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Abstract (Provide an abstract of the mini-dissertation. An abstract is a short summary of the contents covered in the item.)	The demand in the warehouses fluctuates at different periods and the labour needed over these periods differs as well. The paper covers the planning of labour that can be used to satisfy the monthly demands in 3 warehouses at Bidvest Panalpina Logistics company for the year 2013.
Category (Enter the category in which the project was done. E.g. Operations Research, Simulation, Logistics…)	Simulation, Logistics and Operations Management

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Annual Labour Planning
At Bidvest Panalpina Logistics

by

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Submitted in partial fulfillment of the requirements for the degree of

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Executive Summary

Bidvest Panalpina Logistics (BPL) aims at providing world class supply chain solutions for their clients. These clients are from different industries ranging from mining to fast moving consumables. The BPL operations can be divided into the contract logistics and the De-group operations. One of the most important sectors within BPL is the warehousing department.

The annual volumes of the operations peak at different times of the year and the labour requirements will be at its highest during the peak period however it will not necessarily be the lowest during the slow times of the year. During peak periods casual labour is recruited to fulfill the increased labour requirements in the short term. Thus an annual labour forecast is required to minimize labour costs by optimizing the labour recruitment numbers throughout the year.

This project will cover the annual labour requirements of the De-group operations. The main deliverable of the project is a hiring schedule for the company that will enable them to meet the demand at the lowest possible cost. This paper ends by giving a workforce annual plan for the year 2013 that was created with the help of the simulation model. This plan is the main deliverable that management can use for hiring and firing labour.

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Chapter 1

1.1 Background and Introduction

Bidvest Panalpina Logistics (BPL) is a logistics company whose mission is to provide world-class Supply Chain solutions that are aimed at the transformation and expansion of the reach of their clients' businesses globally. As considered a leader who provides global supply chain and logistics services, Bidvest Panalpina Logistics provides all-inclusive door-to-door solutions for any consignment extending from rail, road, sea or air consignments, to and from anywhere in the world and throughout South Africa.

One of Bidvest Panalpina Logistics' main focus is on the delivering of practical solutions to their customers, and these solutions optimize their clients' overall supply chain effectiveness and also improves the operational effectiveness and cost. The solutions include global forwarding, warehousing, transportation, supply chain management and consulting, financial services and customs solutions. The total are that is occupied by the multi-user warehouses of BPL is estimated at around 180 000 square meters.

Comprehensive security, safety, health, environmental and quality systems are in place at all the warehouses. To assist in the delivering of world class warehousing solutions of high standards, there are a couple of measures in place at BPL; these include advanced training programmes, equipment and urbane computer systems. The company has a firm assurance to employment fairness, training and expansion which are all intended at safeguarding the progress and improvement of employees.

Continuous investment in state-of-the-art materials handling and IT equipment ensures efficiencies and improved service delivery. It includes vehicles ranging from 1.4 Tons reach trucks to 32 Tons straddles, sheathable trailers, and particular forklift clamps, GPRS tracking systems, RFID technology and a complete range of racking systems.

Bidvest Panalpina Logistics' experience and understanding of complex supply and demand chains allows it to synchronize cargo flows through its infrastructure, inclusive of customized warehousing, transport and distribution solutions, with the objective of increasing the overall efficiency of clients' particular logistics requirements.

1.2 Warehousing value added services

- Order fulfillment
- Picking and packing
- Specialized handling
- Order mixing
- Scanning of bar-codes
- Inventory reflectiveness
- Inventory and Warehouse management
- Bonded warehousing
- Advanced and reliable security proficiencies
- Extended logistics services, including sea, air, transport, warehousing and supply chain optimization
- Industry vertical tailored solutions

1.3 Problem Statement

The annual volumes of the operations peak at different times of the year and the labour requirements will be at its highest during the peak period however it will also be the lowest during the slow times of the year. During peak periods casual labour is recruited to fulfill the increased labour requirements in the short term. Thus an annual capacity plan is required to minimize labour costs by leveling the labour recruitment numbers throughout the year as per required number. The use of casual labour is sometimes not the best option for recruiting labour since it slows down the productivity of the company. The problem is that sometimes there is an over-utilization of labour and other times the workforce is under-utilized. This causes a burden on the company since they sometimes pay labour that is not really required and sometimes they pay for less people than is required, therefore their service time will be slowed down than expected.

1.4 Project Aim

The main aim of the whole project is to determine an optimized capacity plan that will be used for hiring moving around workers within the BPL divisions. The forecast will be a yearly plan that outlines the number of people required in each warehouse at different times of the year. The purpose of the annual labour plan is to assist the warehouses to achieve the best possible service level with a minimum labour cost being incurred by the company.

In order to achieve the set goal, there are a number of objectives that are there to provide a guideline of what has to be done. The objectives are as follows:

I. Investigate the inbound and outbound volume curve for the operations In the BPL warehouses based on historical data.

II. Data of the number of transactions that were processed during the year 2011 was collected and documented as per different groupings that are available in Unit 2 warehouse and it was grouped into monthly segments. These data will be used to determine the input of work into the warehouse and the amount of output that is expected per month. For this data to be more useful, an assumption is made that the difference between the 2011 data and what can be considered for 2013 is an increase of 10% from both the input and output transactions.

III. Investigate the skills gap that is created during the peak periods of the operations by use of a simulation model.

IV. Investigate the ideal personnel numbers at different positions for the annual inbound and outbound volumes flow.

V. Investigate the applicability of the ideal annual personnel numbers based on the BPL volumes

1.5 Project Scope

The project will mainly cover the de-group operations (consolidation) side of Unit 2 warehouse at BPL and will not consider the contract logistics part of the warehouse.

Chapter 2

2.1 Literature Review

In order to solve the problem of knowing how many workers of specific skills are required each month at the 3 different warehouses in order to meet the demand and also improve the service level of the company and also taking into consideration the cost implications of hiring more permanent workers or even using casual labour, a model has to be developed in order to optimize the labour-scheduling. In this chapter, a study of existing literature is compiled with the aim of finding the best possible method that can be used to create a model that will solve the problem being faced by the company.

2.1.1 Investigation of current environment

Investigating time-dependent data and forecasting future data of a time series are amongst the most significant difficulties that analysts face in many fields, extending from finance and economic, to managing operations of production, to the analysis of political and social policy sessions, to investigating the impact of human and the policy decisions that they make on the environment (Montgomery, Jennings and Kulahci, 2008).

It is said that the use of TESs (Temporary Employment Services), also known as ‘Labour brokers’, poses a huge thread to the productivity of the company itself and that there is high job insecurity for the workers who fall under those TESs since they only make use of them when there is a demand for them from clients (Hastie, 2011). Most companies that have an uncontrolled demand throughout the year are faced with a challenge of trying to meet the demand whenever it occurs and on the other hand, the South African Government is trying to limit the use of Labour brokers since they are said to be unfair to their workers.

2.1.2 Forecasting

It is common to classify forecasting as more art-based rather than being science-based.

There exists a wide variety of forecasting models and no single model is known to be universally applicable. When a forecasting technique/procedure is to be chosen, there are certain sets of conditions that have to be taken into consideration. Forecasting is the estimation of the value of a variable (or set of variables) at some future point in time. Under normal conditions, a forecast is usually completed with the aid of providing assistance for planning for the future and also decision-making purposes (Beasley, 2011). Normally such work is done with the hope that if we can predict or project into the future now, we can be able to adjust our behaviour or plans in order for us to stand in a better position in the future, than what we would have had if no forecast was available (Beasley, 2011).

Montgomery, Jennings and Kulahci (2008:2) discuss the areas business where forecasting can be successfully applied. The list of the areas is given as follows:

- *Operations Management*: Most businesses usually make use of forecasts of sales of products and/or their service's demands in order to plan production, monitor inventories, manage their supply chain, plan capacity and determine staffing requirements. Sometimes forecasts can assist in predicting the future expected product mixes or services and also the specific sites where each of the specific products have to be manufactured/ produced.
- *Industrial Process control*: forecasted values of the future in regards to perilous quality features of a production procedure can be useful in the determination of when significant well-regulated variables in the process have to be altered, or even when the process must be switched off or even revamped. Both feedback and feed-forward control systems are extensively used in observing and fine-tuning of industrialized processes, and estimates of the process' output are fundamental part of these methods.
- *Marketing*: A forecast of sales reaction to advertising overheads, new promotions, or even changes in the policies of pricing allows organizations to assess their success, define the degree in which they are meeting their goals, and make amendments.
- *Economics*: A clear forecast of key economic variables such as gdp (gross domestic product), inflation, unemployment, job growth, population growth, rates of interest, consumption, and production is required by Governments, financial institutions and policy organizations. These kinds of forecasts form a crucial part of the regulation behind financial and economic strategy and accounting plans and judgments made by

administrations. They also have a contribution to the premeditated organization decisions made by corporate and financial organizations.

- *Finance and Risk Management*: forecasts are an interest to investors in financial assets since they use them to predict the returns from their investments. Some of these assets may include commodities, stocks and bonds. Other venture resolutions can be made with relation to predictions of the rates of interest, rates of exchange of currency and options. The importance of forecasts to financial risk managers is to predict the unpredictability of returns on assets in order to make sure that the risks associated with investment assortments can be estimated and insured, and to make sure that a proper pricing can be determined for financial derivatives.
- *Demography*: Most countries and regions normally have routine forecasts of the population, and these are stratified by factors such as age, race and gender. The forecasts made by demographers such as deaths, births and migration patterns are then used by governments for the planning of policies and actions pertaining to social services, such as retirement programs, antipoverty programs, and spending on healthcare. Forecasts of population by age group is also for many businesses since they use these information to compile tactical plans concerning the development of new products or the kinds of services to be offered.

Chatfield (2004) classifies forecasting methods into three broad groups explained below:

I. *Subjective*

The kinds of forecasts that are completed on a subjective foundation are those made by judgement, instinct, viable knowledge and any additional appropriate information. A wide variety of methods are available for this kind of forecasting, and they range from freehand extrapolation to the Delphi technique. In practice, you will find that most forecasters do not use these kinds of techniques due to the fact that most of them would want their forecast to be at least a bit objective rather than fully subjective. Rowe and Wright (1999) is one of the references that is available for readers who are interested in finding out more on subjective forecasting. Nonetheless, we should take into mind that some subjective judgement is sometimes applied in a more statistical approach, for example, when we choose an appropriate model and perhaps make adjustments to the resulting forecast.

II. *Univariate*

Under this classification, we find that forecasts of a given variable are based on a method fitted only to present and past observations of a given time series, possibly augmented by a simple function of time, such as a global linear trend (Ferreira, 2011). These kinds of methods are referred to as naïve or projection methods.

III. *Multivariate*

Under this classification forecasts are partly dependent on values of one or more other series, referred to as a predictor/ descriptive variables. As an example, the sales forecasts may dependent on stocks and/or on economic guides. The models from this type of forecasts are sometimes referred to as casual models.

Usually in practice we find that forecasting procedures may involve a combination of the above mentioned approaches. Chatfield (2004: 74-75) makes mention of the below mentioned points as some of the important points that will determine the method to be chosen:

- The way in which the forecast is intended to be used
- The type of time series and all of its properties. A time plot of the data is always useful.
- The exact amount of observations that are available for use
- The planned extent of forecasting prospect
- The quantity of sequence to be predicted and the allowable cost for each series
- The capabilities and experience of the analyst.

It is of vital importance to elucidate the intentions; it basically means identifying exactly how the forecast will essentially be used, and if either it will influence the future or not.

Up until this point, the theory seems to show that the problem faced in this project could be addressed through the use of a time series forecasting technique. The main goal of this approach is to extrapolate the behaviour from the past into the future. This data/ information can be analyzed to identify a trend and can integrate the trend that is present inside the firm's corporate tasks (Arsham, 1994). This type of model may be developed via automatic or non-automatic means. Automatic forecasting is the use of software to develop the model, while non-automatic forecasting is when the model is built manually.

There are various models of forecasting to choose from when using the time-series modeling approach. These models will be discussed briefly in the next sub-chapter. The diagram below shows a flow chart of a typical forecasting system; it starts with attaining of data from the past up to the point where the final forecast in being updated. The system has two main categories; firstly it is the analysis of data and the selection of appropriate model to be used. The second part is the actual development of the forecast.

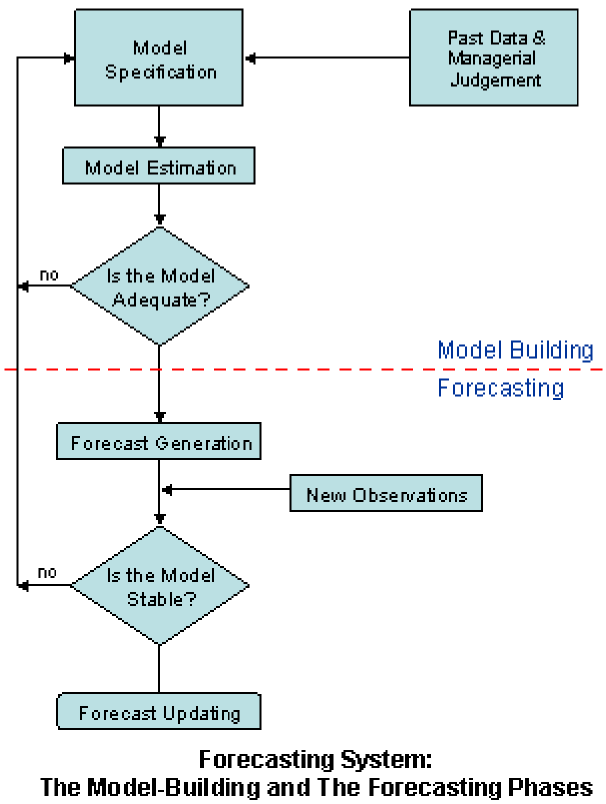

Figure 1: Forecasting system (Arsham, 1999)

2.1.3 Workforce Planning

There are a number of ways that different human resource managers in different companies do their yearly plan, especially when it comes to planning of the workforce capacity is to be needed at the different periods within the entire year. The most challenging workforce planning/ forecasting is one where labour is required to do a certain capacitated-task and the amount of work is not constant and it fluctuates depending on the period of the year. Such companies could include, but not limited to, manufacturing companies, warehousing companies and services companies.

