krijgen. Expediteurs die grote zendingen doen zijn bijvoorbeeld DHL Global Forwarding, DB Schenker, Expeditors en Kuehne Nagel.

Dollyritten airside

Daarnaast is het interessant om te kijken naar de dolly bewegingen aan airside. Als er een faciliteit komt die aan een 1st line van 2 km staat dan moeten er veel meer dolly ritten gereden worden dan dat er nu gebeurt. Wie zou er opdraaien voor de kosten van die dolly ritten de extra medewerkers die daarvoor ingeschakeld zouden moeten worden? Daarnaast is de trend dat de full freighter vracht verschuift naar belly vracht. Dit betekend dat de kisten aan de pax pieren staan opgesteld, nog een eind verder dan de huidige freighter VOP's op Zuid-oost. Misschien moet dit in een scenario meegenomen worden?

Wellicht is het ook handig om verschillende scenario's te schetsen aangaande 1, 2 of misschien wel 3 verschillende fast-track faciliteiten aan de 1e linie neer te zetten. Dit scheelt natuurlijk weer dolly ritten. Als er veel kleine aantallen BUPs uit vluchten komen dan is een faciliteit misschien genoeg. Als er grote aantallen uitkomen (wat mr. Radstaak vermoed) dan zijn wellicht meerdere faciliteiten nuttiger.

Trucks

Het is van belang om te controleren welke truck maatschappijen eigenlijk allemaal rollerbed trucks hebben. Niet alle trucks kunnen BUPs vervoeren. Jan de Rijk en Bos logistics hebben het sowieso wel. Misschien is het een idee om de grote expediteurs te bellen en te vragen welke trucking maatschappijen zij gebruiken als ze BUPs willen vervoeren.

Financiën

Bekijk hoeveel momenteel DB Schenker betaalt aan Skylink en aan de afhandelaar. Kijken of er een break-even punt te vinden is waarin het goedkoper is voor de afhandelaar om de vracht door de FTF te doen i.p.v. door de eigen loods.

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