Human resource managers tend to look at strategies of planning for this labour so as to avoid a shortage or excess number of workers being hired at a certain period in time since this could impact the productivity and financial status of the company if not well planned. For most of these companies, they relate their productivity to the standards that they require, especially in labour productivity, then they use this to plan for their labour in the future by looking at the expected total work during those particular periods, then they match that to the number of workers hired during that period.

The general classification of workforce forecasting methods that is based on the utilization of past data can be divided into two main categories. There are also some methods available for forecasting that are not reliant on the past data and these methods include employer's survey, labour market signal analysis and international comparisons. On the contrary, the reliance and use of past trends is what gives basis to the labour-output ratios approach or input-output analysis. There is an availability of some refined macroeconomic modeling techniques that are being used in some of the advanced companies in the world, but also with these techniques, there is a need for some input parameter estimates that are extracted from past economic data.

So far, there has been no perfect method that has been found to be effective in forecasting the need of workforce in many industries. The availability of relevant data from the past is a precondition for the use of methods that are reliant on past trends in forecasting what will be required in the future. Nevertheless, by considering the dynamic nature of markets, we would find that the most reliable and detailed past data would not be sufficient for drawing up a conclusion about the forecast. Yet, methods without the availability of past data have to rely on subjective opinions that could prove cumbersome long-term forecasting (Kwon, 2000). It would, therefore, be of great importance to identify a method that combines the two approaches available into one and it would output the desirable results.

2.1.4 Simulation

A simulation is the modelling of the process of real-world system over time. Regardless of whether it is done manually by hand or by computer, a simulation requires the generation of an artificial history of a system, and the observation of that artificial history is used to draw inferences concerning the operating characteristics of the real-world system.

Simulation enables the study of and experimentation with, the core interactions of a complex system, or of a sub system within a complex system. Changing simulation inputs and observing the resulting outputs can help you to obtain valuable understanding of which of the variables are more crucial and how variables interact. Simulation can be used as an informative device to support systematic solution methodologies. Simulation can be used to experiment with new designs or polices prior to implementation, so as to prepare for what may happen. Simulation may also be used to predict (forecast) demand for the future and how to handle the demand.

A simulation can be used in a demand management system to make sure that the forecasted demand is met, either through production or through labour planning. Experiments can be done on simulation software that will allow for changes to the system in order to see which situation would best suit the planned/ forecasted demand. A sequence of steps has to be followed in a typical simulation study;

- Problem Formulation.
- Setting of Objectives and overall project plan.
- Model conceptualization and Data collection.
- Model Translation, its verification and validation.
- Experimental Design.
- Production runs and analysis.
- Documentation and Reporting.
- Implementation

2.1.5 Using simulation to schedule resources

The manufacturing industry has shown interest and they are carrying out research on combining scheduling, capacity planning and discrete event simulation in their work environment. Scheduling is the process of deciding how to commit resources between a variety of possible tasks. Capacity planning is the process of determining the production capacity needed by an organization to meet changing demands for its products. Infinite capacity and static time calculations are the techniques that were traditionally used in capacity planning and scheduling. Quite often the results are inaccurate and non-representative solutions to very important questions (Thompson, 1993).

In one of their research, Drake and Smith (1996) have a formulated framework that can be used for online simulation in scheduling, controlling and planning of manufacturing systems. The simulator that they used allows for input of various rules of scheduling and is written in SIMAN. Kunnathur et al. (1996) have also developed a rule based expert system that is driven by a simulator model for dynamic shop floor scheduling. Simulation and scheduling were implemented in a real world scenario at AMP+AKZO company where 80% of their customer delivery requirements change on a weekly basis (Flower and Cheselka, 1994).

Chapter 3

3.1 Solution Generation

In order to achieve/ reach the objectives/ goals stated in an earlier chapter, a certain approach has to be followed in the design of a solution for the project's problem. There is also some data and information that was collected that would help in the modeling and solution generation. The following procedure will be followed until the solution is met:

1. A simulation model of Bidvest Panalpina Logistics' unit 2 warehouse will be modeled. This model will be based on the process flow of all the activities from that start from the receiving of the cargo at the receiving bay until the cargo is being fully transferred into the dispatch cages.
2. The time factor of the activities in the simulation model will be based on the performance measurement with respect to time that was compiled through a time study at the warehouse over a two month interval at different times of the day. The average time will be used for simplicity.
3. The labour resources and allocation of these resources will all be based on an operational profiling that was compiled at Unit 2 warehouse.
4. There are some warehouse management equipment that are required in the warehouse to carry out the tasks, the data about these equipment was collected and documented and these equipment will be allocated to specific activities in the simulation model of the warehouse.
5. Data of the number of transactions that were processed during the year 2011 was collected and documented as per different groupings that are available in Unit 2 warehouse and it was grouped into monthly segments. These data will be used to determine the input of work into the warehouse and the amount of output that is expected per month. For this data to be more useful, an assumption is made that the difference between the 2011 data and what can be considered for 2013 is an increase of 10% from both the input and output transactions.

6. After the whole model has been completed, a simulation will be run for that specific month. How this is going to happen is that the data that was collected for each month will be divided equally among a 28 day month whereby 20 of those days are active working days and the average time worked per day will be 8 hours per day; then a day's simulation will be ran and there will be 20 iterations for each day in order to cover up for all the working days of the month. This is an assumption that was agreed upon the Industrial engineers at Bidvest Panalpina Logistics.

7. The simulation report for that month will be studied in order to see the resource utilization for that month, especially the labour resource since that is the main objective of the project: to balance out the workforce in the warehouse per month. Then these utilization results will be studied to find out if there is under- or over-utilization of the labour resources.

8. Depending on whether there is under- or over-utilization of labour resources, labour resources will be added or subtracted respectively in order to make sure that there is balance between the required workforce and the available resources in the simulation. The addition and subtraction of resources will be done as an experiment until the required utilization levels are obtained for each and every month.

9. A list that highlights the number of workers required per skill group will be compiled for each of the months. These numbers will be compared to the number of workers that are currently available in the warehouse.

10. Bidvest Panalpina has two other main warehouses around the same vicinity as Unit 2 warehouse, these warehouse are called Rockwell automation warehouse and NSN warehouse. From these warehouse, information has been collected and a study was done in the past that reflect the number of people that are available in each of the warehouses and the number of workers that are actually required in each of the warehouses at different periods. A projection was made and the details of these labour requirements for 2013 in these warehouses are compiled and it will be used in this project as given.

11. The requirements of these other 2 warehouses will be considered and the shortages and additional labour resources of those warehouses will be noted. Then these will be compared with those of Unit 2 warehouse labour requirements. The plan is to see how many of these people can be moved around each month in order to try and have all the labour working effectively somewhere, every month. This is a cheap way of meeting the productivity target at minimum labour cost.

12. The final output would be a work schedule showing how many people, per skill type, will be required in each of the warehouse and how many, if any, part-time workers they would need to hire at a specific month.

13. What this project does not focus on is the actual rough-cut capacity planning of the labour since this would need financial information of employment and it is unfortunate that Bidvest Panalpina Logistics' financial department is not willing to publicly disclose such information, so that part of the implementation would be considered after in a different project.

14. The implementation of the project's outcome is not guaranteed since this is going to be a concept to prove to management that such a system can be used in order to achieve the best probability standards at minimum labour cost.

3.2 Process Flow Diagram

In Unit 2 warehouse section, the warehouse is divided into 4 main groups. These groups are:

I. General cargo operations;
II. HP operations;
III. IBM operations and
IV. Contract logistics

The project will only be focused at regulating labour from the first 3 divisions, i.e. it will exclude the contract logistics side of the warehouse since it is controlled by a different Human Resource Manager. The diagrams below show the process flows that take place in the 3 different divisions.

The process flows will be useful in the modeling of the operations of the warehouse in Arena. It should be noted that in all the three process flows, the process are sometimes similar, except for a few documentations that are required and a few other processes that occur depending on the division's requirements. For this reason, the process flow diagrams will be combined into one cumbersome simulation model that will take into account, all those differences highlighted in the process flow diagrams.

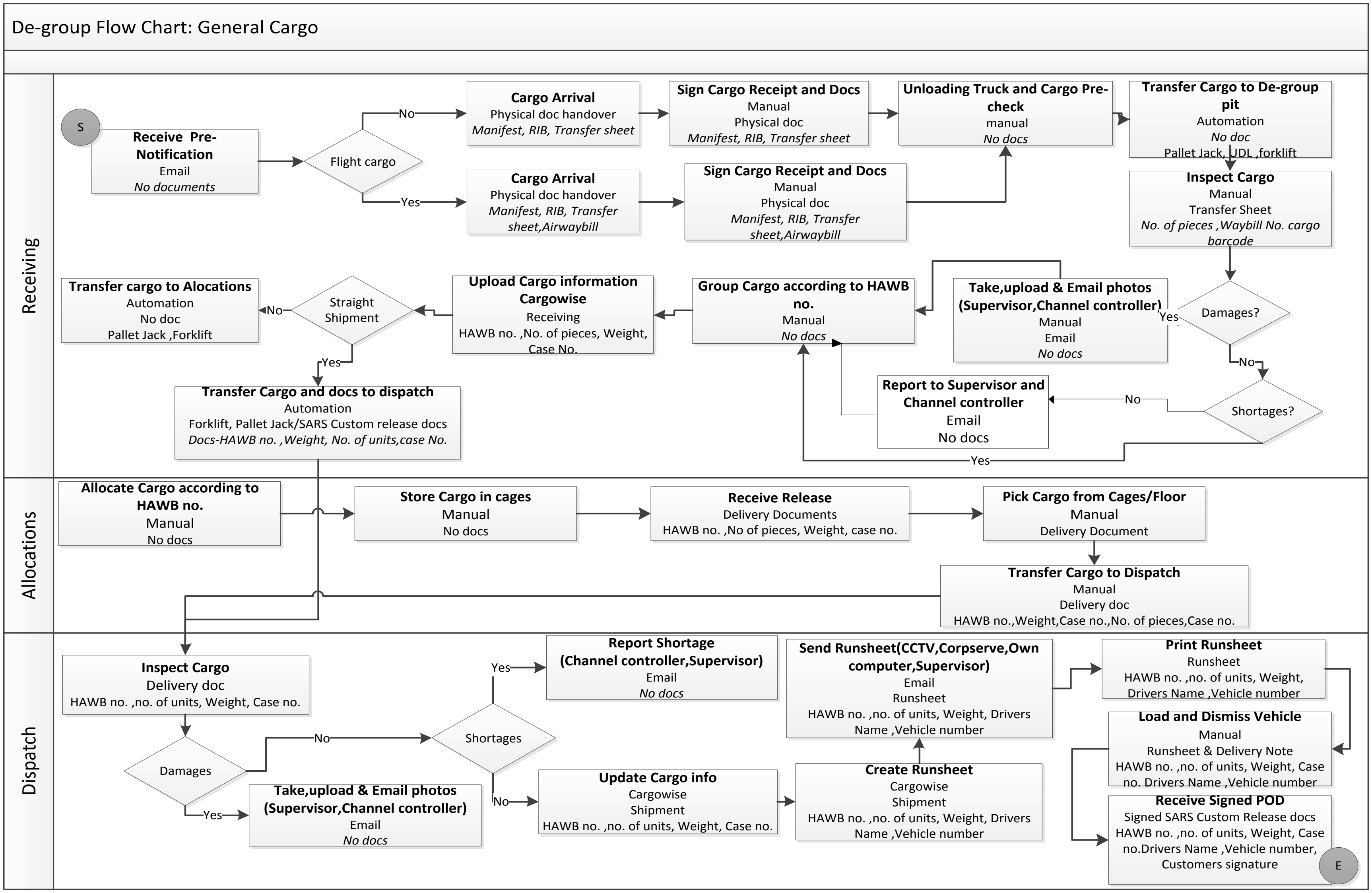

Figure 2: Process flow diagram (General cargo)

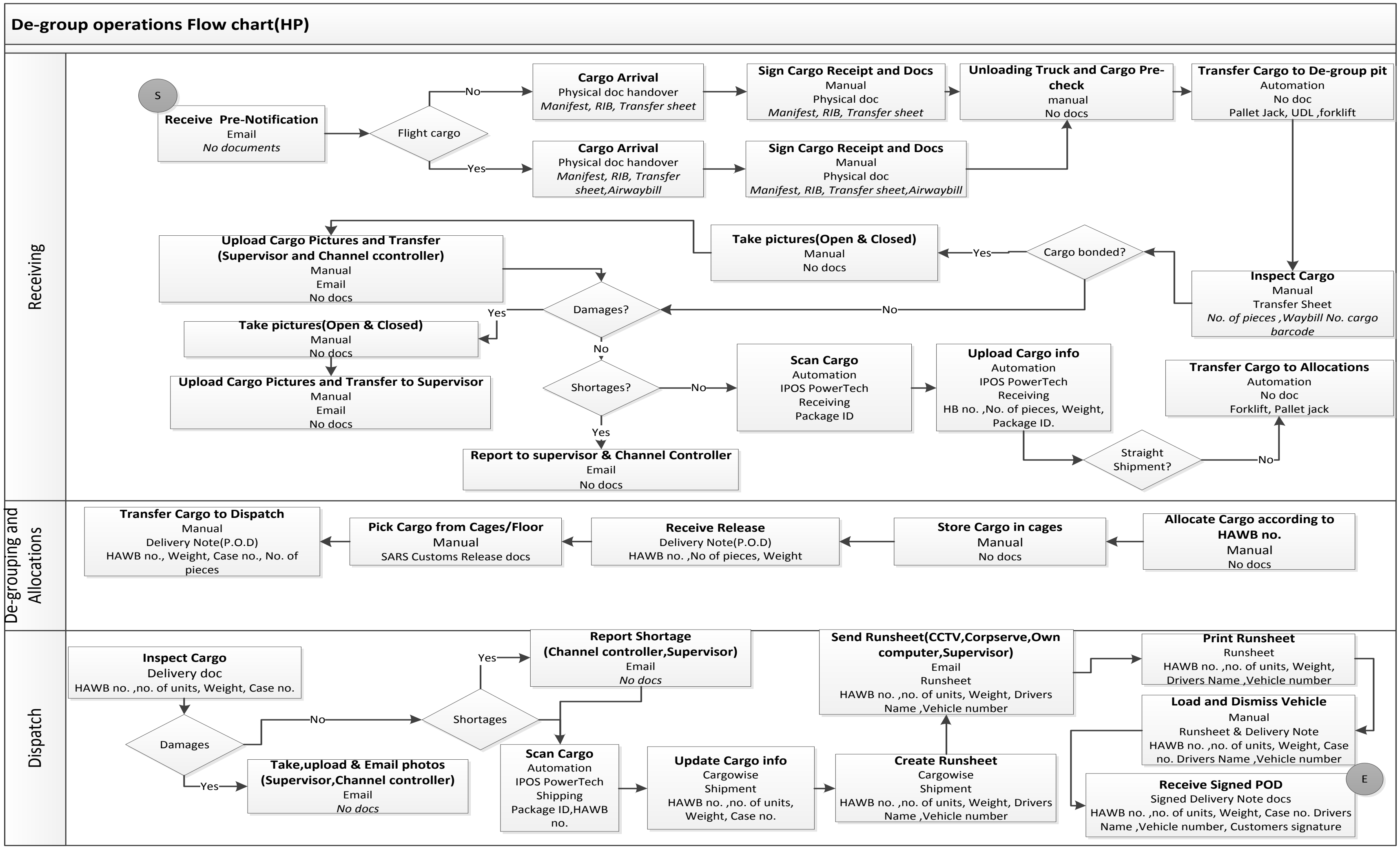

Figure 3: Process flow diagram (HP)

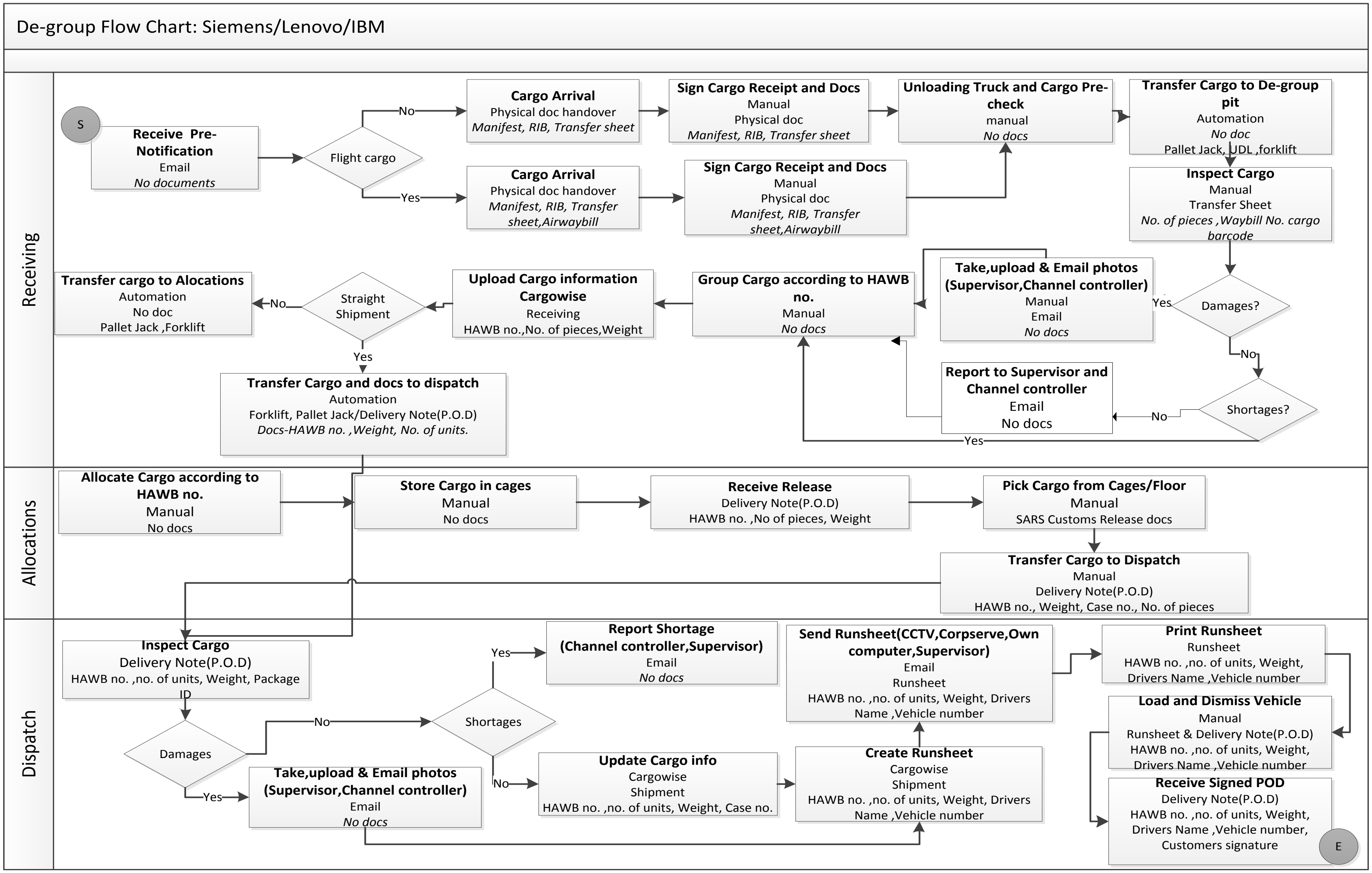

Figure 4: Process flow diagram (IBM, Lenovo)

3.3 Operational Profiling

In the operational profiling section, this is where a description of all the skills that are required in the warehouse are described and it also gives a clear head count of the labour in the warehouse at the moment.

Job Title	Job description	Other duties they can perform	No. of people	Mandatory requirements for job
Fork lift driver	-The drive forklifts and ULD carriers around the warehouse	-General works	8	A forklift drivers' license is required
Supervisor	Responsible for monitoring the performance of all workers within their departments	-General works -Dispatch coordinator -Administration work -Cargo coordinator	3	Have to have a general view of all the other jobs within the warehouse so that the can be able to know what is exactly expected from each of the workers in the warehouse
Dispatch coordinator	Responsible for the arrangement of a run-sheet for the purpose of the cargo that is to be loaded to a truck and delivered to the relevant client(s). Also confirms that the expected number and type of cargo is loaded onto the truck. Also responsible for performing damage report for cargo that is about to be loaded into a truck for deliver.	-General works -Cargo coordinator -Admin work	10	Need to be computer literate and be careful when checking the cargo for completeness.

Admin Clerk	Responsible for the provision of all the delivery notes being requested by different clients.	None	2	General administration knowledge and good organizational skills
Cargo coordinator	Responsible for receiving cargo and also allocating cargo into the corresponding houses and updating the received cargo onto Cargowise. Also responsible for doing damage reporting for cargo that is being received.	-General works -Dispatch coordination	12	Need to be computer literate and be careful when checking the cargo for completeness.
General worker	Responsible for all general warehouse management tasks. These tasks includes arranging of shipments into the specific houses; using of pallet jacks to move cargo on pallets; manual offloading of cargo from trucks; cross-docking responsibilities.	None	16	Must just have a sound knowledge of the operations in the entire warehouse

Table 1: Operational profile

This data will be useful in the allocation of duties in the simulation model. These people will become the labour resources of the simulation model.

3.4 Simulation Model

A simulation model has been developed in order to conceptualize the processes in Unit 2 warehouse at Bidvest Panalpina Logistics. The overall simulation model was based on the process-flow diagrams that are shown in Chapter 3.2 earlier. The process-flow diagrams were combined together to form one simulation model of the warehouse as it is now. Some of the processes in the flow-chart were combined together to make the model simpler but the model still represents the warehouse. The figures below show the simulation in detail and the purpose of all the modules in the simulation model will be discussed later in Chapter 3.5.

The pictures of the simulation model are included in the appendix at the end of the document.

3.5 Simulation Definition

From the latter sub-chapter, the simulation model is shown as on the simulation program (Arena). This chapter will take a step further and try to give an overview of why each and every module in the process is being included in the simulation model. The information on these modules will be as brief as possible.

3.5.1 Create Module

I. <u>Arrival of cargo</u>

This is the beginning of the process; it is actually the number of transactions (deliveries) that are made of incoming cargo coming from the airport or from a client. This is based on the number of transactions made in the previous months: This value from the same month in the previous year is increased by 10% and divided by 20 days in order to get the average daily transactions (It has been assumed that the number of transactions in a day are equally spread between the 20 working days of that particular month). There are different numbers of transactions that take place at different months so these values will change depending on the monthly transactions. Only one entity will be recorded on one arrival (i.e. the full truckload that is being received)

3.5.2 Assign Modules

I. <u>Received</u>

This module actually makes sure that all the incoming cargo is given a different variable number and this number actually keeps track of the number of deliveries received into the warehouse on a particular day. As seen above this module, there is a variable animation bar that shows the number of incoming deliveries that are received into the warehouse while the simulation is in running.

II. <u>Horse and trailer cargo</u>

There are two types of trucks that deliver cargo into the warehouse, i.e. Horse and trailer and also container trucks. So this module assigns the cargo an attribute value of 1 to show that it is a cargo from the horse and trailer. This assignment will help in identifying the cargo later in the simulation. The attribute is called the Cargo size.

III. <u>Container Cargo</u>

As explained by in the Horse and trailer assigned module, the other truck type is the container truck. This assign button assigns the cargo going into this side an attribute value of 2. This will also assist in the identification of this type of cargo later in the simulation. The attribute that is assigned here is called the *Cargo size.*

IV. <u>Pallet Assignment</u>

After a process of unbundling the received cargo onto pallets, the cargo is assigned an attribute value of 22 under this module in order to identify that the cargo was packed onto 22 different pallets. The attribute under this is called the pallet size.

V. <u>Pallet Assignment 2</u>

Same as in the Pallet Assignment module, the pallet size attribute value is assigned to the entities passing through the module, the only difference is that in this case, the new attribute value is 18 to symbolize that the cargo was packed onto 18 pallets.

VI. <u>Ready for delivery</u>

After the cargo has been allocated into different houses, it is now know how many pallets will be delivered with which truck and which pallets will be delivered together. Based on completed number of scheduled deliveries, there is a need to keep record of all the cargo that is available in the warehouse and awaiting delivery; this module helps us to assign a new variable value to the *No_of_outgoing* variable by increasing it by 1 every time a full schedule is completed. On top of the module, is a variable animation bar that shows the number that had been scheduled (both delivered and non-delivered) for that particular scenario.

VII. Delivered

After the cargo is moved from allocations and ready to be transferred, they keep record of the number of cargo that has been moved to dispatch cages (It is assumed that once cargo is moved from allocations to dispatch, it will be automatically be delivered so they record it as delivered items in the de-group department).

3.5.3 Decision Modules

I. Size of truck

Since there are two different truck sizes of trucks that bring in cargo at the receiving bay of the warehouse, the incoming cargo should be differentiated into horse and trailer or container cargo since these two will have different requirements in some parts of the simulation model (as in the actual warehouse). According to information collected from the warehouse administration, it has been calculated that approximately 70% of the trucks coming in at the receiving end of the warehouse are horse and trailer trucks and the rest of the 30% are container trucks. So this decision module helps to separate the incoming transactions into 70% horse and trailer and 30% container trucks.

II. Cargo from?

After all cargo has been transferred to the pit, it has to be differentiated whether it is a cargo from a horse and trailer or a container truck. This decision module is a 2-way conditional module that is based on the cargo size attribute number that was assigned earlier. The separation here is important to the other upcoming processes in the simulation model.

III. Bonded cargo

Some of the cargo that is received from the airport by horse and trailer trucks is said to be bonded cargo, so this cargo has to be shot pictures while it is still wrapped with black wrapping plastics. It is said that 75% of cargo received from the horse and trailer is bonded cargo, so this means that 75% of the cargo needs to be taken pictures of before unwrapping the cargo. The rest of the 25% can continue straight to the next process.

IV. Damage control

After the cargo has been packed onto the different number of pallets, a damage control has to be done by the workers. Usually it is said that 15% of the pallets actually fail to stand against the quality requirements as per the company's standards. This 15% of pallets have to be evaluated and a damage report has to be compiled. This is a 2-way by chance decision.

V. <u>HP?</u>

Since the HP cargo has a few different processes that it has to go through in the warehouse, there has to be a separation of the cargo when it is inside to decide whether it is from HP or not. There is a chance condition that 25% of the incoming cargo belongs to HP, so this becomes our probability percentage for cargo coming from HP. This basically means that 25% of the pallets in the warehouse still at the unpacking stage will go through some extra processes and the other 75% will not have to go through these processes.

VI. <u>House Allocation</u>

After all received cargo is placed onto pallets, it has to be allocated to different houses; this allocation is based on a 3-way chance decision that says the following:

a. 66% of the pallets will be placed in the 8-tonner truck house; i.e. the truck can be able to take 6 pallets in order to have a full load.
b. 5% of the pallets have to be allocated to the horse and trailer house section; i.e. the truck can be able to take 20 pallets in order to be fully loaded.
c. The rest of the 29% of the pallets will be allocated to the 14-tonner truck house; i.e. the trucks that will deliver this cargo will be able to carry 12 pallets on board in order to have a full load.

3.5.4 Process Modules

As per the process flow diagrams that are used for generating the simulation model, a number of processes are found and for the time distributions of each processes, input analyzer from Arena was used to get the distributions of times. The graphs from input analyzer are included in Appendix B.

I. <u>Signing of cargo receipt docs</u>

Cargo coming if from the airport has to come with delivery documents. The cargo coordinator at the receiving bay of Unit 2 warehouse has to accept the cargo by signing the documents and giving a copy to the driver of the delivery truck. The process can only be done by a cargo coordinator. The distribution is a triangular distribution with the expression Tri (0.5, 1.5, 2) minutes.

II. Unloading of cargo from horse and trailer and pre check

After the delivery documents have been signed, the cargo from the horse and trailer is unloaded using a mechanized crane that pulls out the cargo from the truck to the receiving door. This process requires the utilization of 2 general workers. The distribution is a uniform distribution with the expression Uni (5, 7) minutes.

III. Unloading of cargo from container and pre check

Same as the latter process, the unloading of cargo from container trucks is also done after the documents have been signed by the cargo coordinator. This process requires the use of 2 forklifts and 2 forklift drivers. One forklift goes inside the container and carries cargo to the door of the container and the other forklift does the movement of the cargo into the warehouse's receiving door. The distribution is a triangular distribution with the expression Tri (9.5, 10, 15.5) minutes.

IV. Transfer to pit

Once the cargo is received and is unloaded from the truck, it is moved by 2 ULD (Unit load device) carriers driven by forklift drivers, the cargo is moved to a section called the pit where it can be easily unbundled. The distribution is a uniform distribution with the expression Uni (2.5, 5.5) minutes.

V. Photo shooting before unwrapping

For cargo that was unloaded from a horse and trailer and comes as bonded cargo, the cargo has to be taken pictures before the covering plastic is removed. This process requires the utilization of 1 general worker. The distribution is a triangular distribution with the expression Tri (2, 2.5, 3) minutes.

VI. Unwrapping of cargo

Cargo that comes in with the horse and trailer (from the airport) comes wrapped in black plastics. This process focuses on un-wrapping the plastics so that the cargo can be accessible. 3 general workers are required for the process. The distribution is a triangular distribution with the expression Tri (4.5, 10, 15.5) minutes.

VII. **Pack onto pallets**

After the cargo from the horse and trailer is unwrapped, it is then packed onto 22 pallets. This process is done by 2 workers under the general works set of worker by the preferred order. The distribution is a triangular distribution with the expression Tri (1, 1.5, 2) minutes.

VIII. **Damage report**

There are some pallets which have items that are damaged or squashed or not in the required condition; a damage report has to be compiled and sent to the supervisor for formality. This process requires only one worker from the general works set can carry out the process (Chosen randomly). The distribution is a uniform distribution with the expression Uni (0.45, 1) minutes.

IX. **Scan cargo on pallets and upload cargo info**

Cargo that belongs to HP client has a different process from the rest of the other clients; the need to scan all the packages on all the pallets for HP. The process requires 2 cargo coordinators to complete the task per pallet. The distribution is a normal distribution with the expression Norm (15, 0.196) minutes.

X. **Transfer to allocations**

After all cargo has been packed onto pallets and all damage control and scanning processes are complete, the cargo is moved to the allocations section of the warehouse (the allocation is based on the house number, which determines the fleet size that it is to be carried in). The process utilizes one general worker and one pallet jack per pallet. The distribution is a uniform distribution with the expression Uni (3, 6) minutes.

XI. **In Storage**

Once the cargo has been sorted and batched into different houses as per truck size, the cargo waits for customs clearance or client confirmation for them to prepare the cargo for delivery. The distribution is a triangular distribution with the expression Tri (12, 180, 360) minutes.

XII. Move to dispatch cage

After the cargo has been customs cleared, the cargo is moved into the dispatch cages in preparation to the load them onto trucks. 3 workers from the general works set are chosen from a preferred order. The distribution is a uniform distribution with the expression Uni (19.5, 30.5) minutes.

3.5.5 Dispose Module

I. Hand over to trucking company

Once the cargo is moved to the dispatch cage, the de-group section's work is done and the responsibility is given to the transportation company which is outsourced, so BPL does not have much control over their labour.

Chapter 4

4.1 Monthly transactions

Historical data from the year 2011 was collected from the warehouse’s database that highlights the number of transactions that were processed during each month. The data is arranged in the table below. Also what has been included in the table, is the average daily transaction that will be expected from the warehouse if a 10 % increase is made to the data of 2011(This is an assumption that was made by the management that they expect the transactions from 2011 to increase by 10% in 2013). In order to get the daily transactions, we had to divide every month’s data by 20 (Since the average working days per month are 20 days). The input in the simulation model will be based on hourly rate; therefore they we will further divide it by 8, since there are 8 active working hours per day.

	2011 (Monthly)		2013 (Monthly)	
Month	**Incoming transactions**	**Delivery transactions**	**Incoming transactions**	**Delivery transactions**
January	1818	3273	2000	3600
February	1455	3200	1600	3520
March	1545	3145	1700	3460
April	1091	2709	1200	2980
May	1364	3073	1500	3380
June	1636	3091	1800	3400
July	1236	3055	1360	3360
August	727	1818	800	2000
September	691	1673	760	1840
October	1455	2818	1600	3100
November	1927	3327	2120	3660
December	2000	3091	2200	3400

Table 1: Monthly transactions

4.2 Data Input

The table below give the data that will be changed on the create module of the simulation model in order to the daily utilization report for a specific month. The data is based on Table 1 above. The create module is based on the number of incoming transactions per day (but it is given in an hourly rate fashion). The number of entities per arrival will be the changing variable depending on the month and this has to be changed manually and the value to be changed is in the table below.

Month	Incoming entities (hourly)	Expected output (daily)
January	13	180
February	10	176
March	11	173
April	8	149
May	9	169
June	11	170
July	9	168
August	5	100
September	5	92
October	10	155
November	13	183
December	14	170

Table 2: Model input

4.3 Results from As-Is Model

The simulation was run for all the 12 months of 2013 by using the input data from Table 2 above and the results were viewed. From the results that were generated, it can be verified that the model is performing as expected since the output variable is an approximate value of the actual expected output value; this can be seen from the ready to be delivered variable bar in the simulation model as animated. Since the project is based on the labour forecasting in the warehouse, the results from the simulation model of each month based on resource utilization will be monitored. The results for the different trials ran are posted below.

	Labour Utilization		
Month	**Cargo Coordinator**	**Forklift driver**	**General worker**
January	0.84	0.77	0.97
February	0.86	0.78	0.95
March	0.89	0.78	0.95
April	0.81	0.74	0.9
May	0.82	0.8	0.94
June	0.85	0.82	0.97
July	0.85	0.75	0.92
August	0.75	0.5	0.71
September	0.84	0.37	0.55
October	0.86	0.78	0.95
November	0.89	0.8	0.97
December	0.89	0.8	0.97

Table 3: Labour utilization levels

At this point, we know what is happening currently in the warehouse since we have a well-functional simulation model and also have the statistics of historical transactions and the number of transactions that are expected for the year 2013. We have generated the utilization of the workers with data from the 2013 plan and we have tabled the data. This utilization will now help us know if we should increase or decrease the number of workers per skill group.

Chapter 5

5.1 TO-BE situation

At this point, we know what is happening currently in the warehouse since we have a well-functional simulation model and also have the statistics of historical transactions and the number of transactions that are expected for the year 2013. We have generated the utilization of the workers with data from the 2013 plan and we have tabled the data. This utilization will now help us know if we should increase or decrease the number of workers per skill group. From the previous chapter up to this point in the project, it has now been shown that the utilization of labour in the warehouse is fluctuating with the change in monthly transactions and now this gives way for improvements to be made in the warehouse.

The main activities that are to be carried out from now on so that we can make recommendations are as follows:

- Creating scenarios for every month by playing around with the number of resources allocated and checking the results to see if a utilization level of between 80 and 90% per labour resource can be achieved
- Recording the number of workers per skill type that will be required for each month
- Comparing the scheduled labour to the required labour to see how many people can be schedule to other warehouses and how many can be used from the other warehouses.
- Generating a list that shows the labour requirements for all the warehouses in all the months of 2013

All the above mentioned activities will be carried out in this chapter but the only thing that can be documented is the table that shows the number of workers hired and required as a summary of the Workforce Labour Plan.

The scenarios are done in the simulation model and this cannot be documented here.

5.2 Yearly Workforce plan

		Unit 2 Warehouse				NSN Warehouse				Unit 1 Warehouse(Rockwell automation)			
Month	**Skill type**	**Currently hired**	**No. Required this month**	**Extra needed**	**More than required**	**Currently hired**	**No. Required this month**	**Extra needed**	**More than required**	**Currently hired**	**No. Required this month**	**Extra needed**	**More than required**
January	**Cargo Coordinator**	12	14	2	0	3	3	0	0	2	1	0	1
	Forklift driver	8	6	0	2	0	0	0	0	1	1	0	0
	General worker	16	23	7	0	8	6	0	2	6	4	0	2
February	**Cargo Coordinator**	12	13	1	0	3	3	0	0	2	1	0	1
	Forklift driver	8	6	0	2	0	0	0	0	1	1	0	0
	General worker	16	23	7	0	8	6	0	2	6	4	0	2
March	**Cargo Coordinator**	12	13	1	0	3	2	0	1	2	3	1	0
	Forklift driver	8	6	0	2	0	0	0	0	1	2	1	0
	General worker	16	23	7	0	8	4	0	4	6	10	4	0
April	**Cargo Coordinator**	12	12	0	0	3	2	0	1	2	3	1	0

	Forklift driver	8	2	0	6	0	0	0	0	1	2	1	0
	General worker	16	16	0	0	8	4	0	4	6	10	4	0
May	**Cargo Coordinator**	12	12	0	0	3	6	3	0	2	5	3	0
	Forklift driver	8	4	0	4	0	0	0	0	1	3	2	0
	General worker	16	19	3	0	8	12	4	0	6	14	8	0
June	**Cargo Coordinator**	12	14	2	0	3	7	4	0	2	4	2	0
	Forklift driver	8	6	0	2	0	0	0	0	1	3	2	0
	General worker	16	21	5	0	8	14	6	0	6	12	6	0
July	**Cargo Coordinator**	12	11	0	1	3	7	4	0	2	5	3	0
	Forklift driver	8	4	0	4	0	0	0	0	1	3	2	0
	General worker	16	19	3	0	8	14	6	0	6	14	8	0
August	**Cargo Coordinator**	12	8	0	4	3	5	2	0	2	3	1	0
	Forklift driver	8	2	0	6	0	0	0	0	1	2	1	0
	General worker	16	13	0	3	8	10	2	0	6	10	4	0

September	Cargo Coordinator	12	6	0	6	3	3	0	0	2	3	1	0
	Forklift driver	8	2	0	6	0	0	0	0	1	2	1	0
	General worker	16	11	0	5	8	8	0	0	6	10	4	0
October	Cargo Coordinator	12	13	1	0	3	4	1	0	2	2	0	0
	Forklift driver	8	6	0	2	0	0	0	0	1	1	0	0
	General worker	16	23	7	0	8	9	1	0	6	6	0	0
November	Cargo Coordinator	12	18	6	0	3	3	0	0	2	2	0	0
	Forklift driver	8	8	0	0	0	0	0	0	1	1	0	0
	General worker	16	28	12	0	8	8	0	0	6	6	0	0
December	Cargo Coordinator	12	20	8	0	3	2	0	1	2	1	0	1
	Forklift driver	8	8	0	0	0	0	0	0	1	1	0	0
	General worker	16	30	14	0	8	6	0	2	6	4	0	2

Table 4: Comparison of required and currently available labour

Month	Skill type	Total extra workers	Part-time workers to be employed
January	Cargo Coordinator	--	1
	Forklift driver	2	--
	General worker	--	3
February	Cargo Coordinator	--	--
	Forklift driver	2	--
	General worker	--	3
March	Cargo Coordinator	--	1
	Forklift driver	1	--
	General worker	--	7
April	Cargo Coordinator	--	--
	Forklift driver	5	--
	General worker	--	--
May	Cargo Coordinator	--	3
	Forklift driver	2	--
	General worker	--	11
June	Cargo Coordinator	--	4
	Forklift driver	--	--
	General worker	--	11
July	Cargo Coordinator	--	2
	Forklift driver	2	--
	General worker	--	11

August	**Cargo Coordinator**	1	--
	Forklift driver	5	--
	General worker	--	1
September	**Cargo Coordinator**	5	--
	Forklift driver	5	--
	General worker	1	--
October	**Cargo Coordinator**	--	1
	Forklift driver	2	--
	General worker	--	7
November	**Cargo Coordinator**	--	6
	Forklift driver	--	--
	General worker	--	12
December	**Cargo Coordinator**	--	6
	Forklift driver	--	--
	General worker	--	10

Table 5: Summary of required and extra people

In table 4 above, the colour types signify some kind of relevance. Table 6 below explains all the colour coded fields. Table 5 was generated from table 4 above, it took into consideration all the extra people per month in each warehouse and all the shortages per skill group per month and summarized the total to give management a better view of how many extra people they will have in each month, if any, and how many more people they should hire per month in order for them to be able to maintain the service level that they promise to their customers.

Colour coding	Relevance
12	This indicates the field that show the number of workers currently hired
11	This indicates the field for the expected number of workers that should be working in the warehouse in order to avoid under- and over-utilization of worker
4	This indicates the field for the workers that should be added to the warehouse during a particular month in order to avoid over-utilization of the workers
1	This indicates the field for the workers that can be taken from the warehouse to other warehouses warehouse during a particular month in order to avoid under-utilization of the workers

Table 6: Colour coding explanation

Chapter 6

6.1 Conclusion and Recommendations

A lot has been done since the initiation of the project up to this point. The scope had changed a couple of times for reasons that are justifiable. The project became clearer and clearer as time went by. The main aim of the project was to plan for labour recruitment and retrenchment so that management can have a better view of the people to be ideally hired every month, and in each of their 3 main warehouses.

The historical data was very important in helping us determine the transactions to that are to be expected in our planned year. The 10% increase from management is taken as an average from management that might have been seen from experience and no questions could be asked with regards to that. The use of a simulation based model was very helpful since it could actually show the utilization level of all the labour skills in each of the months, which was a step forward in getting to the final output of the project. Selection of Arena was because of its agent-based modelling technique.

The to-be scenarios were done in order to get to a utilization level of between 80-90% per skill group which was required by human resource department. The tables given in Chapter 5 of the report are a summary of the final output of the project. It is recommended that management should make use of table 5 since it gives a brief summary in terms of how many more workers are needed and how many more can actually be sold out for specific months. Table 4 should be used by the Industrial Engineer in scheduling the works for all the specific months as guided by the table. If the schedule is used by management, they will be able to achieve a service level that was promised to their customers at a minimum labour cost.

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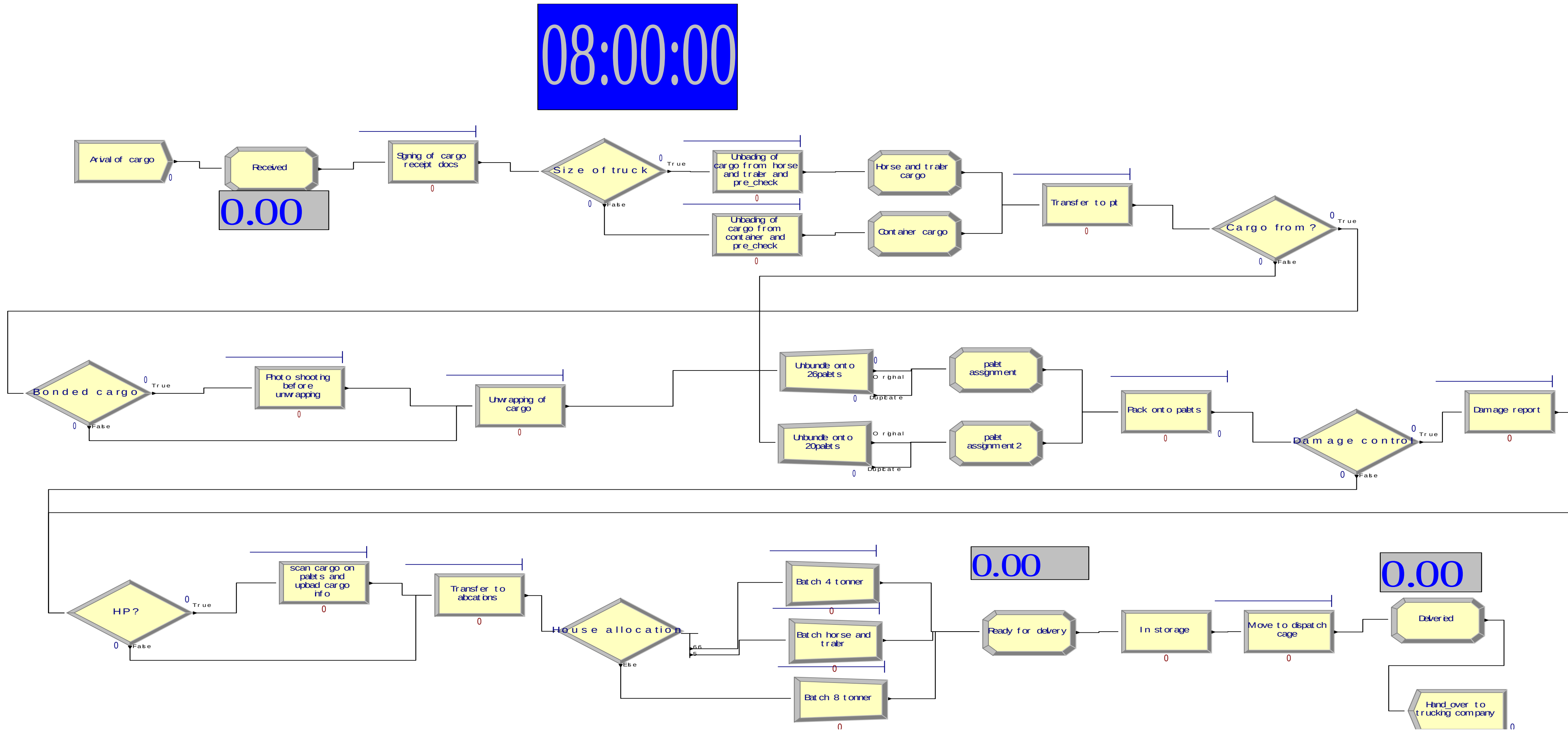
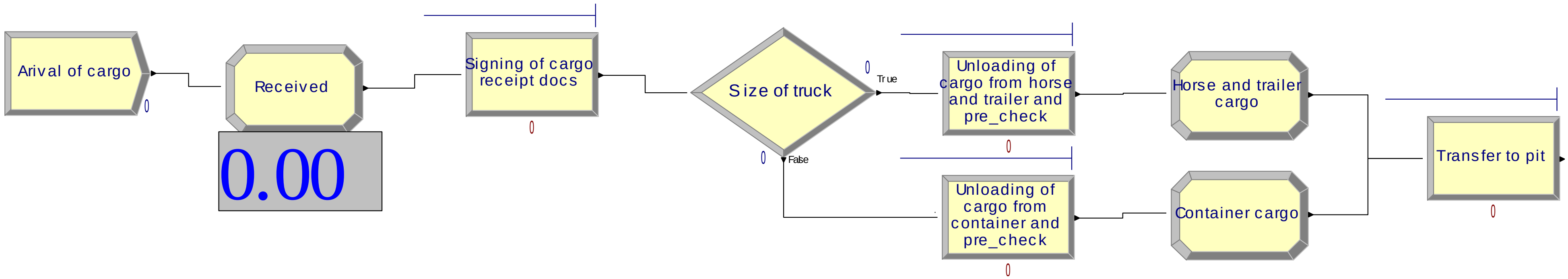
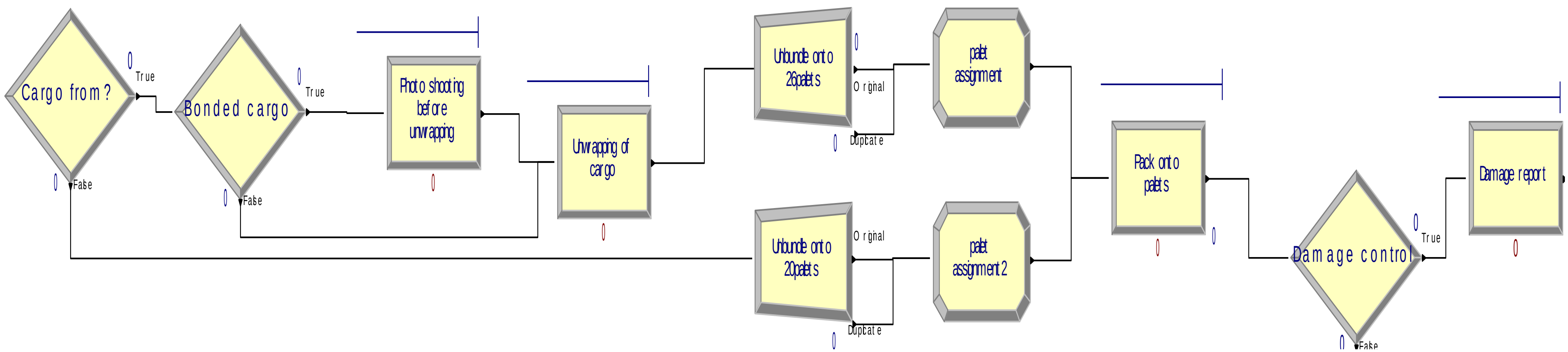
Appendix A: Simulation model



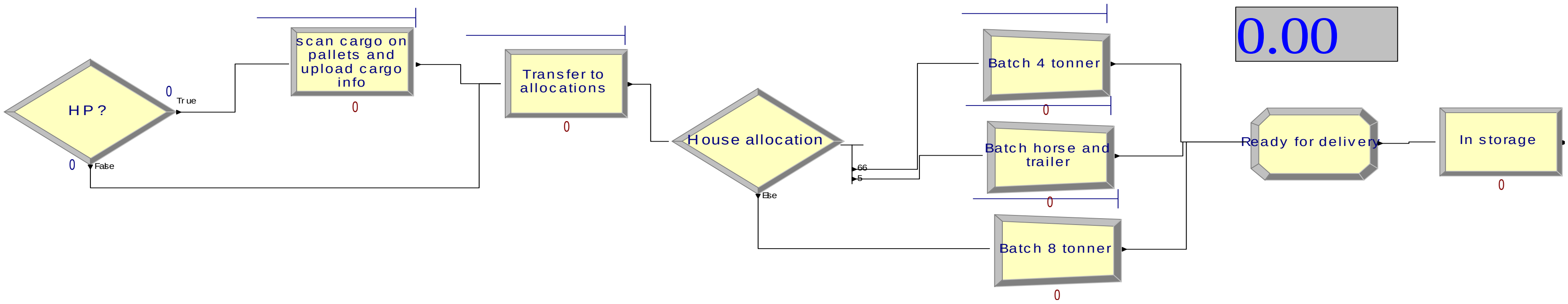
Appendix A 1: Overview of BPL warehouse simulation model



Appendix A 2: Receiving bay

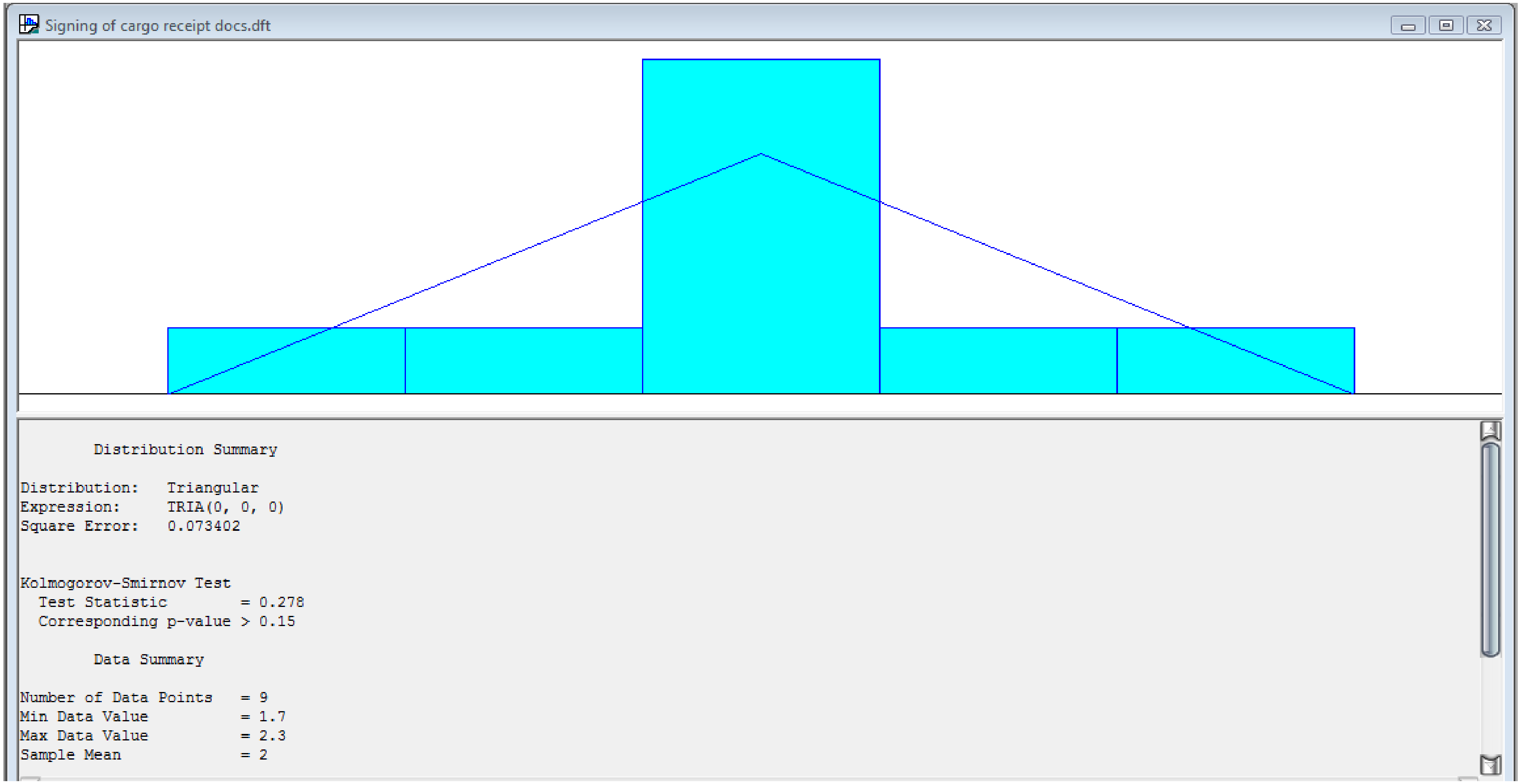


Appendix A 3: Staging Area

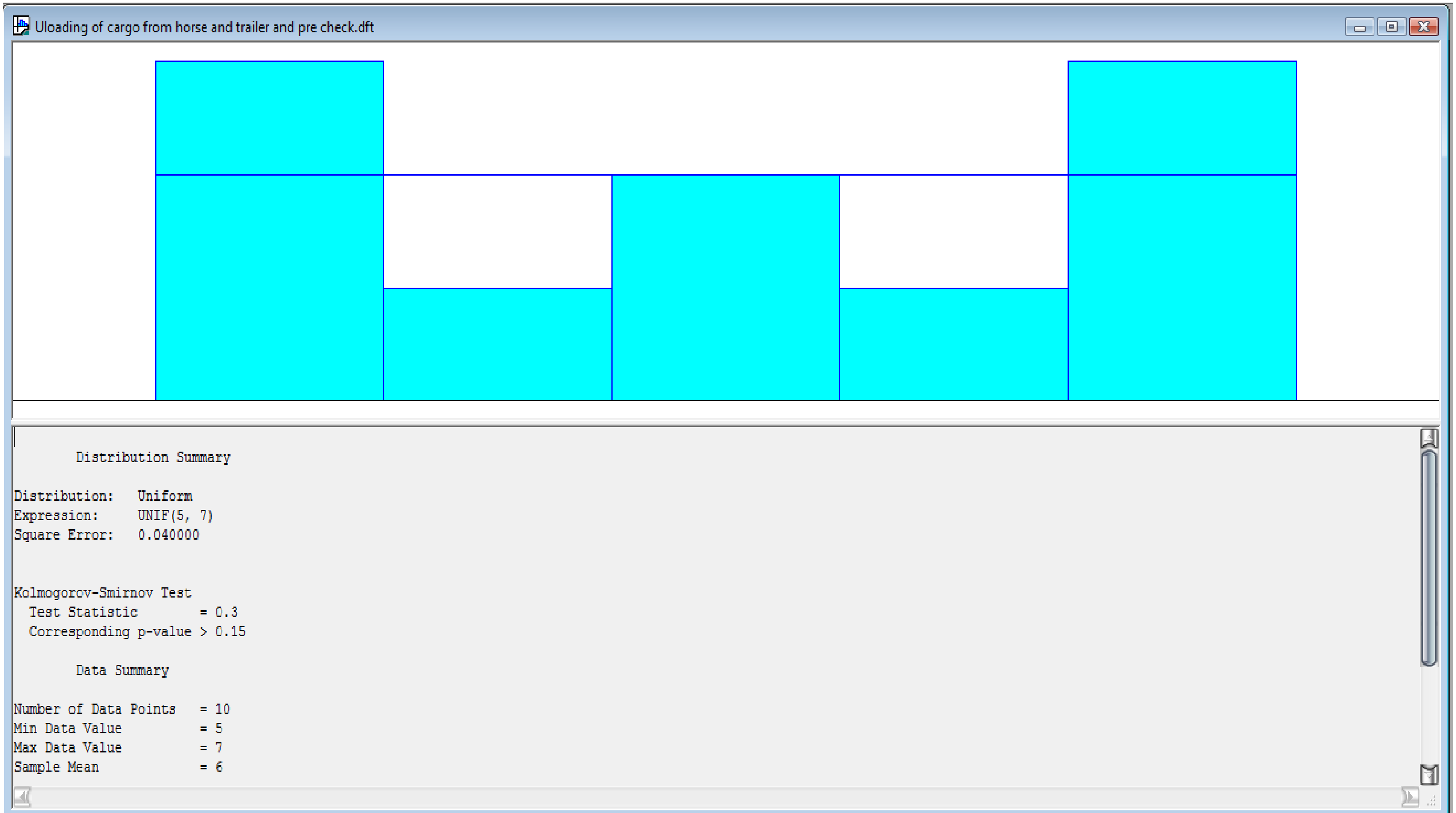


Appendix A 4: Allocations Area

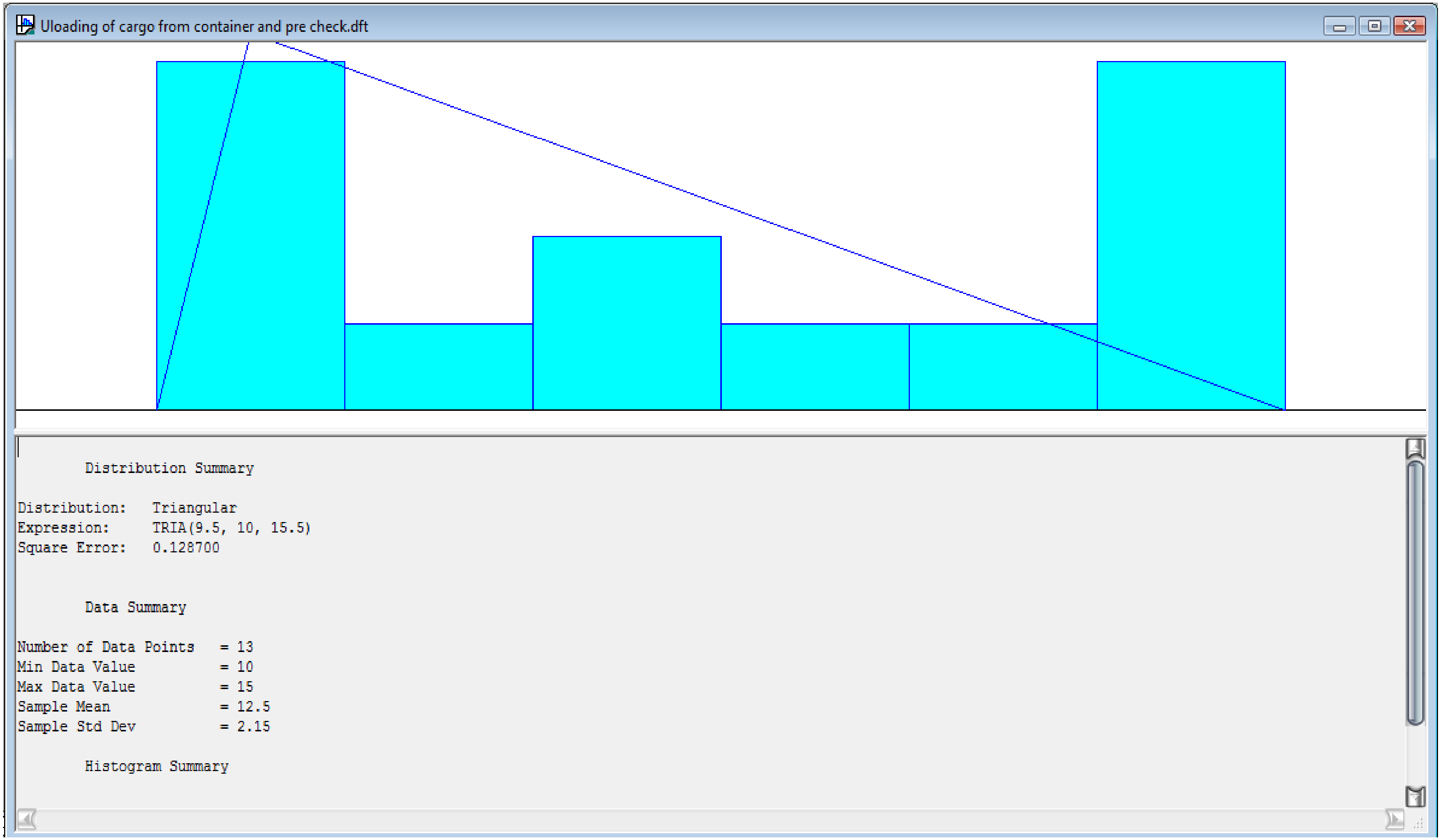
Appendix B: Distribution Graphs



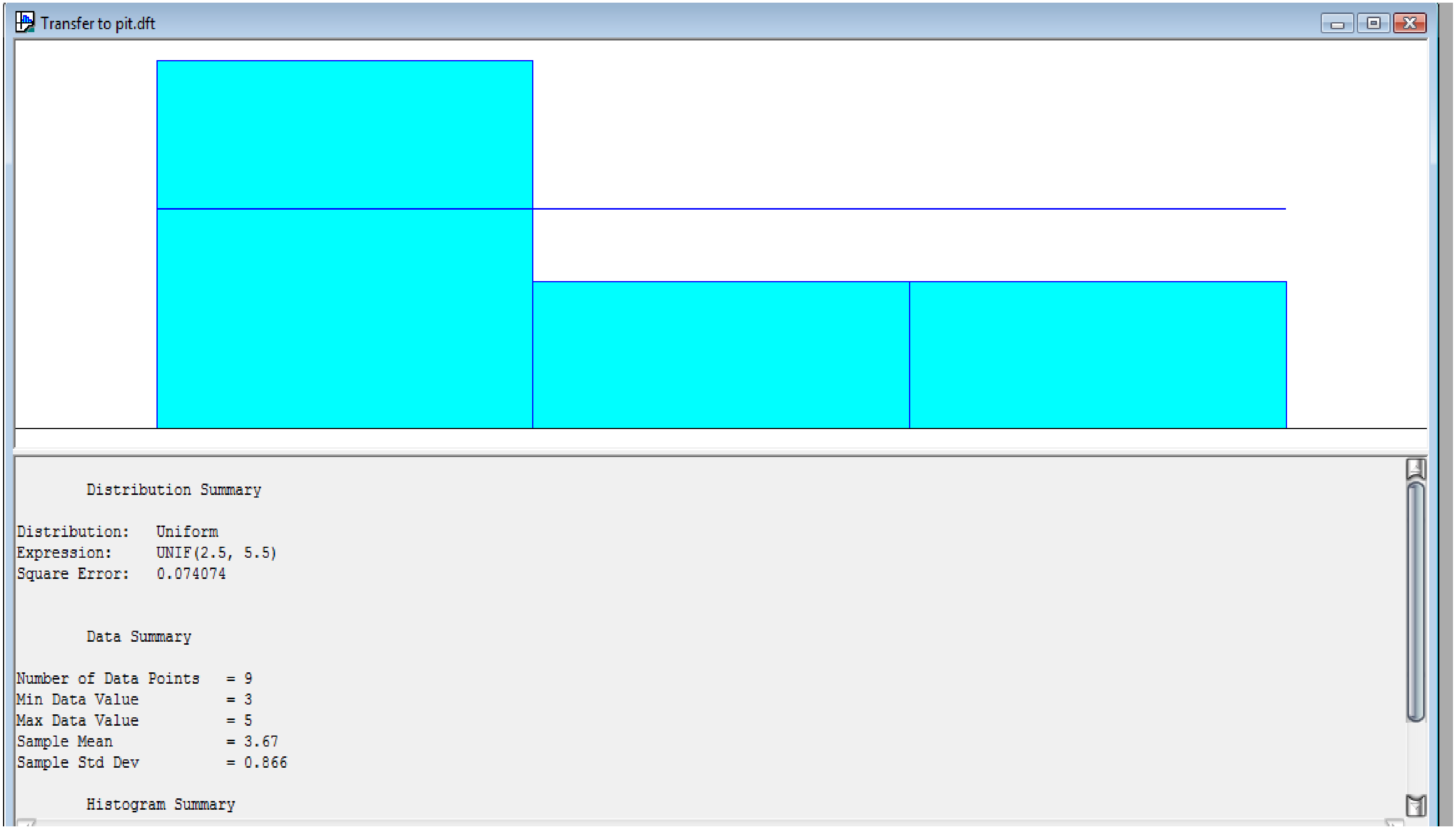
Appendix B 1: Signing of cargo receipts docs



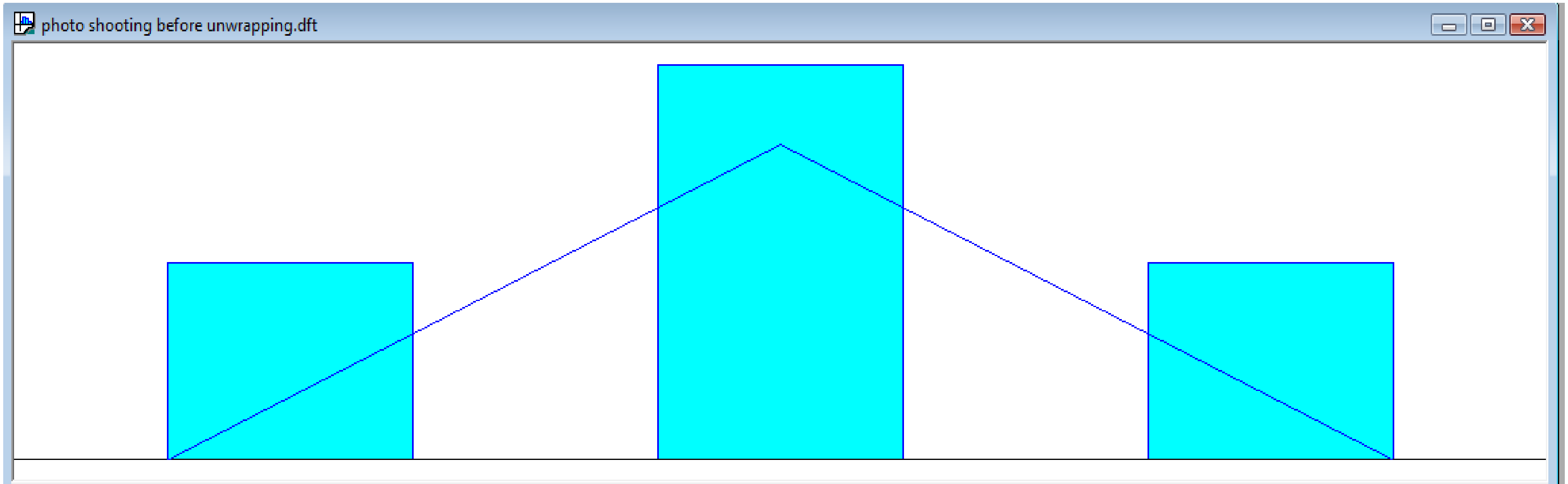
Appendix B 2: Unloading of cargo from horse and trailer and pre_check



Appendix B 3: Unloading of cargo from container and pre_check

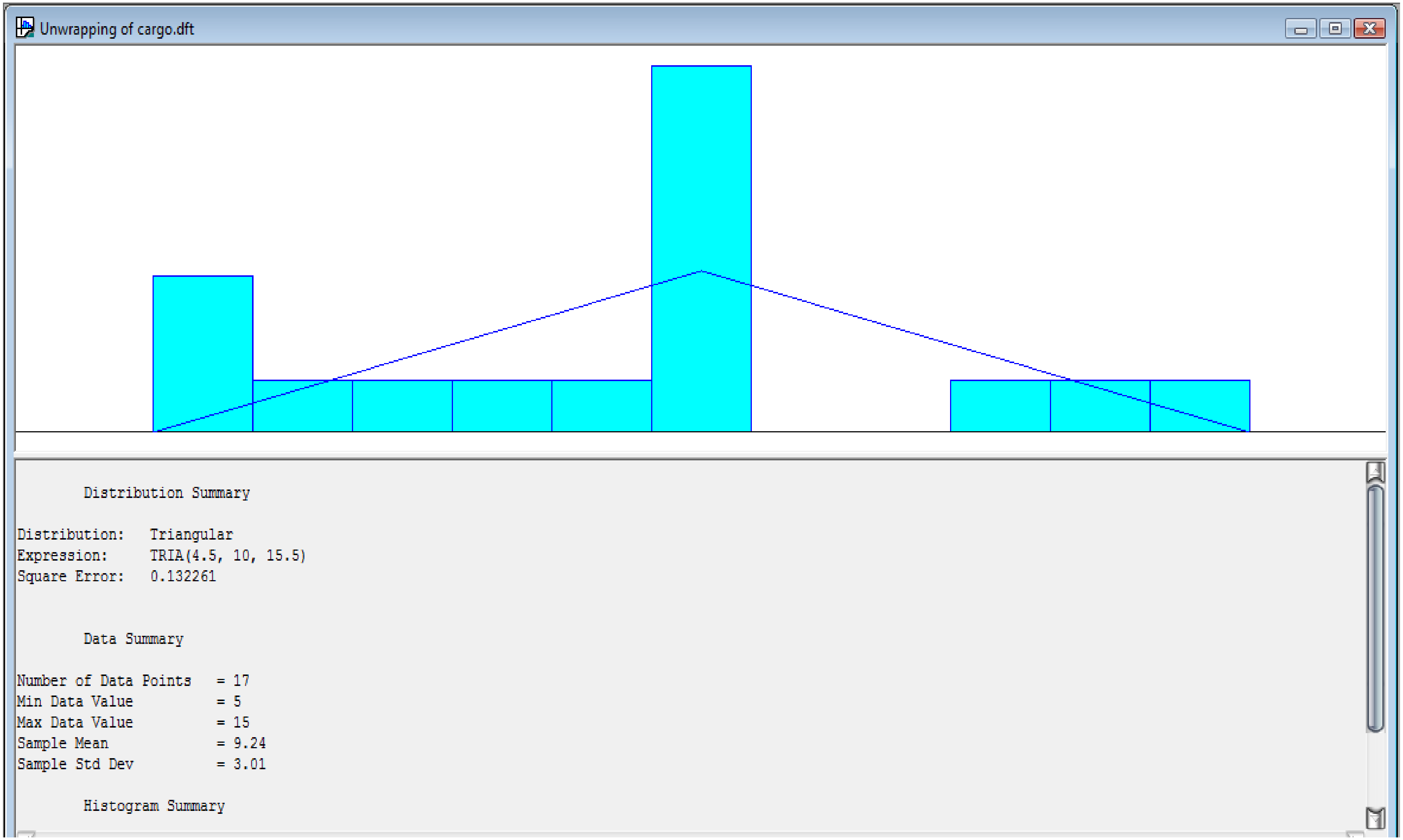


Appendix B 4: Transfer to pit

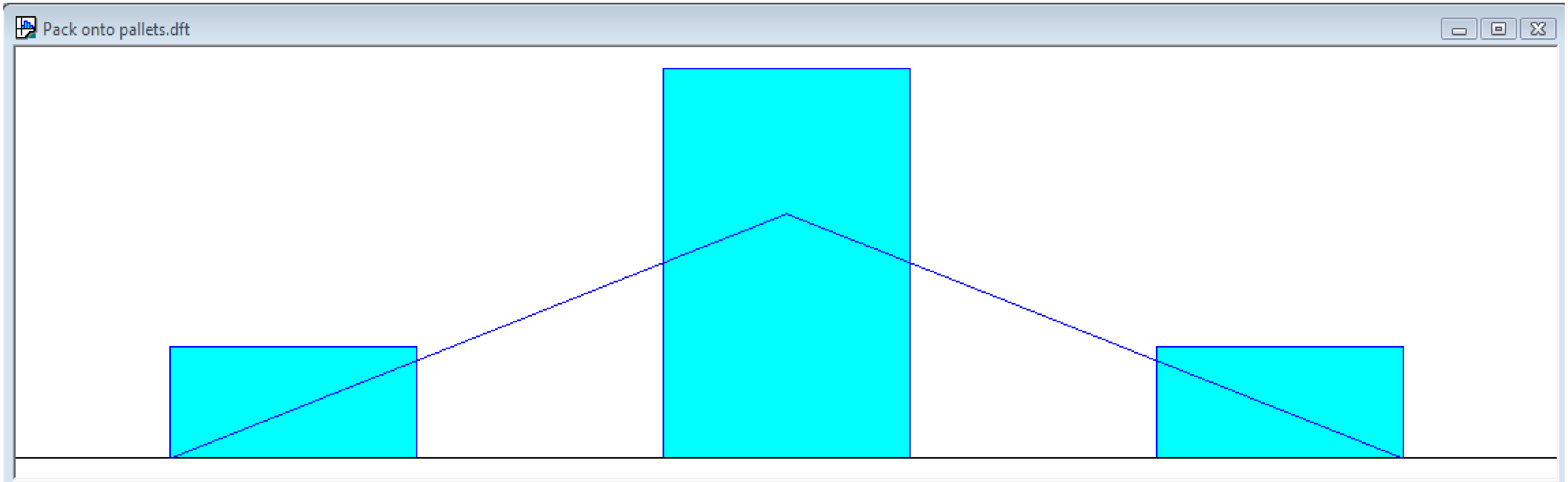



```
Distribution:   Triangular
Expression:     TRIA(2, 2.5, 3)
Square Error:   0.192600


Kolmogorov-Smirnov Test
  Test Statistic         = 0.25
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points    = 12
Min Data Value           = 2
Max Data Value           = 3
Sample Mean              = 2.5
Sample Std Dev           = 0.369
```

Appendix B 5: Photo shooting before unwrapping

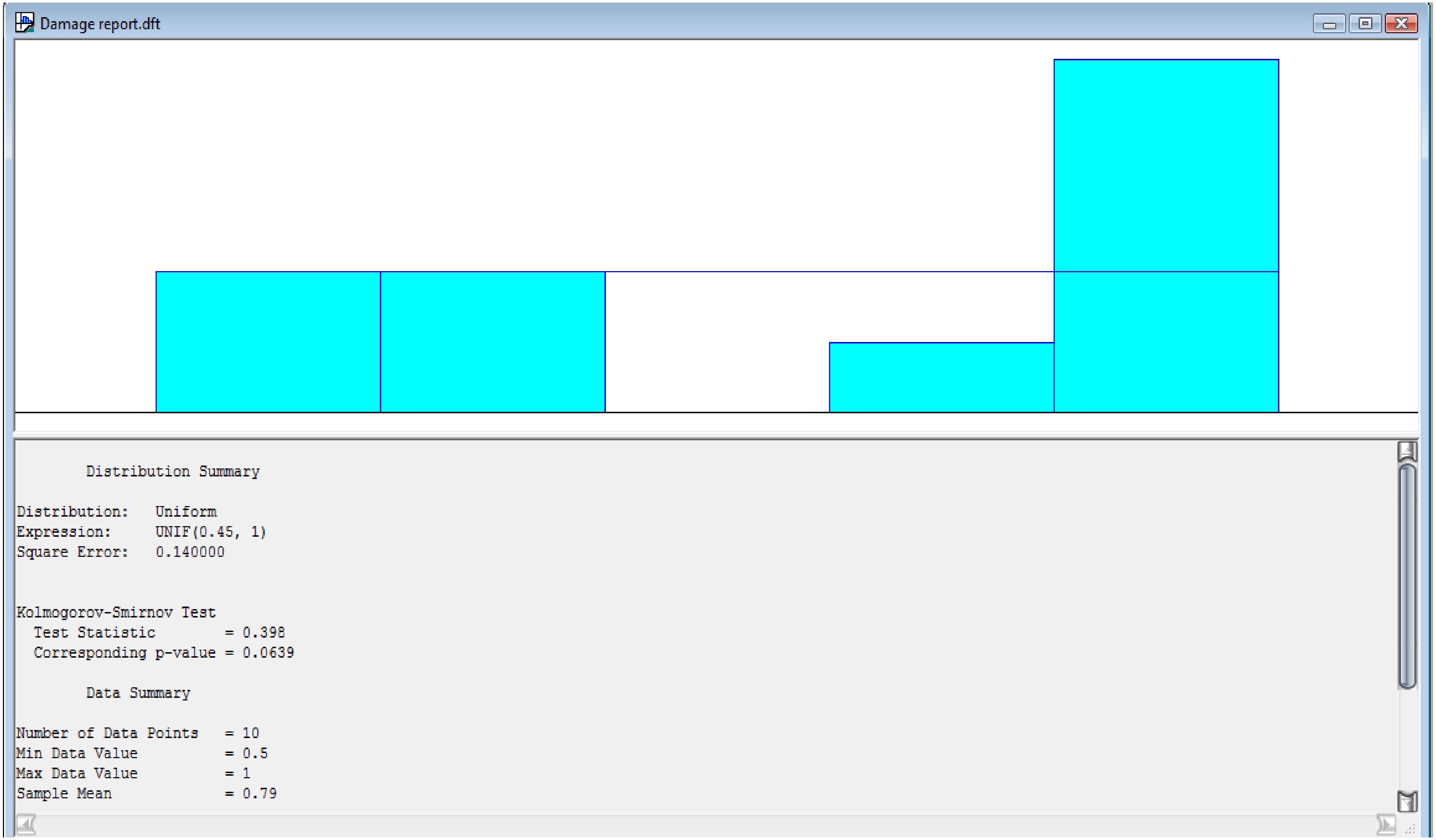


Appendix B 6: Unwrapping of cargo

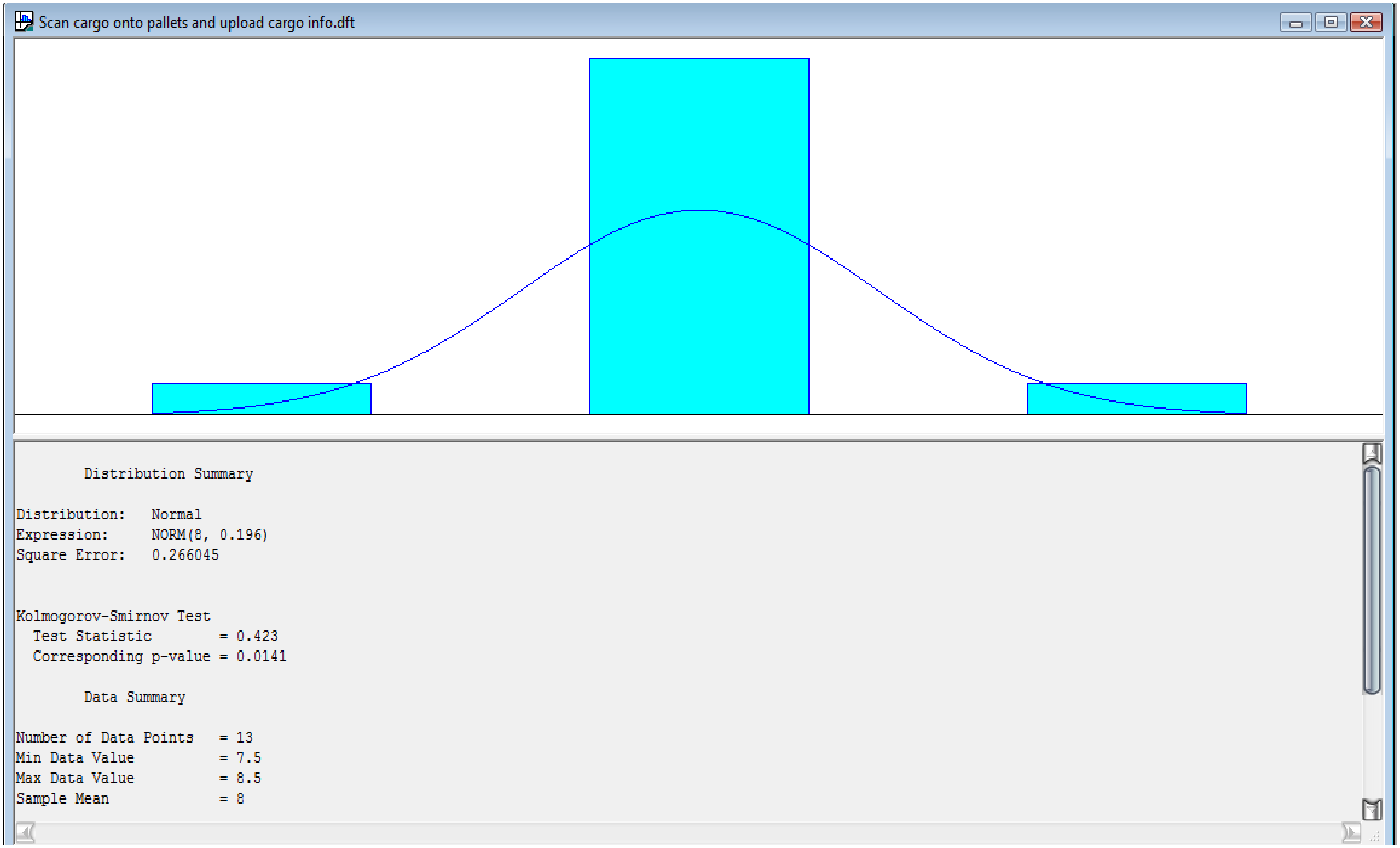



```
        Distribution Summary

Distribution:   Triangular
Expression:     TRIA(0.999, 1.5, 2)
Square Error:   0.212311


Kolmogorov-Smirnov Test
  Test Statistic        = 0.318
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 11
Min Data Value          = 1
Max Data Value          = 2
Sample Mean             = 1.5
```

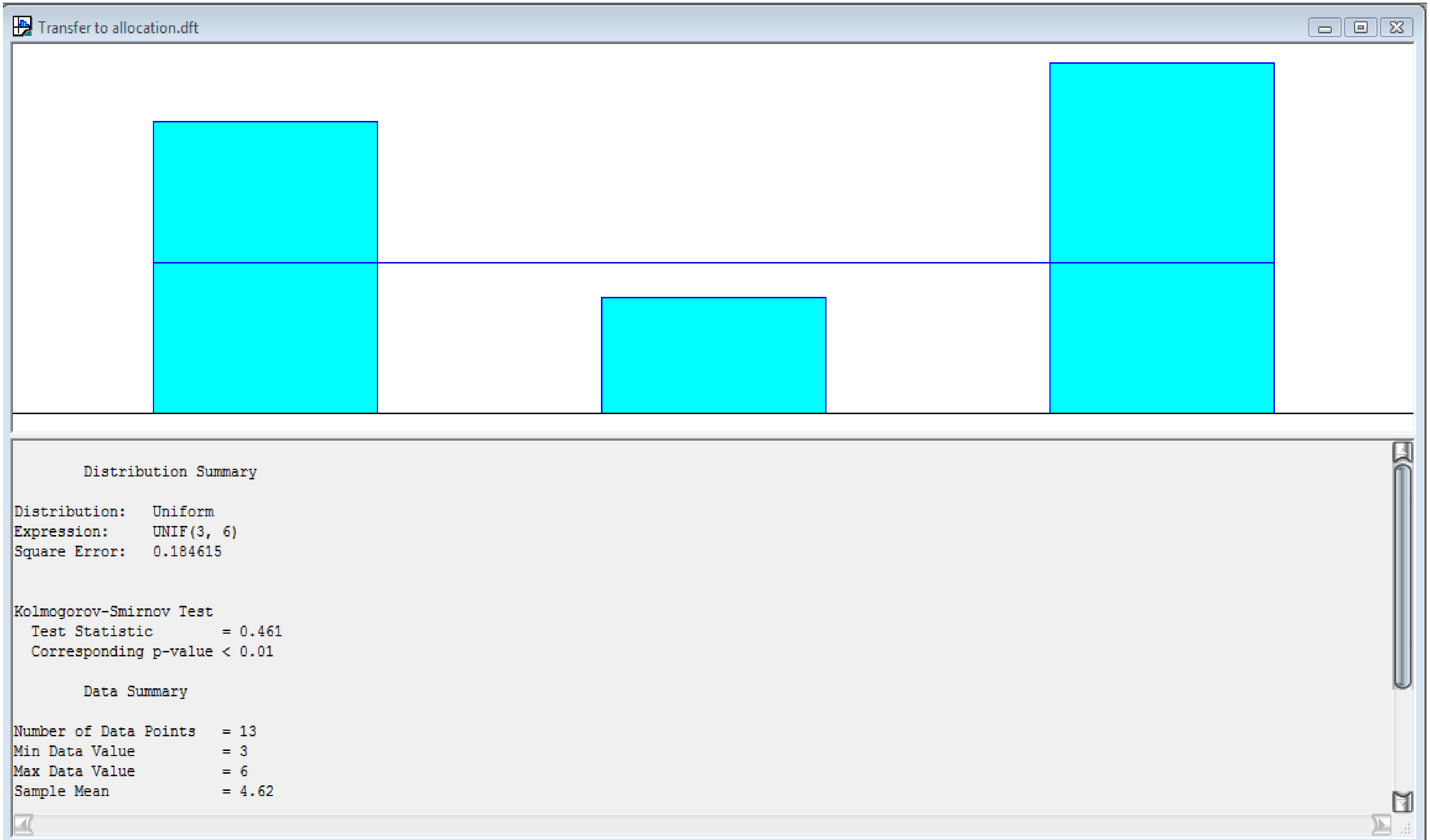
Appendix B 7: Pack onto pallets



Appendix B 8: Damage report

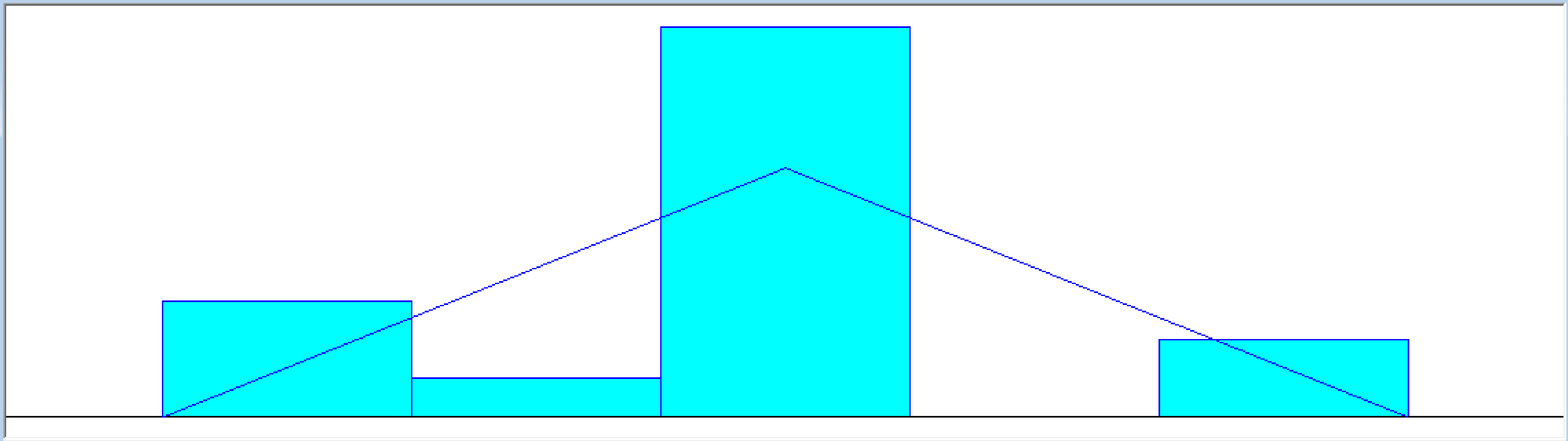


Appendix B 9: Scan cargo on pallets and upload cargo info



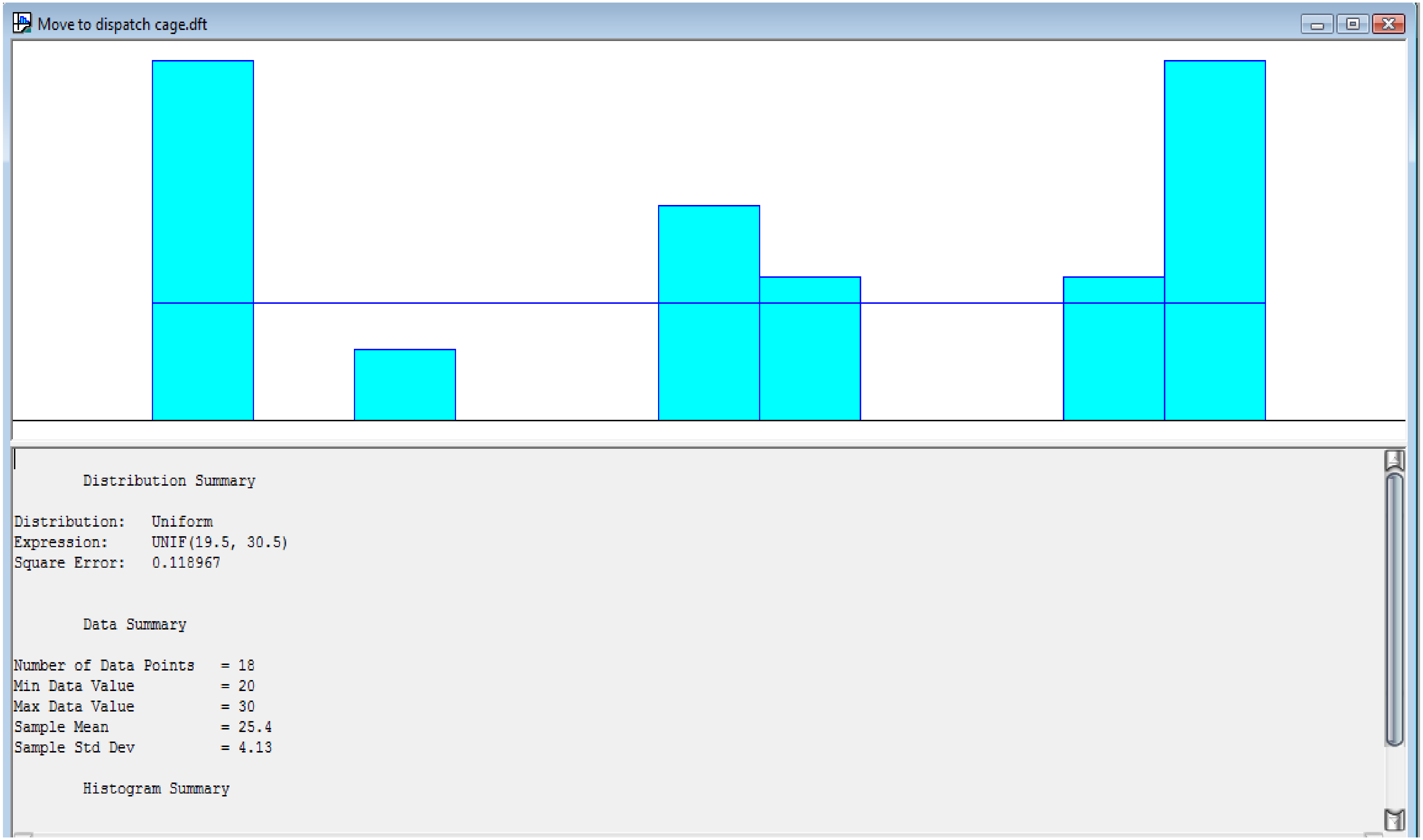
Appendix B 10: Transfer to allocations

In storage.dft



```
       Distribution Summary

Distribution:   Triangular
Expression:     TRIA(12, 186, 360)
Square Error:   0.172913


Kolmogorov-Smirnov Test
  Test Statistic        = 0.235
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 16
Min Data Value          = 12
Max Data Value          = 360
Sample Mean             = 170
```

Appendix B 11: In storage



Appendix B 12: Move to dispatch cage